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3D Printed Bionic Ears

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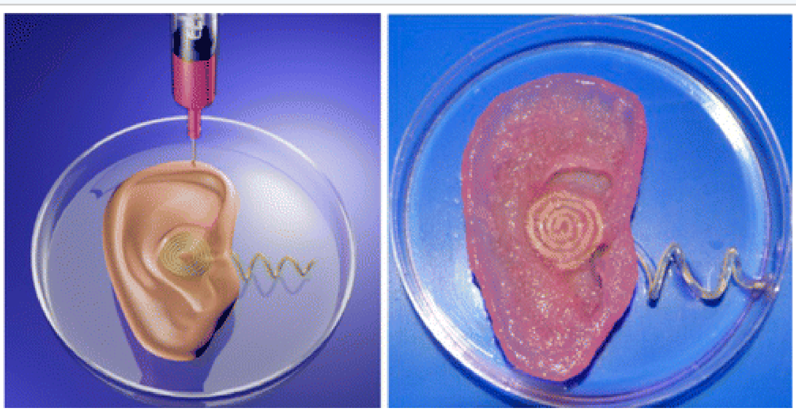
Abstract



The ability to three-dimensionally interweave biological tissue with functional electronics could enable the creation of bionic organs possessing enhanced functionalities over their human counterparts. Conventional electronic devices are inherently two-dimensional,

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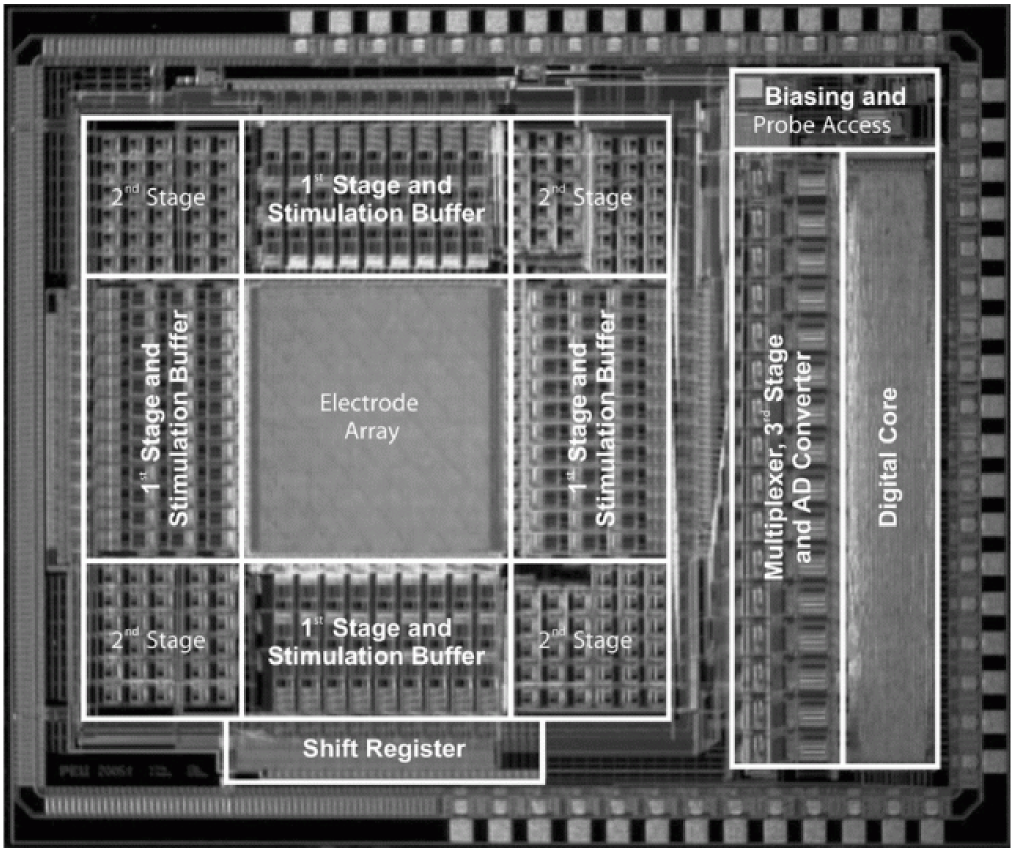
preventing seamless multidimensional integration with synthetic biology, as the processes and materials are very different. Here, we present a novel strategy for overcoming these difficulties via additive manufacturing of biological cells with structural and nanoparticle derived electronic elements. As a proof of concept, we generated a bionic ear via 3D printing of a cell-seeded hydrogel matrix in the anatomic geometry of a human ear, along with an intertwined conducting polymer consisting of infused silver nanoparticles. This allowed for in vitro culturing of cartilage tissue around an inductive coil antenna in the ear, which subsequently enables readout of inductively-coupled signals from cochlea-shaped electrodes. The printed ear exhibits enhanced auditory sensing for radio frequency reception, and complementary left and right ears can listen to stereo audio music. Overall, our approach suggests a means to intricately merge biologic and nanoelectronic functionalities via 3D printing.

Keywords: Cybernetics; tissue engineering; bioelectronics; cyborg organs; electronic implants; additive manufacturing

11,000-electrode reprogrammable chip takes brain-computer interfaces to a new level

By John Hewitt on July 22, 2013 at 2:36 pm | 1 Comment

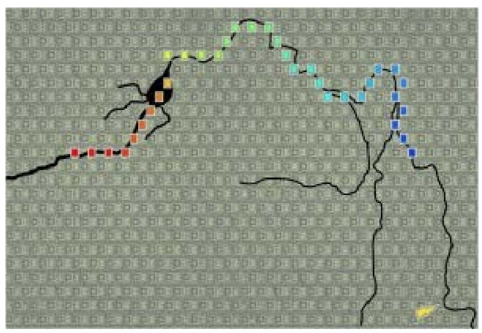
The ability to dynamically reconfigure hardware components has become critical to many computing systems. For example, to maintain optimal performance when the protocols, data rates, or physical medium attachment (PMA) layers change in communications systems, it is often essential to able to change more than just the software. Modern FPGA (field-programmable gate array) chips, which can be partially reconfigured at run time, are now in ubiquitous use to meet some of these needs in dedicated systems. For the rapidly advancing class of chips that have been developed to communicate with the brain, the ability to dynamically reconfigure the interface nodes has emerged as one of the most desirable features. A group of researchers from the Swiss Federal Institute of Technology has built a powerful new chip that can be rapidly adapted to changing conditions at its interface points. Furthermore, they have used their chip to show that the speed of communication between neurons is not independent from any computations a brain might be said to perform, but rather, it is an essential component of the computation itself.



The chip developed by the Swiss group has some 11,011 electrodes packed into a CMOS chip with area less than 2x2mm. At 3,150 electrodes per square millimeter, that's a higher density than anything we have seen to date. High-density chips with up to 65,000 stimulation sites have been manufactured before by other groups, but they generally have had little or no *record* (measure) ability. The key feature here is that the 126 signal-conditioned and amplified channels can be dynamically switched within a few milliseconds to any of the electrode sites in the grid, permitting multiresolutional access to neurons in its field on different spatial scales. The analog switch matrix which makes this possible consists of 13,00 static RAM cells which set the routing.

What the researchers have essentially built here is a voltage microscope for neurons. When they trained it on an individual cell, the researchers could actually watch the real time propagation of an electrical spike down an axon. Suprisingly, they found that the speed of this pulse changed from moment to moment at every segment along the axon. Normally in the brain, the axons are wrapped up by special glial cells called oligodendrocytes, which make signal transmission more efficient. Glial cells were part of the culture preparation used here, but it is not clear to what extent, if any, they participated in these regulatory effects. In the absence of functional oligodendrocytes, the axons themselves could in theory control propagation speed by altering the density of ion channels in their membranes.

The researchers were able to stimulate different points in the grid to generate spikes going in either direction down axons. Their analysis did not specifically address the interesting question of whether spikes sent in the normal direction (away from the cell body), actually propagate faster by virtue of directionally-organized machinery based on the subcellular cytoskeleton — but that could in principle be investigated later.



The ability to "watch" neurons electrically on multiple scales has many advantages over techniques that rely on slower, and potentially phototoxic, imaging dyes. Not to take anything away from them them, bu these optical reporters sometimes interfere with the natural cell physiology and, as for the case of calcium dyes, can modulate the very effect they attempt to measure. When mapped to its highest resolution, the chip could actually resolve changes in the shape and position of the axons over time. Theoretically these movements could be correlated with the electrical activity, giving new insight into how neurons grow and interconnect. Being able to watch these movements is useful to understand what happens when the signal drops out after the recording has been going on for a while. Often this loss is attributed to changes in electrode impedance from build up of extracellular material, or other reactive tissue effects, but in fact it could just be that the cell has moved.

As these new chips are adapted to more complex 3D geometries they will be better suited for use inside intact brains. Undoubtedly they will be of great value in creating stable, and more nimble, interfaces to the brain.

Now read: Neuromimetic processor board beats supercomputers at their own game

Research paper: doi:10.1038/ncomms3181 - "Tracking axonal action potential propagation on a high-density microelectrode array across hundreds of sites"

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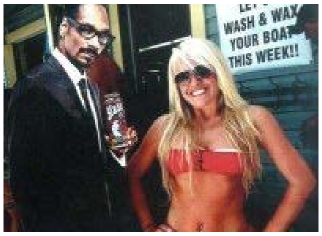

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From: Stephanie lichtenfeld
To: Jim Girards
Subject: Antw: Green effect
Date: Tuesday, April 17, 2012 9:11:19 AM

Dear James Girards,

We have used different shades of green in our experiments and published the LCh values in our methods sections.

Here are the values for

Experiment 1:
green: LCh[52.4/60.2/155.9],
Experiment 2:
green: LCh[52.4/60.2/155.9],
Experiment 3:
LCh[57.8/50.3/153.1],

Kind regards,
Stephanie Lichtenfeld

****

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80802 Munich

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Fax: +49 89 / 2180 5250
mail to: lichtenfeld@psy.lmu.de

****
>>> "Jim Girards" <jim@girardslaw.com> 14.04.2012 06:09 >>>
Would you please tell me what wavelength or shade of green you used in your study published recently in Personality and Social Psychology Bulletin?

James E. Girards
The Girards Law Firm
10000 N. Central
Suite 750
Dallas TX 75231
Voice: 214.346.9529
Fax: 214.346.9532

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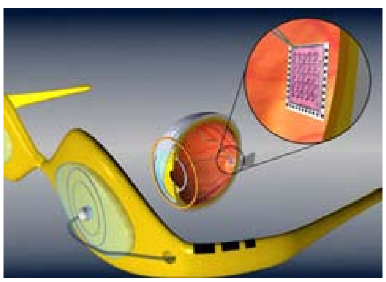
OPHTHALMOLOGY

Argus II Retinal Prosthesis Gets European Clearance

by GENE OSTROVSKY on Mar 3, 2011 • 12:00 am

Second Sight Medical of Sylmar, California has received European approval for its bionic eye system that can bring a modicum of sight to people with advanced retinal degenerative diseases. The Argus II system uses a head worn video camera to capture the scene, processes it by a computer, and sends a signal to an implant that stimulates the retina's still functioning cells. Although the resulting sight is nowhere near normal, it is nevertheless a major improvement on total blindness.



- •Most clinical experience of any retinal prosthesis ever developed
- •Improvements in ability to perform visual tasks demonstrated in many patients
- •Upgradable hardware and software to benefit from future innovations
- •Minimal time from implantation to first system use and use at home
- •Implant is compatible with MRI testing
- •Video processor with adjustable settings for individual preferences, for example:
  - •Edge enhancement
  - •Contrast enhancement
- •20° maximum possible field of view
  - •Can be compared to a 30 cm (12 in.) ruler held out at arm's length
- •Audible signals that provide information on system functionality

Press release: Second Sight Medical Products Announces European Market Approval of a Retinal Prosthesis for the Blind...
Product page: Argus II Retinal Prosthesis System ...
Flashbacks: Experimental Bionic Eyes Give Hope to Totally Blind ; Second Sight Medical Retinal Prosthesis to Receive a Wider Trial; Argus II Retinal Prosthesis Implanted Into First Two Patients in Europe; Second Sight Medical Retinal Prosthesis Receives FDA Approval for Clinical Trials

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PROSTHETICS

Attitudes changing as artificial limbs impro

Patients amputating more extensively to fit into high-tech options

Five years ago, Ann Kornhauser was out walking her golden retriever in Hicksville, N.Y., when bones in her left foot suddenly cracked.

Kornhauser, then in her late 50s, soon learned why: Doctors discovered a rare tumor in her foot. They amputated half of it.

The prosthetic foot she received afterward left her in constant pain. Her prosthetist offered a solution. Artificial limbs had greatly improved, he said, and she could benefit from one of the new high-tech models — but it would fit only if her left leg was amputated below the knee.

The idea of losing the rest of her leg, which was healthy enough, seemed preposterous and frightening. But after two years of discomfort, Kornhauser decided to do it.

"All my family said was, 'You're going to be sitting there without a leg.' But they didn't know what I knew," she said. "I knew it was going to look like a leg and that people ran marathons on them. I knew that I would have a life."

Josh Haner/The New York Times

After losing half her foot, Anne Kornhauser opted to amputate more so she could wear a high-tech prosthetic.

About 2 million people in the United States are living with amputations, according to the Amputee Coalition, a national advocacy group.

But as artificial limbs are infused with increasingly sophisticated technology, many amputees are making a once-unthinkable choice. Instead of doing everything possible to preserve and live with whatever is left of their limbs, some are opting to amputate more extensively to regain something more akin to normal function.

Occasionally this choice is made by someone with a missing hand or arm. But more common are amputations below the knee, which permit patients such as Kornhauser to take advantage of robotic and fleshlike prosthetics.

Bionic, or lifelike, prosthetics with custom skins, motors and microchips that replicate human motions are edging older models out of the market.

Amputees "are realizing they can do everything that they did before," said Amy Palmiero-Winters, 39, a celebrated ultramarathon runner who lost her left leg in a motorcycle accident when she was 24. She now works at A Step Ahead, a Long Island prosthetics clinic. "They look at people today and see the different things that they're doing and how it's more out in the open and accepted."

And not just accepted: While the loss of a limb remains a medical trauma, many amputees have come to embrace their bionic enhancements.

Many "have little desire for the artificial limb to look human," said Hugh He heads the biomechatr search group at the M at the Massachusetts of Technology, which oping wearable roboti "They want it to look ing and have a machi ty."

Alexis
The New Y

Assessing the efficacy of visual prostheses by decoding ms-LFPs: application to retinal implants. - Cottaris NP - *J Neural Eng* - 01-APR-2009; 6(2): 026007 (MEDLINE® is the source for the citation and abstract of this record)
DOI: 10.1088/1741-2560/6/2/026007

Abstract:

Visual prostheses are brain-computer interfaces that are implanted in early processing stages of the visual system of blind patients. In an effort to induce light sensations, visual prostheses inject, via arrays of stimulating electrodes, spatiotemporal trains of current pulses which excite the adjacent neural tissue. Human experiments with current state-of-the art retinal prostheses have revealed that, although visual percepts can be elicited by electrical stimulation, these percepts are not closely related to the spatial patterns of stimulation. One of the main reasons for this failure is that present methods of prosthetic stimulation result in non-specific activation of multiple retinal pathways. Recent evidence, however, suggests that the specificity of neural activation can be increased by manipulations of the spatiotemporal parameters of stimulation. Before these notions are evaluated in human experiments, which are subjective and prone to patient fatigue and frustration, it is imperative that they are assessed in animal models using cortical recordings. Toward this end, we have developed a computational method for analyzing the cortical multi-site local field potential (ms-LFP) evoked in response to electrical stimulation of a site presynaptic to where LFPs are recorded. This method applies a nonlinear decoding technique on the recorded ms-LFP signal to quantify the information transmitted downstream from the stimulation site. Validation of this method using an implant attached to the epiretinal surface of cats and ms-LFP recordings from layer 4 of cat primary visual cortex, demonstrates that the spatial origin, the duration and the amplitude of injected current pulses can all be decoded simultaneously from single-trial ms-LFP responses. Our findings indicate that the developed method is a highly sensitive probe for characterizing the efficacy of visual prosthetic stimulation.

Citation:

Assessing the efficacy of visual prostheses by decoding ms-LFPs: application to retinal implants.
Cottaris NP - *J Neural Eng* - 01-APR-2009; 6(2): 026007
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Full Source Title:
Journal of neural engineering

Publication Type:
Journal Article

Language:
English

Author Affiliation:
Department of Ophthalmology, Ligon Research Center of Vision, Wayne State University School of Medicine, Detroit, MI 48201, USA. nico@med.wayne.edu

Authors:
Cottaris NP; Elfar SD

Major Subjects:

- Models, Neurological
- Prostheses and Implants
- Retina / * physiology
- User-Computer Interface
- Vision, Ocular / * physiology

Additional Subjects:

- Algorithms
- Animals
- Cats
- Electric Stimulation
- Electrodes, Implanted
- Principal Component Analysis
- Probability
- Time
- Visual Cortex / physiology
- Visual Perception / physiology

5 June 2013 Last updated at 13:12 ET

Invisibility 'time cloak' developed

By Melissa Hogenboom
Science reporter, BBC News

Scientists were able to hide data sent by optical transmission

An "invisibility" time cloak which is able to hide events in a continuous stream of light has been developed by scientists.

The cloak works by manipulating the speed of light in optical fibres and means any interaction which takes place during this "hole in time" is not detected.

That is, a beam of light can be manipulated along its path.

The study is **published in the journal Nature**.

The research builds upon a time cloak **described last year** that was only able to hide single brief events of time in an optical beam.

Hidden data

This work is different to other "invisibility cloaks" in that it hides events in time, rather than spatial objects - which similar efforts have looked into.

The team from the Purdue University in Indiana has shown it can hide events in the path of a continuous light beam by having several "holes in time".

The researchers were able to cloak nearly half the data put in the beam's path, which they would otherwise be able to detect.

Cloaking, just as it sounds, is where an object or event is hidden from vision. This can apply to frequencies of light or sound. For example,

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stealth war planes can be difficult to detect on enemy radar.

"We were able to push the light forward and back using commercial telecoms components, that are controlled by electrical signals," said Andrew Weiner, who co-authored the paper.

"When one sends high-speed data over an optical fibre in the existing infrastructure, in many cases it's just 1s and 0s (binary code).

Bendy light

"In our system, we can hide the 1s and 0s. There can also be other kinds of disturbances in the light but this cloak provides a zone where one doesn't see how the light is being changed," Prof Weiner told BBC News.

He compared how a stream of light is manipulated to a flowing river.

"Think about taking a region of that river and pushing some of it forward, and some backwards so there are holes where there isn't any water. Maybe there's a dam, and we can pop the dam on and off very quickly, to somehow disturb or divert the water.

"If we part the water so it doesn't see the dam popping up and down, it isn't disturbed, and afterwards we can put the water back together so it looks like a nice calm river again.

"That's how we control the flow of the light. We're pushing it forward and backwards in time, so it avoids events that would otherwise disturb it," Prof Weiner explained.

Though called a time cloak, it's actually "not a manipulation of time, it's a manipulation of light" explained Greg Gbur, who specialises in optical physics at the University of North Carolina at Charlotte.

Other work on cloaking

- **Optical camouflage technology**: A modified background image is projected onto a cloak of retro-reflective material (the kind used to make projector screens); the wearer becomes invisible to anyone standing at the projection source
- **The "mirage effect"**: Electric current is passed through submerged carbon nanotubes to create very high local temperatures, this causes light to bounce off them, hiding objects behind
- **Adaptive heat cloaking**: A camera records background temperatures, these are displayed by sheets of hexagonal pixels which change temperature very quickly, camouflaging even moving vehicles from heat-sensitive cameras
- **Calcite crystal prism**: Calcite crystals send the two polarisations of light in different directions. By gluing prism-shaped crystals together in a specific geometry, polarised light can be directed around small objects, effectively cloaking them

The researcher, who was not involved in the study, said it showed a huge advance in the work on the time cloak.

"**In the first time cloak paper**, they discussed hiding events of a few billionths of a second once in a while. Here, they are talking about being able to hide data 46% of the time. This really suggests that this has gone from a curiosity to something that could be used in optical communications and data processing," added Dr Gbur.

Ortwin Hess, a physicist at Imperial College London, said the study was a "remarkable extension of the previously demonstrated time lens principle".

'Undesirable communication'

"An important part of the present paper exploits the principle of space-time duality, which means that like in the original concept of a temporal cloak, one of the directions of spatial cloaking had been replaced by time.

"It shows how beautiful the space-time principles are that can be used in optics. While previous cloaks are interesting as well, in the sense that they change optics in space, now we can change the way light, and thus information, behaves in space and time," Prof Hess told BBC News.

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The research has several possible applications, he added. It could make data more tamper proof, could be used to monitor "undesirable communication" and could be used by governments or large firms that handle sensitive or confidential information.

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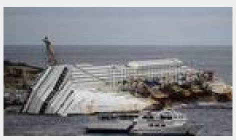

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Blind subjects implanted with the Argus II retinal prosthesis are able to improve performance in a spatial-motor task. - Ahuja AK - *Br J Ophthalmol* - 01-APR-2011; 95(4): 539-43 (MEDLINE® is the source for the citation and abstract of this record)

Abstract:

BACKGROUND/AIMS: To determine to what extent subjects implanted with the Argus II retinal prosthesis can improve performance compared with residual native vision in a spatial-motor task.

METHODS: High-contrast square stimuli (5.85 cm sides) were displayed in random locations on a 19â€³ (48.3 cm) touch screen monitor located 12â€³ (30.5 cm) in front of the subject. Subjects were instructed to locate and touch the square centre with the system on and then off (40 trials each). The coordinates of the square centre and location touched were recorded.

RESULTS: Ninety-six percent (26/27) of subjects showed a significant improvement in accuracy and 93% (25/27) show a significant improvement in repeatability with the system on compared with off ($p<0.05$, Student t test). A group of five subjects that had both accuracy and repeatability values <250 pixels (7.4 cm) with the system off (ie, using only their residual vision) was significantly more accurate and repeatable than the remainder of the cohort ($p<0.01$). Of this group, four subjects showed a significant improvement in both accuracy and repeatability with the system on.

CONCLUSION: In a study on the largest cohort of visual prosthesis recipients to date, we found that artificial vision augments information from existing vision in a spatial-motor task. Clinical trials registry no NCT00407602.

Citation:

Blind subjects implanted with the Argus II retinal prosthesis are able to improve performance in a spatial-motor task.
Ahuja AK - *Br J Ophthalmol* - 01-APR-2011; 95(4): 539-43
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Full Source Title:
The British journal of ophthalmology

Publication Type:
Clinical Trial; Journal Article; Multicenter Study; Research Support, N.I.H., Extramural

Language:
English

Author Affiliation:
Second Sight Medical Products, Sylmar, CA 91342, USA. aahuja@2-sight.com

Authors:
Ahuja AK; Dorn JD; Caspi A; McMahon MJ; Dagnelie G; Dacruz L; Stanga P; Humayun MS; Greenberg RJ
Argus II Study Group

Major Subjects:

- Blindness / physiopathology / * surgery
- Retina / physiopathology / * surgery
- Task Performance and Analysis
- Visual Prosthesis

Additional Subjects:

- Adult
- Aged
- Aged, 80 and over
- Female
- Humans
- Male
- Middle Aged
- Motor Activity / physiology
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- Prosthesis Design
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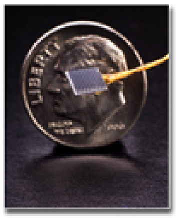
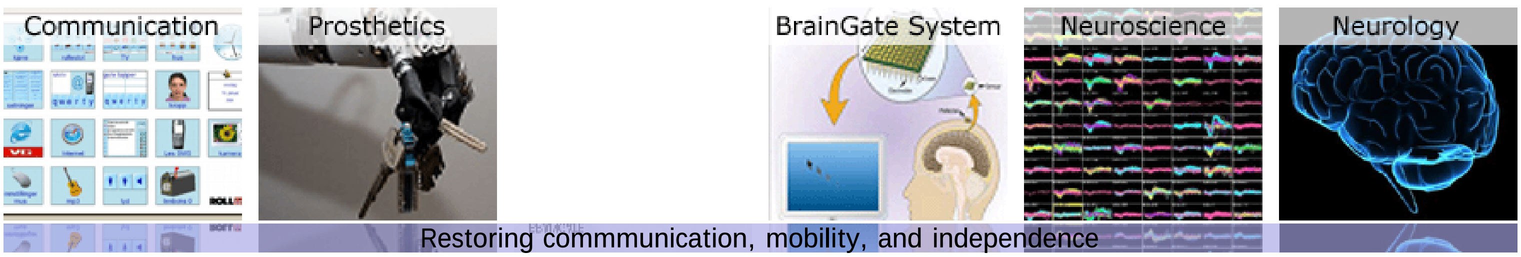


4x4mm array of 100 electrodes for recording neuronal action potentials, multi-unit activity, and local field potentials from the brain.

A long-term goal of the BrainGate research team is to create a system that, quite literally, turns thought into action – and is useful to people with neurologic disease or injury, or limb loss. Currently, the system consists of a "sensor" (a device implanted in the brain that records signals directly related to imagined limb movement); a "decoder" (a set of computers and embedded software that turns the brain signals into a useful command for an external device); and, the external device – which could be a standard computer desktop or other communication device, a powered wheelchair, a prosthetic or robotic limb, or, in the future, a functional electrical stimulation device that can move paralyzed limbs directly.

Our current BrainGate containing the computers that recognize and decode neural signals, plus the monitors used by trial participants and researchers.

Research supported by:



BrainPort Vision Technology

What is the BrainPort vision device?

The BrainPort vision device is an investigational non-surgical assistive visual prosthetic device that translates information from a digital video camera to your tongue, through gentle electrical stimulation.

How is the BrainPort vision device related to the Tongue Display Unit (TDU)?

The TDU is the first prototype of the technology that has evolved into today's BrainPort vision device.

Who could benefit from the BrainPort vision device?

The current investigational prototype works best for individuals who are blind and have no better than light perception. Since we do not stimulate the eye or optic nerve, our technology has the potential to work across a wide range of visual impairments. We are actively developing device modifications to address the needs for those with low vision such as macular degeneration.

How does the BrainPort vision device work?

The BrainPort vision system consists of a postage-stamp-size electrode array for the top surface of the tongue (the tongue array), a base unit, a digital video camera, and a hand-held controller for zoom and contrast inversion. Visual information is collected from the user-adjustable head-mounted camera (FOV range 3–90 degrees) and sent to the BrainPort base unit. The base unit translates the visual information into an stimulation pattern that is displayed on the tongue. The tactile image is created by presenting white pixels from the camera as strong stimulation, black pixels as no stimulation, and gray levels as medium levels of stimulation, with the ability to invert contrast when appropriate. Users often report the sensation as pictures that are painted on the tongue with Champagne bubbles.

With the current system (arrays containing 100 to 600+ electrodes), study participants have been able to recognize high-contrast objects, their location, movement, and some aspects of perspective and depth. Trained blind participants use information from the tongue display to augment understanding of the environment. Our ongoing research with the BrainPort vision device demonstrates the great potential of tactile vision augmentation and we believe that these findings warrant further exploration. As a result, we are currently working on improvements to the tongue display hardware, software, and usability, and on overall device miniaturization.

What is the resolution of the display?

The images below demonstrate how information from the video camera is represented on the tongue. Today's prototypes have 400 to 600 points of information on a ~3cm x 3cm tongue display, presented at approximately 30 frames per second, yielding an information rich image stream. Our research suggests that the tongue is capable of resolving much higher resolution information and we are currently working to develop the optimal tongue display hardware and software.

How long does it take to learn?

Our current research studies involve participation between 2-10 hours*. Within minutes of introduction, users may understand where in space stimulation arises (up, down, left and right) and the direction of movement. Within an hour of practice, users can generally identify and reach for nearby objects, and point to and estimate the distance of objects out of reach. With additional training, subjects can identify letters and numbers and can recognize landmark information when using the device in a mobile scenario.

Will I experience vision similar to what I once had?

After a few hours of training, some users have described the experience as resembling a low-resolution version of the vision they once had. In addition, neuroimaging research suggests that for blind individuals, visual regions of the brain are activated while using the BrainPort vision device. Ultimately, the experience is uniquely individual. However, the resulting perception does not need to "feel" like eye-based vision in order to provide assistive benefit.

Can Electrical Stimulation Hurt My Tongue?

You can adjust the intensity of the stimulation to your comfort level. Participants have reported that the impulses feel like champagne bubbles effervescing on their tongue.

How can I obtain the BrainPort vision device?

The BrainPort vision device is an investigational prototype and is not yet for sale in the US or abroad. Wicab plans to develop an assistive device suitable for commercial introduction in the near future. In the meantime, the prototype BrainPort vision device is being used in research studies across the country to measure perceptual enhancement resulting from BrainPort vision device use*.

Are there research studies that I may be eligible to participate?*

A number of academic and research institutions have had or will have studies using the BrainPort vision device with specific participation requirements. Please contact us for more information. If you are a research institution and would like to conduct research with the BrainPort vision device, please contact us for options regarding collaboration.

Wicab, Inc. in Middleton, WIsconsin announced today the initiation of a clinical study to evaluate the safety and efficacy of the BrainPort vision device in subjects who are blind. This year long study allows subjects to use the device at home after completion of initial clinic screening and training. Eligible subjects must be between the ages of 18 and 79 years of age and have had a medical diagnosis of blindness (light perception of no light perception) for at least 6 months. Blindness may not be a result of cortical injury, such as a traumatic brain injury or stroke. Subjects must have completed rehabilitation (such as orientation and mobility training with a white cane or guide dog). Previous use of the BrainPort vision device, pregnancy, and allergies to nickel or steel exclude participation in this study. Participants should be able to easily commute to and from the nearest clinical trial site and are required to make four quarterly clinic visits in addition to the initial training sessions. If you are interested in participating in this clinical study, please review our website, or contact Wicab at (608) 829-4511.

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1929 Bayview Ave
Toronto, Ontario Canada M4G 3E8
PI: Dr. Keith Gordon
Ph: (416) 486-2500

* Research studies are conducted under Institutional Review Board approved protocols and with participant consents.

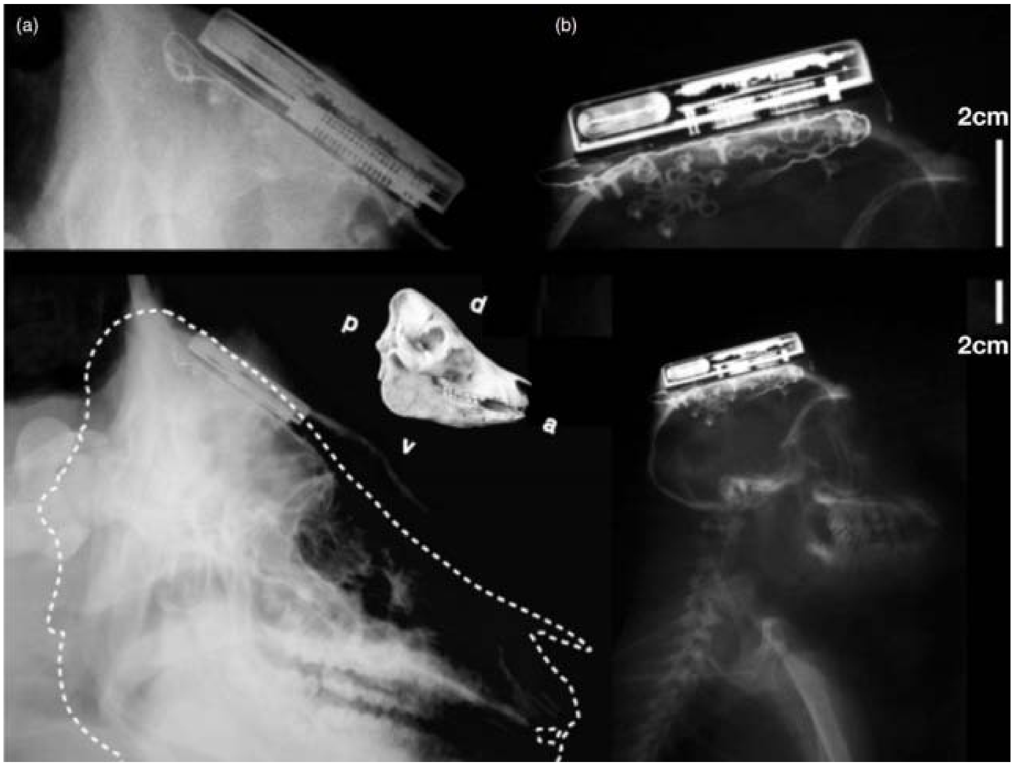
The BrainPort® vision device is an Investigational Device and its use remains limited by U.S. Federal Law to investigational uses only. THE BRAINPORT VISION DEVICE HAS NOT YET BEEN SUBMITTED TO THE FOOD AND DRUG ADMINISTRATION (FDA) FOR CLEARANCE OR APPROVAL AND IS NOT AVAILABLE FOR SALE. WICAB MAKES NO REPRESENTATIONS REGARDING THE DEVICE SAFETY OR EFFICACY.

Brown University creates first wireless, implanted brain-computer interface

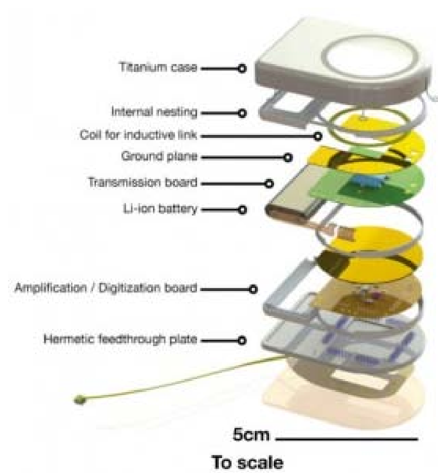
By Sebastian Anthony on March 4, 2013 at 8:03 am | 18 Comments

Researchers at Brown University have succeeded in creating the first wireless, implantable, rechargeable, long-term brain-computer interface. The wireless BCIs have been implanted in pigs and monkeys for over 13 months without issue, and human subjects are next.

We've covered BCIs extensively here on ExtremeTech, but historically they've been bulky and tethered to a computer. A tether limits the mobility of the patient, and also the real-world testing that can be performed by the researchers. Brown's wireless BCI allows the subject to move freely, dramatically increasing the quantity and quality of data that can be gathered — instead of watching what happens when a monkey moves its arm, scientists can now analyze its brain activity during complex activity, such as foraging or social interaction. Obviously, once the wireless implant is approved for human testing, being able to move freely — rather than strapped to a chair in the lab — would be rather empowering.



Brown's wireless BCI, fashioned out of hermetically sealed titanium, looks a lot like a pacemaker. (See: Brain pacemaker helps treat Alzheimer's disease.) Inside there's a li-ion battery, an inductive (wireless) charging loop, a chip that digitizes the signals from your brain, and an antenna for transmitting those neural spikes to a nearby computer. The BCI is connected to a small chip with 100 electrodes protruding from it, which, in this study, was embedded in the somatosensory cortex or motor cortex. These 100 electrodes produce a lot of data, which the BCI transmits at 24Mbps over the 3.2 and 3.8GHz bands to a receiver that is one meter away. The BCI's battery takes two hours to charge via wireless inductive charging, and then has enough juice to last for six hours of use.



One of the features that the Brown researchers seem most excited about is the device's power consumption, which is just 100 milliwatts. For a device that might eventually find its way into humans, frugal power consumption is a key factor that will enable all-day, highly mobile usage. Amusingly, though, the research paper notes that the wireless charging does cause significant warming of the device, which was "mitigated by liquid cooling the area with chilled water during the recharge process and did not notably affect the animal's comfort." Another important factor is that the researchers were able to extract high-quality, "rich" neural signals from the wireless implant — a good indicator that it will also help human neuroscience, if and when the device is approved.

Moving forward, the wireless BCI is very much a part of BrainGate — the Brown University research group that's tasked with bringing these neurological technologies to humans. So far, the pinnacle of BrainGate's work is a robotic arm controlled by a tethered BCI, which paralyzed patients can use to feed themselves (video embedded below). While the wireless BCI isn't approve for human use (and there's no indication that they're seeking approval yet), it was designed specifically so that it should be safe for human use.

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The Brown researchers now intend to develop a different version of the device to help them study the motor cortex of an animal with Parkinson's disease. They are also working on reducing the device's size, improving its safety and reliability, and increasing the amount of data it can transmit — for the eventual goal of equipping those with movement disabilities, or elective transhumanists, with a wireless brain-computer interface.

Now read: MIT discovers the location of memories: Individual neurons

Research paper: doi:10.1088/1741-2560/10/2/026010 – "An implantable wireless neural interface for recording cortical circuit dynamics in moving primates"

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Simon Crowley

I'd volunteer as a healthy test subject.

Muhammad Shadi Al-Rajeh

Me too :-)

Chad Zelgore Lumenarcus

Sign me up.

chojin999

They could have implanted a server rack chassis on the brain.. uh? These people play Frankenstein on humans.

Such a device should be tiny.. which means in the 50millimetres range. Not such a huge dangerous piece of metal with huge antennas connected on a human brain!

AUGUST 4, 2013, 1:39 PM | 90 Comments

Computer-Brain Interfaces Making Big Leaps

By NICK BILTON

David Lee/Focus Features

In the movie, "Eternal Sunshine of the Spotless Mind," a character played by Jim Carrey uses a service that erases memories to wipe his brain of his former girlfriend, played by the actress Kate Winslet.

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Scientists haven't yet found a way to mend a broken heart, but they're edging closer to manipulating memory and downloading instructions from a computer right into a brain.

Researchers from the Riken-M.I.T. Center for Neural Circuit Genetics at the Massachusetts Institute of Technology took us closer to this science-fiction world of brain tweaking last week when they said they were able to create a false memory in a mouse.

The scientists reported in the journal Science that they caused mice to remember receiving an electrical shock in one location, when in reality they were zapped in a completely different place. The researchers weren't able to create entirely new thoughts, but they applied good or bad feelings to memories that already existed.

"It wasn't so much writing a memory from scratch, it was basically connecting two different types of memories. We took a neutral memory, and we artificially updated that to make it a negative memory," said Steve Ramirez, one of the M.I.T. neuroscientists on the project.

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It may sound insignificant and perhaps not a nice way to treat mice, but it is not a dramatic leap to imagine that one day this research could lead to computer-manipulation of the mind for things like the treatment of post-traumatic stress disorder, Mr. Ramirez said.

Technologists are already working on [brain-computer interfaces], which will allow us to interact with our smartphones and computers simply by using our minds. And there are already gadgets that read our thoughts and allow us to do things like dodge virtual objects in a computer game or turn switches on and off with a thought.

But the scientists who are working on memory manipulation are the ones who seem to be pushing the boundaries of what we believe is possible. Sure, it sounds like movie fantasy right now, but don't laugh off the imagination of Hollywood screenwriters; sometimes the movies can be a great predictor of things to come.

In the movie, "Eternal Sunshine of the Spotless Mind," a character played by Jim Carrey uses a service that erases memories to wipe his brain of his former girlfriend, played by Kate Winslet.

But it seems the movie's screenwriter, Charlie Kaufman, was selling science short.

"The one thing that the movie "Eternal Sunshine of the Spotless Mind" gets wrong, is that they are erasing an entire memory," said Mr. Ramirez of M.I.T. "I think we can do better, while keeping the image of Kate Winslet, we can get rid of the sad part of that memory."

Hollywood and science-fiction writers, of course, have had fun with memory manipulation over the years.

In the film "Total Recall," which is based on a short story by Philip K. Dick, a character played by Arnold Schwarzenegger receives a memory implant of a fake vacation to Mars. In "The Matrix," characters can download new skills like languages or fighting techniques to their mind, much like downloading a file to a computer.

Far-fetched? Perhaps, and we're not yet fighting our robot overlords as the humans were in "The Matrix," but researchers really are exploring ways to upload new information to the brain.

In 2011, scientists working in collaboration with Boston University and A.T.R. Computational Neuroscience Laboratories in Kyoto, Japan, published a paper on a process called [Decoded Neurofeedback], or "DecNef," which sends signals to the brain through a functional magnetic resonance imaging machine, or FMRI, that can alter a person's brain activity pattern. In time, these scientists believe they could teach people how to play a musical instrument while they sleep, learn a new language or master a sport, all by "uploading" information to the brain.

Writing to the brain could allow us to interact with our computers, or other human beings, just by thinking about it.

In February, Dr. Miguel A. Nicolelis, a neuroscientist at Duke University [successfully connected] the brains of two rats over the Internet, allowing them to communicate with their minds so when one rat pressed a lever, the other one did the same. The rats were in different locations, one at Duke University, in North Carolina, and another in a laboratory in Natal, Brazil.

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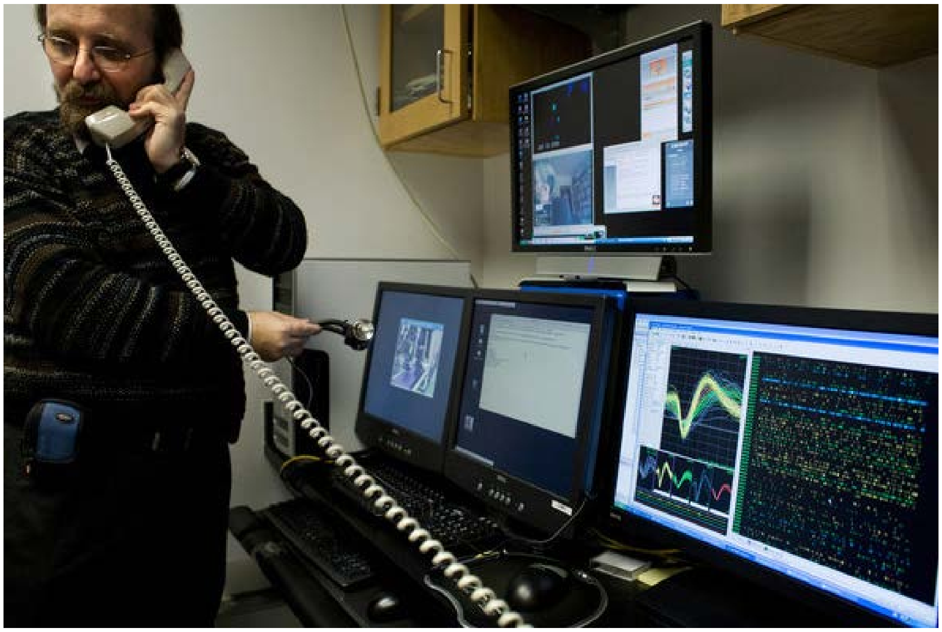

Jeremy M. Lange for The New York Times

Dr. Miguel A. Nicolelis, a neuroscientist at Duke University, in 2008.

Dr. Nicolelis said he has recently performed other experiments in his lab where he has connected the brains of four mice in what he calls a "brain net" allowing them to share information over the Internet. In another experiment, he took two monkeys and gave them both half of a piece of information to successfully move a robotic arm, which required them to share the information through their brain.

Last week scientists at Harvard Medical School created a brain-to-brain interface that enables a human to move a rat's tail just by thinking about it.

Of course, in all the movies about brain technology and enhancing memories there is usually a downside. In "Total Recall," the character has a difficult time distinguishing between reality and his fantasy adventure. This leads to mayhem. In "Eternal Sunshine," after Mr. Carrey's character erases his memories, they reappear in a jumble. Hilarity (and insight into love and loss) ensues.

But some researchers don't appear to be worried about that sort of thing. In his book, "Beyond Boundaries: The New Neuroscience of Connecting Brains with Machines — and How It Will Change Our Lives," Dr. Nicolelis said he believes it is possible that humans will be able to communicate wirelessly without words or sound, where brain waves are transmitted over the Internet.

"I think this is the real frontier of human communication in the future. We already can get our monkeys, and even humans, to move devices just by thinking," he said. "Once you can write to the brain, I can imagine the same type of logic working for communication where your thoughts and a message will be communicated to another human being and they will be able to understand it."

It looks like mending that broken heart, through manipulation of our memories, might be here closer than we think.

A version of this article appeared in print on 08/05/2013, on page B4 of the NewYork edition with the headline: Big Leaps in Linking Computers and Brains.

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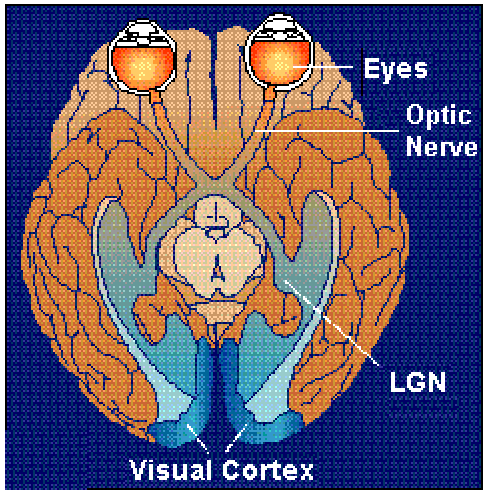
Cortical Prosthesis

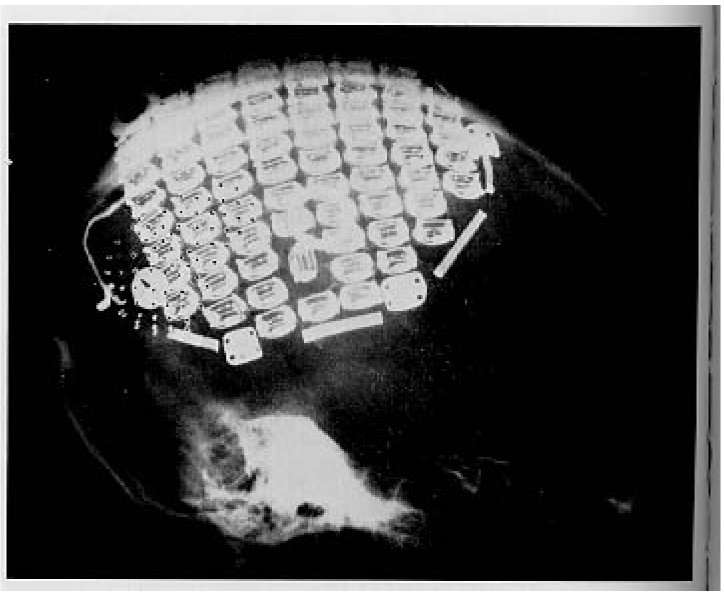
Introduction



Many blind individuals will not benefit from the development of a retinal prosthesis. The reason for this is simple: retinal prostheses rely on the circuitry of the brain to transmit electrical signals from the eye to the center of visual processing in the brain, the visual cortex. If this circuitry is not functional, a prosthesis must bypass these systems and intervene directly at the cortical level. The group of people for which this applies (see "Who Benefits") includes anyone who has sustained trauma to the optic nerve, as well as individuals with severe cases of retinal diseases that leave few functional ganglion cells. Of course, if a cortical visual prosthesis (CVP) works well, a patient that would also qualify for a retinal prosthesis could opt for a CVP instead.

History

The history of the cortical prosthesis begins in 1929 when Foerster investigated the effects of electrical stimulation of the occipital lobe of the human cortex [3]. He found that this stimulation caused a subject to "see" a small point of light, later called a "phosphene". This result was reproduced many times after the original experiment with both sighted subjects and blind subjects. The idea that concurrent stimulation of many sites in the brain could produce a single coherent image was postulated as early as 1953 by Krieg [4]. Because there is rough retinotopy in the visual cortex, Krieg thought it would be possible to use this technique to restore sight to the blind.



In order for a CVP to be even a remotely viable option, a permanent device for chronic stimulation of neural tissue needed to be developed. This was accomplished in 1968 by Drs. Brindley and Lewin [1]. Their device was implanted in a 52-year-old woman who had gone totally blind six months before the operation. The device had 80 electrodes, each with its own controlling unit (receiver). The set of 80 receivers sat directly beneath the pericranium, while the electrodes lay on top of the occipital cortex. As described in the paper, "To activate a given receiver, and so stimulate the cortex through its electrode, the transmitting coil of an oscillator tuned to the appropriate frequency is pressed against the scalp immediately over it." Using this system, Brindley and Lewin were able to demonstrate the plausibility of a permanent CVP.

Brindley and Lewin's device was an immediate success. An electrode voltage of about 25 V resulted in the subject's perception of a small point of light. More importantly, many electrodes could be stimulated at the same time, resulting in many small points of light. The position of the electrodes corresponded roughly to the position of the phosphenes in the visual field, and the subject was able to identify patterns of phosphenes. Of course, this device was far from ideal. One of the major problems they reported was that a single electrode could cause many phosphenes to appear. Sometimes this was a function of current, with a greater current leading to the production of more phosphenes, but other times it was independent of stimulus parameters. Additionally, there was a serious limitation on spatial resolution: electrodes spaced closer than 2-3 mm created a large strip of light when activated simultaneously. Finally, the patient reported seeing flicker in every phosphene created.

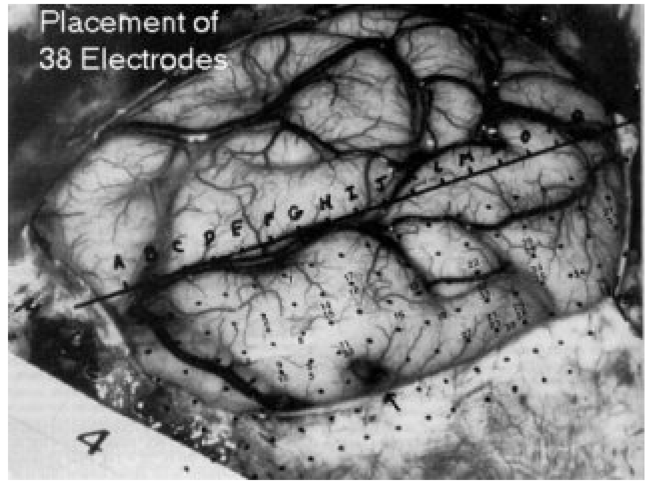
The next major advance pertaining to CVPs was made by Drs. Dobelle and Mladejovsky in 1974 [2]. They tested various parameters of electrical simulation of human visual cortex on 38 volunteers who were admitted into a hospital for non-elective cranial surgery. Even though they did not implant an actual prosthesis, they were able to provide important data because of the number of patients analyzed (compared to Brindley and Lewin's one subject). Some of the results they obtained complemented those presented by Brindley and Lewin, but others directly conflicted. For example, they also found that a single electrode could elicit a multi-phosphene response, and their subjects also reported constant flicker of the phosphenes. However, in contrast to the 1968 paper, Dobelle and Mladejovsky concluded that a constant stimulus did not produce a sustained phosphene, but rather one that grew dimmer over time and eventually faded after 10-15 sec. This is important in designing a cortical prosthesis, because it means that an image will have to be refreshed at a certain rate to prevent adaptation. Another important design consideration results from the fact that phosphenes move with eye movements. That is, if a phosphene appears in the center of vision when a subject is looking straight ahead, it will appear in the right hemisphere when the subject looks to the right. An eye position-detector is therefore needed if an image is to be stabilized in the visual field. Finally, although safety was not considered an issue while they were conducting their experiments, the currents required to produce phosphenes (3-5 mA) were potentially dangerous. A phenomenon known as "kindling" can occur when the cortex is repeatedly stimulated with high currents -- the added electrical activity can cause local seizures. With these problems in mind, researchers continued to work towards an implantable device.

Research in the 90's

Throughout most of the 1990's there were two groups working towards a permanent CVP. The first was based at the National Institutes of Health (NIH) in Washington, D.C., and was headed by Dr. E. M. Schmidt. The second was based at the John Moran Laboratories in Applied Vision and Neural Sciences at the University of Utah, headed by Dr. R. A. Normann. Both of these groups approached the problem of a cortical prosthesis differently than their colleagues in the 1970's: instead of using surface electrodes on the visual cortex, they chose to employ penetrating microelectrodes.

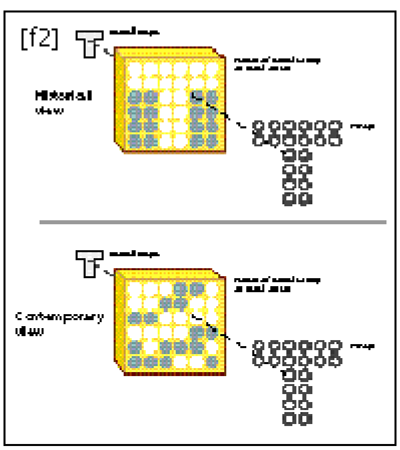
The first paper from the NIH group was published in 1990 [5], and it described the various parameters required to produce phosphenes from intracortical microstimulation (ICMS). The motivation for this research came from reports of low stimulus thresholds for visual cortex ICMS in primates. Indeed, instead of the 3-5 mA threshold described by Dobelle and Mladejovsky, they reported a more modest range of 20-200 uA (depending on depth of insertion, from 3-5 mm) in their human subjects. Moreover, the phosphenes they produced were described as identical to the ones generated by surface stimulation, except that these did not flicker at all. Also important is the difference in spatial resolution between surface stimulation and ICMS -- Schmidt was able evoke the percept of two distinct phosphenes with microelectrodes separated by only 0.7-1.0 mm.

Because of the encouraging data in the 1990 paper, the NIH group proceeded to manufacture a 38-microelectrode penetrating array for implantation in a blind volunteer. The subject they chose was a 42-year-old woman who had been blind for 22 years due to severe glaucoma. She was tested with the device frequently over the course of 4 months, during which time she had a percutaneous connector emanating from the back of her head. Since there was no power source incorporated into this design, she was unable to use the prosthesis outside the lab.

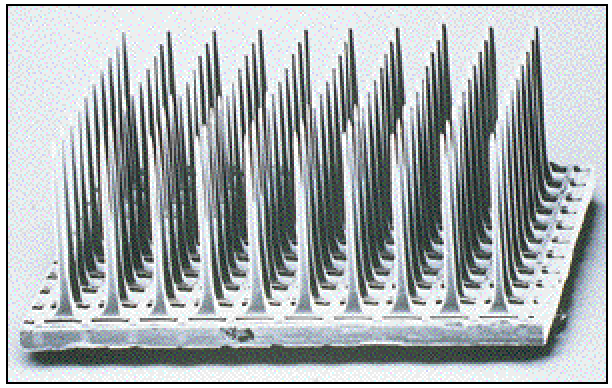


Initially, the results were encouraging. It was unclear whether someone who had been blind for 22 years would respond to ICMS, but they were able to evoke a response from 36 of the 38 microelectrodes. The group published an extensive account of the sensations reported by their subject, and she experienced many of the same visual sensations as Brindley and Lewin's subject [6]. The size of the phosphenes ranged from a "pinpoint" to a "nickel held at arm's length". They were colored either white, yellow, red, or blue, but not green. Sometimes the phosphenes appeared to be different distances away from the subject, and they always moved when she moved her eyes. However, the researchers noticed that most of these effects were variable by changing the current or presenting multiple phosphenes simultaneously. For example, as the number of phosphenes generated increased, they became increasingly coplanar and uniformly colored.

After a few weeks' time, the project became fraught with difficulties. Although the researchers expected to find an optimal set of stimulus parameters, they found that their subject adapted differently to different aspects of the electric stimulus, and the optimal settings changed over time. For example, the current threshold level required to produce a phosphene increased by an average of 52% over a sequence of 50 stimuli. During that same interval, the brightness of a given perceived phosphene decreased by 75% . These and other issues of accommodation could pose a significant problem in the development of a permanent CVP, because it is difficult to design a device when the specifications are continually varying. Separate from the problem of finding stable stimulus parameters, the NIH group had problems with the microelectrode array itself. By the second month of testing, more than half of the electrodes had broken. Some of this breakage was due to accidental movement during sleep, some was due to the initial insertion of the array, and still some was due to bad luck. Obviously, a permanent implant must be viable for much longer than this experimental device.



To determine whether the subject could recognize meaningful spatial patterns of stimulation, the researchers needed to map the location of the phosphenes in the subject's visual field. The reason for this is that the retinotopy in the cortex is true for gross measurements, but not for precise locations. Furthermore, the cortical representation of the visual field is distorted, not linear; stimulation of electrodes in a square grid will not produce the perception of a square. Mapping the location of phosphenes is simple with a sighted subject, but it is significantly more difficult with a blind individual. Without any point of reference, it is difficult for a blind person to reliably indicate the location of phosphenes. This was demonstrated by research conducted last summer [7], and it remains a problem in the application of a cortical prosthesis. Regardless, the NIH subject reported seeing a vertical line when a set of seven electrodes were activated simultaneously, and she suggested that "the size of the resultant image would be adequate to represent a letter 'I' or one leg of the letter 'M'." This suggests that an ICMS-based CVP might be adequate for a reading aid.

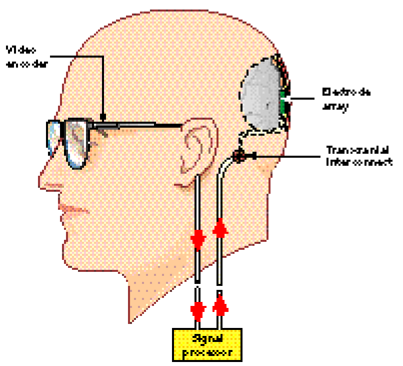


While 38 electrodes are useful in proof-of-concept experiments, a commercial CVP would require a significantly larger number of electrodes. As an incremental advance towards achieving that goal, Dr. Richard Normann has been working on the development of the Utah Intracortical Electrode Array (UIEA), a 100 microelectrode array designed for recording and stimulating single cells in the cortex [8]. Although the long-term safety and stability of the UIEA have not yet been demonstrated, they have proven that the design works and does not immediately damage the neural tissue into which it is inserted [9]. The next stage in this research is the implantation of the UIEA in a human subject.

Future Prospects

Although the cortical visual prosthesis was conceptualized almost 50 years ago, the technology required to build such a device has become available only recently. The first generations of CVPs will likely have between 100 and 300 microelectrodes and be useful as reading aids. As the technology advances, devices with more and closer-spaced electrodes will become available, increasing the resolution so that the device can be used to navigate while walking. Eventually, the scenario described in the introduction will become standard, with a video camera processing scenes in real time and transmitting them to a high-resolution microelectrode array. Before any of this can happen, however, studies must be done on the long-term safety of ICMS and the long-term durability of a cortical implant. Furthermore, a good CVP will require precise eye-tracking to stabilize images (see History, above), an accurate method of mapping phosphenes (see 90's, above), and a way to transmit signals to the device without percutaneous connectors to minimize the chance of infection. Finally, more mundane issues will have to be considered, such as minimizing power consumption, making the device cost-effective. The timeline for these developments is difficult to predict, but the outlook is decidedly positive: cortical visual prostheses are on their way!

[f4]



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Cytovis is dedicated to advancement of cellular therapies for ophthalmic conditions that are not addressed well surgically or with traditional therapeutics, yet where cell therapy has been proven to work and medical practice is limited predominantly by lack of sufficient disease-free and otherwise quality human cells.

The lead program is centered on human corneal tissue (**CytoCor**™) as a transplantation source for the over ten million people with corneal blindness or severe vision impairment, particularly in India, China and other Asian countries. The goal is to provide universally applicable corneal tissue, not only epithelium for patients with insufficient limbal stem cell reserves for autologous regeneration therapy but also essentially unlimited supply of stroma (the clear bulk of the cornea) and endothelium (the innermost portion of the cornea that is needed in an increasing portion of patients with corneal disease). The same corneal tissue is being developed as a replacement for live animals and surgically removed animal eyes for testing of cosmetics, food ingredients and household and industrial chemicals, which offers a relatively quick path to commercialization.

A second program involves human retinal cells and structures (**CytoRet**™) to treat dry, age-related macular degeneration, a leading cause of blindness in the elderly globally, and genetic disorders such as retinitis pigmentosa. Small molecule and protein therapeutics are not efficacious in these conditions whereas cells have demonstrated clinical efficacy.

Ophthalmology is an attractive area for development and commercialization. First, rapid and lasting vision restoration improves quality of life for individual patients and provides strong pharmacoeconomic benefit for society by increasing patients’ work ability. Second, relative to systemic and internal disorders, therapeutic development for localized ophthalmic conditions is simplified by more readily achievable safety-efficacy profiles and potential use of the second eye as a study control. Third, many of these conditions affect the elderly that account for an increasing portion of the population. Finally, a small and experienced development team can advance multiple programs in parallel, which translates into modest infrastructure requirements, diversified opportunities and relatively quick paths to inflexion points for investors.

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SCIENCE NEWS

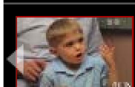
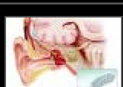
Deaf Boy Hears Dad For First Time (+Video)

By Zachary Stieber, Epoch Times | June 21, 2013

Last Updated: June 24, 2013 4:41 pm

1 of 2

3-year-old Grayson Clamp of Charlotte, NC is the first child to receive an auditory brain stem implant, which allows him to hear and likely to eventually speak well. (Screenshot UNC Health Care)

Deaf boy hears dad: A three year old became the first child in the United States to get a new kind of implant as part of an experimental trial, and can now hear.

Grayson Clamp of Charlotte, North Carolina got an auditory brain stem implant at UNC Hospitals as part of an investigational trial

"We're bringing the potential of hearing to a child that can't hear and has no other options," said Craig Buchman, ear, head, and neck surgeon at UNC.

The surgery is done through an incision behind the ear, through which a small window of bone is removed. The surgeons then go down and open up a plane between the bone and brain, and go deeper into the brain to the cochlear nucleus, where the brain usually gets information from but in deaf people doesn't. They then take a small paddle or electrode and lay it directly on that

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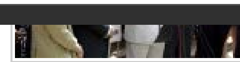
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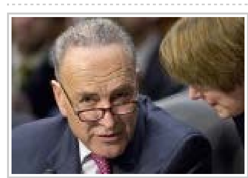
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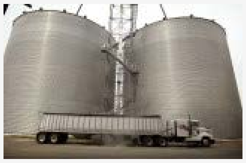

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area, and the cable hooks up to the receiver.

"Instead of traveling through the ear, sound information travels through the cable and stimulates the brain," says UNC in a video. "The processed sound gives Grayson the ability to hear."

The video shows him hearing his dad's voice for the first time. Len Clamp, the father, says his son looked deep in his eyes while hearing his voice and that it was phenomenal. "He was hearing my voice for the first time," said Clamp. "It was absolutely phenomenal to see him take that sound in and try to figure out: what in the world is this?"

Grayson had the procedure done on him in late May, but the UNC Health Care posted the now viral video on June 20.

Grayson, who was adopted by Clamp and his wife Nicole, will undergo several years of special hearing and speech therapy.

"He is a very determined little boy," Nicole Clamp told local broadcaster WRAL. "He makes up his mind, he is going to do something. He's going to do it."

UNC Hospitals is part of UNC Health Care, a non-profit medical system owned by the state of North Carolina.

The auditory brainstem implant is being investigated by the Food and Drug Administration for wider application in restoring hearing to deaf children. It was developed by the Los Angeles-based House Research Institute, which received approval from the administration for a clinical trial in January.

More than 1,000 adults worldwide have received hearing through the procedure and device.

"This will be the first FDA-approved trial of its kind, and represents a major step forward to bring a sense of hearing to deaf children in the U.S. who are born without a hearing nerve or cochlea (hearing organ) and therefore are unable to benefit from hearing aids or cochlear implants," said Neil Segil, Ph.D, executive vice president for research, House Research Institute, in the January announcement.

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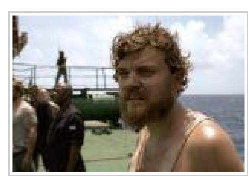

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The trial includes the University of Verona Hospital in Italy, which is looking at expanding the procedure to children around the world. The auditory brainstem implant (ABI) procedure has already been used successfully on children in Italy and in other parts of Europe, although the procedure doesn't work for everyone. Most people who have neurofibromatosis type 2, a genetic defect that results in deafness, who have received ABI "cannot identify words or sentences with only the sound from the ABI—a few patients have more than 20% word understanding," writes Robert Shannon, head of the auditory implant research laboratory at the House Research Institute, in a 2011 analysis of the procedure.

Investigations continue to look at the large differences in performance across patients with the implant, according to Shannon. Children are believed to be one group that can benefit the most, though.

"These children have never heard sound before, so their brains don't know at first what to make of the neural signals coming in from the ABI," said Shannon, an investigator for the clinical trial, and who has been a leading scientist in the development of ABI device technology beginning with the first ABI for adults, in the announcement. "The pattern of information the ABI delivers to their brains is very different from the natural acoustic pattern. Yet their brain is eventually able to make sense of the information and many learn to speak and understand sounds. This demonstrates the amazing power of the brain to learn new patterns of information."

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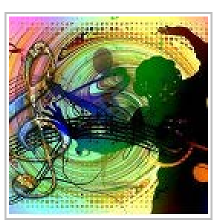

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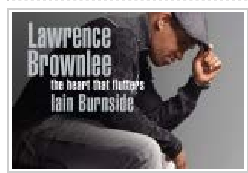

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JUNE 23, 2013, 11:00 AM | 27 Comments

Disruptions: Medicine That Monitors You

By NICK BILTON

SAN FRANCISCO — They look like normal pills, oblong and a little smaller than a daily vitamin. But if your doctor writes a prescription for these pills in the not-too-distant future, you might hear a new twist on an old cliché: "Take two of these ingestible computers, and they will e-mail me in the morning."

As society struggles with the privacy implications of wearable computers like Google Glass, scientists, researchers and some start-ups are already preparing the next, even more intrusive wave of computing: ingestible computers and minuscule sensors stuffed inside pills.

HQ, Inc.

The CorTemp pill, from HQ Inc., has a built-in battery and wirelessly transmits real-time body temperature.

Although these tiny devices are not yet mainstream, some people on the cutting edge are already swallowing them to monitor a range of health data and wirelessly share this information with a doctor. And there are prototypes of tiny, ingestible devices that can do things like automatically open car doors or fill in passwords.

For people in extreme professions, like space travel, various versions of these pills have been used for some time. But in the next year, your family doctor — at least if he's technologically adept — could also have them in his medicinal tool kit.

Inside these pills are tiny sensors and transmitters. You swallow them with water, or milk if you'd prefer. After that, the devices make their way to the stomach and stay intact as they travel through the intestinal tract.

"You will — voluntarily, I might add — take a pill, which you think of as a pill but is in fact a microscopic robot, which will monitor your systems" and wirelessly transmit what is happening, Eric E. Schmidt, the executive chairman of Google, said last fall at a company conference. "If it makes the difference between health and death, you're going to want this thing."

One of the pills, made by Proteus Digital Health, a small company in Redwood City, Calif., does not need a battery. Instead, the body is the power source. Just as a potato can power a light bulb, Proteus has added magnesium and copper on each side of its tiny sensor, which generates just

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Bits Daily Update

enough electricity from stomach acids.

As a Proteus pill hits the bottom of the stomach, it sends information to a cellphone app through a patch worn on the body. The tiny computer can track medication-taking behaviors — “did Grandma take her pills today, and what time?” — and monitor how a patient’s body is responding to medicine. It also detects the person’s movements and rest patterns.

Executives at the company, which recently raised $62.5 million from investors, say they believe that these pills will help patients with physical and neurological problems. People with heart failure-related difficulties could monitor blood flow and body temperature; those with central nervous system issues, including schizophrenia and Alzheimer’s disease, could take the pills to monitor vital signs in real time. The Food and Drug Administration approved the Proteus pill last year.

A pill called the CorTemp Ingestible Core Body Temperature Sensor, made by HQ Inc. in Palmetto, Fla., has a built-in battery and wirelessly transmits real-time body temperature as it travels through a patient.

Firefighters, football players, soldiers and astronauts have used the device so their employers can monitor them and ensure they do not overheat in high temperatures. CorTemp began in 2006 as a research collaboration from the Johns Hopkins University Applied Physics Laboratory and the National Oceanic and Atmospheric Administration.

Lee Carbonelli, HQ’s marketing director, said the company hoped, in the next year, to have a consumer version that would wirelessly communicate to a smartphone app.

Future generations of these pills could even be convenience tools.

Last month, Regina Dugan, senior vice president for Motorola Mobility’s advanced technology and projects group, showed off an example, along with wearable radio frequency identification tattoos that attach to the skin like a sticker, at the D: All Things Digital technology conference.

Once that pill is in your body, you could pick up your smartphone and not have to type in a password. Instead, you are the password. Sit in the car and it will start. Touch the handle to your home door and it will automatically unlock. “Essentially, your entire body becomes your authentication token,” Ms. Dugan said.

But if people are worried about the privacy implications of wearable computing devices, just wait until they try to wrap their heads around ingestible computing.

“This is yet another one of these technologies where there are wonderful options and terrible options, simultaneously,” said John Perry Barlow, a founder of the Electronic Frontier Foundation, a privacy advocacy group. “The wonderful is that there are a great number of things you want to know about yourself on a continual basis, especially if you’re diabetic or suffer from another disease. The terrible is that health insurance companies could know about the inner workings of your body.”

And the implications of a tiny computer inside your body being hacked? Let’s say they are troubling.

There is, of course, one last question for this little pill. After it has done its job, flowing down around the stomach and through the intestinal tract, what happens next?

“It passes naturally through the body in about 24 hours,” Ms. Carbonelli

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said, but since each pill costs $46, “some people choose to recover and recycle it.”

E-mail: bilton@nytimes.com

A version of this article appeared in print on 06/24/2013, on page B1 of the NewYork edition with the headline: A Computer Swallowed, To Monitor Inner Space.

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WHAT IS EKSO?

Ekso™ is a bionic suit, or exoskeleton, which enables individuals with lower extremity paralysis to stand up and walk over ground with a weight bearing, four point reciprocal gait. Walking is achieved by the user's forward lateral weight shift to initiate a step. Battery-powered motors drive the legs and replace neuromuscular function.

WHO IS IT FOR?

The first generation of Ekso is intended for medically supervised use by individuals with complete or incomplete spinal cord injury (SCI) or disease, and other forms of lower extremity paralysis or weakness due to Multiple Sclerosis, amyotrophic lateral sclerosis, Parksinson's Guillain Barre or other neurological disease. With medical clearance, the suit can typically facilitate walking for individuals with up to C7 complete, or any level of incomplete spinal cord injury.

HOW IS IT USED?

The current Ekso device provides functional based rehabilitation, gait training, and upright, weight bearing exercise under the supervision of a medical professional in a clinic or rehabilitation facility. The Ekso suit is strapped over the user's clothing so they can get up in a matter of minutes. Virtually everyone medically cleared for use of Ekso has walked in their first session with a therapist.

WALK MODES

1. FirstStep™

A physical therapist actuates steps with a button push. The user progresses from sit to stand and using a walker to walking with crutches, often in their first session.

2. ActiveStep™

User take control of actuating their steps via buttons on the crutches or walker.

3. ProStep™

The user achieves the next step by moving their hips forward and shifting them laterally. The Ekso device recognizes that the user is in the correct position and steps.

VARIABLE ASSIST

The Variable Assist feature provides the ability to adjust the amount of power the Ekso suit contributes to an individual's walking efforts on either side for indications such as motor incomplete SCI and hemiplegia due to stroke. The power contribution is fully adjustable to either leg based on clinician input or patient's functional strength level.

TRAINING MODE

The Ekso suit provides audio cues to the user when ideal lateral and forward spatial targets are achieved to initiate a step. Training Mode is used to determine the ideal weight shift targets for a user that is preparing to progress to ProStep.

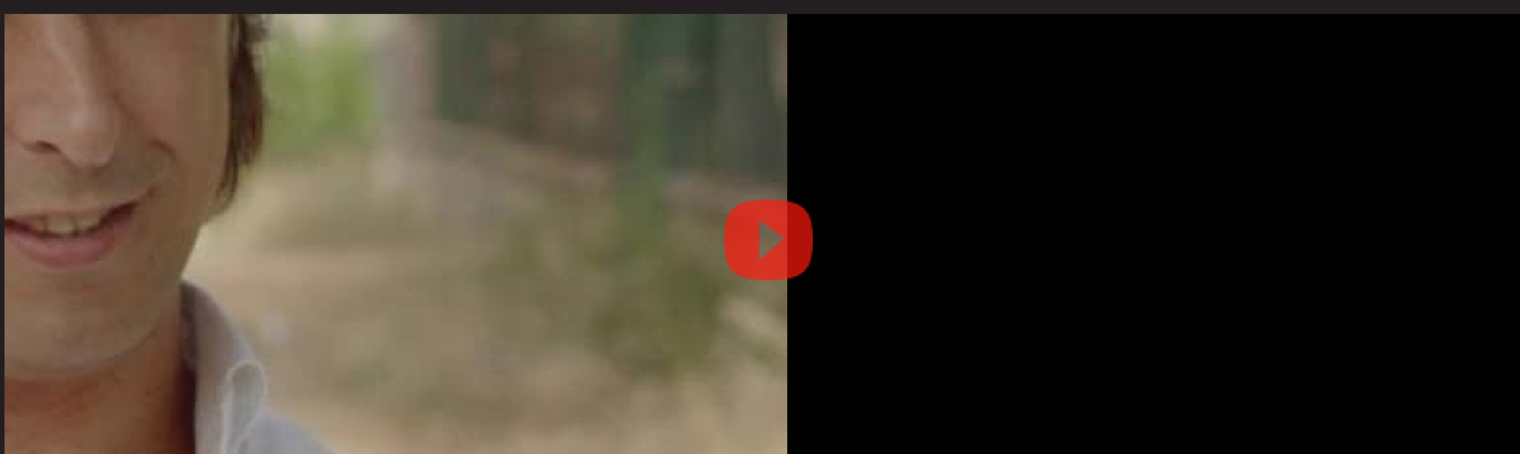
EKSO PULSE

Ekso Pulse automatically gathers and transmits statistics and device information during Ekso walking sessions. Data can be retrieved through our secure web server to view, filter, and export.

CRAIG HOSPITAL

Candy Tefertiller, PT, DPT, ATP, and Director of Physical Therapy at Craig Hospital, Denver, Colorado shares how Ekso is used in their SCI rehabilitation program.

PROSPERIUS INSTITUTE



Paolo Milia, MD, PhD and Chairman of the Rehabilitation Unit at Prosperius Institute in Umbria, Italy discusses the application of Ekso at their clinic.

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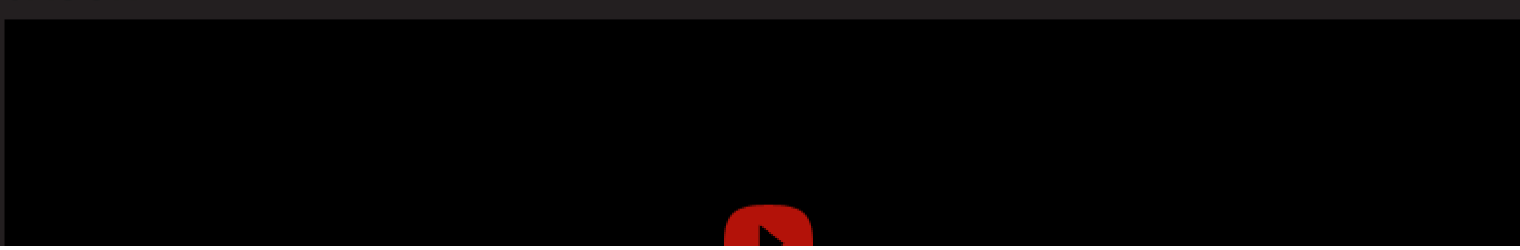

"I knew I would walk again - there was never a doubt in my mind. It was just a matter of time."

FAQ

Find answers to the commonly asked questions such as, "Can I walk in Ekso?"

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WHO

Ekso Bionics™ has embarked on collaborative partnerships with some of the most esteemed facilities around the world which offer leading edge technology for the treatment and rehabilitation of spinal cord injury or disease and other forms of paralysis or weakness.

WHAT

Each Ekso Center has invested in a team of Ekso Certified Physical Therapists to provide best practice patient care. Using the Ekso™ suit, they facilitate safe, functional based gait training and rehabilitation in a weight bearing and over ground environment. The practical application and data gathered from these facilities plays a critical role in the research and product development process.

WHERE

Ekso suits have been integrated into leading rehabilitation and wellness programs across North America and Europe. To find out if you are a candidate for walking in Ekso, visit our frequent questions page or contact the facility nearest you below.

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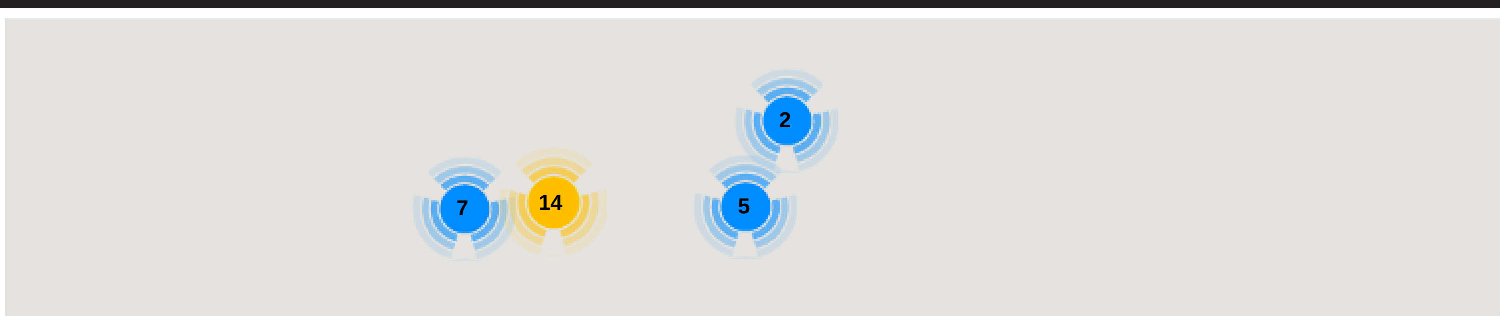

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Raleigh, NC 27610

View center details

OHIO

151 West Galbraith Rd.
Cincinnati, OH 45216

View center details

OKLAHOMA

4219 South Western
Oklahoma City, OK 73109

View center details

PENNSYLVANIA

850 S. 5th Street
Allentown, PA 18103
View center details

1800 Lombard St
Philadelphia, PA 19146
View center details

1500 S Columbus Blvd
Philadelphia, PA 19147
View center details

TEXAS

1333 Moursund
Houston, TX 77030
View center details

DENMARK

Havnevej 25
Department of Spinal Cord Injuries, Glostrup Hospital
3100, Hornbæk
View center details

GERMANY

Kolbermoorer Str. 72
83043, Bad Aibling
View center details

ITALY

Via Carlo Forlanini 5
06019, Umbertide, Perugia
View center details

NORWAY

Bjørnemyrveien 11
1450, Nesodden

View center details

SOUTH AFRICA

33 Wessel Road, Rivonia, Sandton
Finch House - Ground Floor, Rivonia Gardens
2000, Gauteng

View center details

SPAIN

Valderribas Road, 115
28038, Madrid

View center details

Cami de Can Ruti, s / n
08916 , Badalona

View center details

Carrer Dolors Aleu 19-21
3° 3ª/ Carrer Indústria 55
08908, Barcelona

View center details

Ekso

- Product
- Centers
- Hope
- FAQ
- EksoPulse

Company

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- Ambassadors
- Leadership

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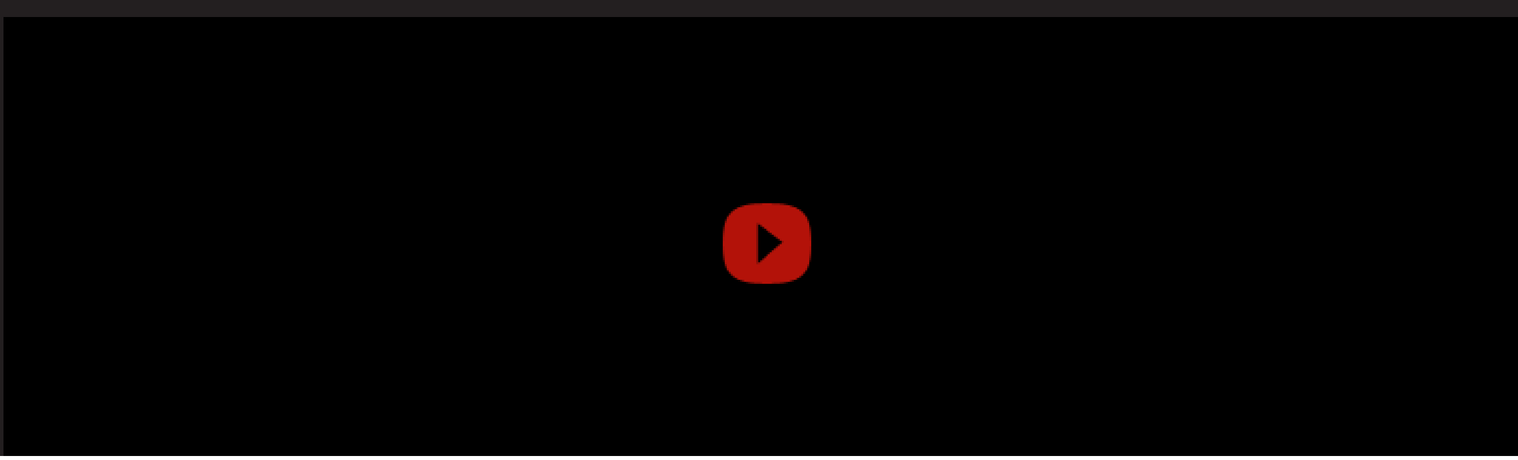
HOME PRODUCT CENTERS OUR STORY

WHO WE ARE

We are in the midst of one of the greatest technological revolutions in history. Since 2005, Ekso Bionics™ has been pioneering the field of robotic exoskeletons to augment human strength, endurance and mobility. We are committed to applying the latest technology and engineering to help people rethink current physical limitations and achieve the remarkable.

Originally Berkeley Bionics, Ekso Bionics was founded in Berkeley, California in 2005. Since inception Ekso Bionics has forged partnerships with world-class institutions like UC Berkeley, received research grants from the Department of Defense and licensed technology to the Lockheed Martin Corporation. Today Ekso Bionics continues to pioneer the field of exoskeletons, designing and creating some of the most forward-thinking and innovative solutions for people looking to augment human mobility and capability.

EKSO'S STORY



HIGHLIGHTS

1 MILLION STEPS

TIMELINE

2005

Pioneering the world of exoskeletons, Berkeley ExoWorks is founded in 2005 when Dr. Homayoon

The ExoHiker is completed. The exoskeleton allows users to carry and even run with up to 200

Kazerooni, Russ Angold and Nathan Harding partner with members of the Berkeley Robotics and Human Engineering Laboratory at the University of California, Berkeley.

lbs. over a variety of terrain.

Berkeley ExoWorks introduces the ExoClimber. It provides the same load carrying capabilities as the ExoHiker but designed to rapidly ascend stairs and steep slopes.

2007

Berkeley ExoWorks becomes Berkeley Bionics.

2008

With a research grant from the Department of Defense, Berkeley Bionics unveils their third generation exoskeleton, the HULC (Human Universal Load Carrier).

2009

HULC technology is licensed to the Lockheed Martin Corporation for further field-ready military development.

2010

In 2010 Berkeley Bionics debuts what was then called eLEGS - an intelligent, bionic exoskeleton that actually allows wheelchair users to stand and walk over ground.

2011

Berkeley Bionics becomes Ekso Bionics.

2012

Ekso Bionics ships Ekso™, the first commercialized robotic exoskeleton for use in rehabilitative and medical facilities, to Craig Hospital, on February 14.

December 2012, Ekso has helped individuals take over a million steps that would not have otherwise been possible.

OUR PARTNERS

Learn about our Ekso Center partners who are helping people walk every day

NEWS

Hear what the world is saying about Ekso Bionics and our technology.

LEADERSHIP

Meet our management, advisors, and board of directors.

MEDIA KIT

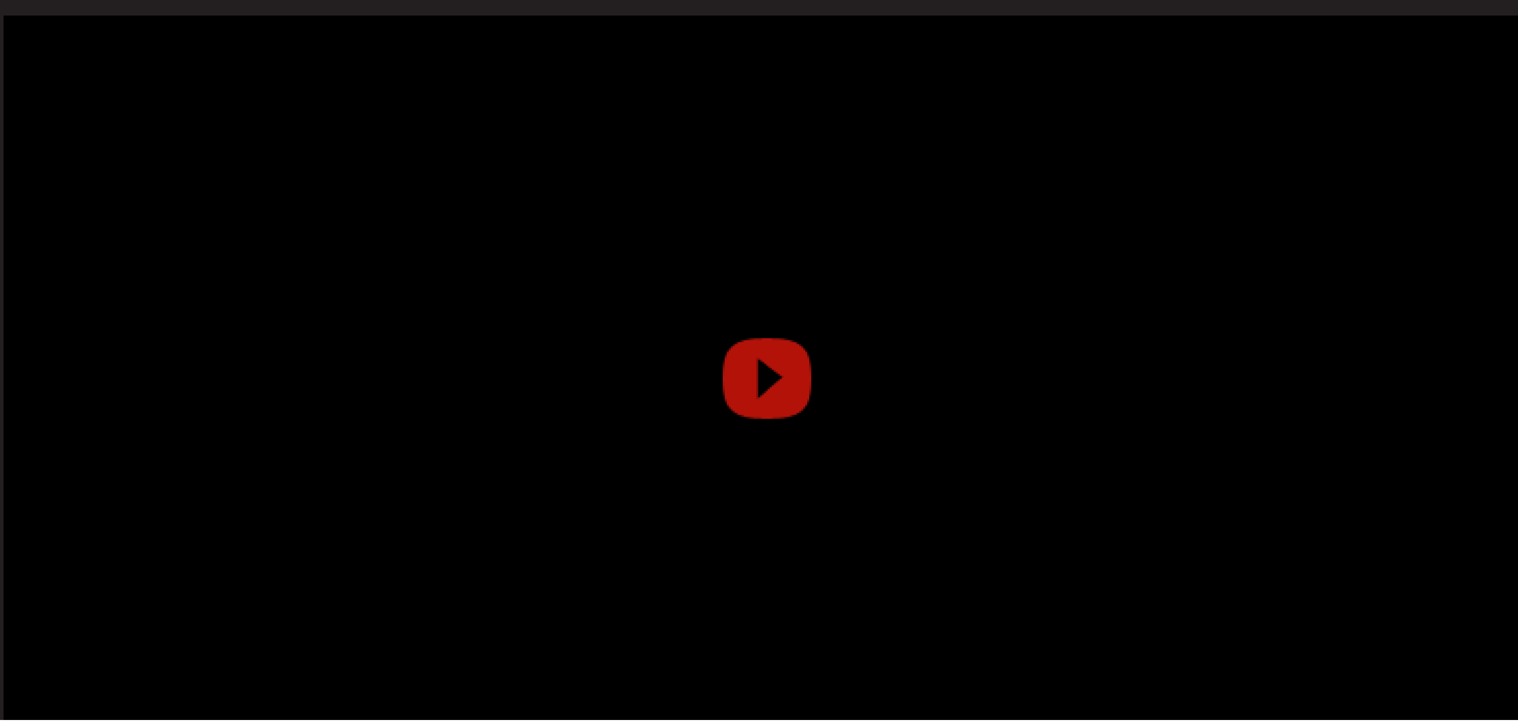
Information and resources to help you share our story

HOME PRODUCT CENTERS OUR STORY

FOR DONORS

Ekso Hope™ connects donors with regional facilities who are actively raising funds to acquire an Ekso™ suit for their community. The program has already helped clinics such as Jim Thorpe Rehabilitation, Mount Sinai Hospital, and Huntington Hospital integrate Ekso into their programs.

Are you passionate about helping individuals with lower extremity paralysis stand and walk again? Ekso Hope is currently supporting fundraising efforts at the following facilities.



PROJECTS SEEKING DONATIONS

DISABILITY WELLNESS CENTER

Sanford, FL

"Recovery, ability, and empowerment. We will continue to bring the latest in cutting edge services and technology to our clients and the community. Standing, walking, and walking independently were things the spinal cord injured could only HOPE for. With Ekso in our program, those hopes can become a walking reality." Learn more.

Donate now

FOOTPRINTS SCI RECOVERY

Nova Scotia

"Our primary goal is to bring tangible hope to our clients and the community, by providing Ekso Bionics' state of the art bionic exoskeleton technology to our center. We anticipate researching the potential gains for our spinal cord injury (SCI) clients in strength and improved health through the natural process of standing and walking independently in Ekso."

Donate now

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FAQ

What is Ekso™?

Ekso™ is a wearable robot or exoskeleton that enables people with lower-extremity paralysis or weakness to stand and walk. It is a ready to wear, battery powered, bionic device that is strapped over the user's clothing.

How does it work?

Ekso is an adjustable, portable, bionic exoskeleton designed to help patients with lower-extremity paralysis or weakness stand up and walk. With the patient providing the balance and proper body positioning, Ekso allows them to walk over ground with reciprocal gait. The physical therapist uses the control pad to program the desired walking parameters, such as step length and speed, as well as control when the Ekso stands, sits, and takes a step. It is powered by two high-capacity lithium batteries which drive the hip and knee motors.

How much does the device weigh?

The device weighs approximately 50 pounds (23 kg). The user doesn't support the weight of the device as it is transferred into the ground through the Ekso structure.

How is a patient evaluated to use Ekso?

In order to be eligible for Ekso a patient needs to bring a medical release. Then, a comprehensive physical evaluation is conducted, which typically takes one hour. During this evaluation, a physical therapist examines key requirements for use including range of motion, muscle strength and spasticity.

How long does it take to fit Ekso after initial evaluation?

The fitting of a patient and the adjustment of Ekso typically takes ten minutes. Ekso can be adjusted to fit most people between 5'2" and 6'2" who weigh 220 pounds or less.

How fast can a user/patient don and doff Ekso?

An experienced user can transfer to/from their wheelchair and don or doff the Ekso in less than 5 minutes. The torso and leg straps are designed to enable the user/patient to easily get in and out of the device with none or minimal assistance.

Who is it for?

Ekso is for patients with lower-extremity paralysis or weakness who would like assistance to stand up and walk. The user needs arm function and adequate upper extremity strength to manage crutches or a walker as determined during the evaluation. If you can transfer independently from a wheelchair to a chair, are between 5'2" - 6'2" (150-190 cm) tall and weigh 220 lbs (100 kg) or less, you are most likely a candidate.

How fast can someone walk in it?

The walking speed of Ekso depends on a patient's aptitude and condition. Ekso allows walking speeds up to 1mph.

Will users always use a walker? When can they use crutches?

All users complete a training program when learning to use Ekso. The learning curve is quite user specific and can depend on many factors. Usually, individuals begin using a walker and progress to crutches.

How does the physical therapist assist a user?

The physical therapist operates the Ekso with a remote control. This allows the PT to teach the patient when to take a step, how to position their body for proper balance, and how to shift their weight in preparation to take another step. The PT also has the ability to modify Ekso's walking pattern (i.e. step speed and length) as the patient progresses.

How can someone try it? Where is it available?

Please contact us to find a certified center near you. This version of Ekso is intended to be used in a medically supervised environment.

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CONTACT US

UNITED STATES

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Richmond, CA 94804

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F +1 510.927.2647

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Twitter @eksobionics
Youtube.com/user/eksobionics
Flickr.com/photos/eksobionics

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E14 5DY
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Kunden Service Deutschland
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Facebook.com/eksobionicseurope

Twitter @eksobionicsuk

LEARN MORE

If you'd like to learn more about Ekso Bionics, our products and be added to our
email list to receive the latest news and updates please provide the following information.

Your privacy is important to us and we won't sell, trade, or
otherwise transfer any of your personal information to an outside party.

Name

Last Name

Email

Phone

Compnay

Address

City

Postal code

Country

Select Country

State

Select State

I'm interested in acquiring Ekso for

--None--

Medical Condition

--None--

Any comments or other questions you may have

Send Your Request

FIND A CENTER

Find the nearest Eko suit in your area, and who is using this technology.

EKSO HOPE

Help someone walk again. Learn how Ekso Hope connects donors with clinics.

MEDIA KIT

Information and resources to help you share our story

FAQ

Find answers to the commonly asked questions such as, “Can I walk in Ekso?”

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CAREERS

Ekso Bionics™ is at the forefront of developing the most technologically advanced devices that increase human mobility, strength and endurance. We are always looking for new team members to help us pioneer the future of exoskeletons and expand the limits of human capabilities.

Email us at HR@eksobionics.com to apply with the following:

- Name and job position in the email subject line
- Attach a PDF of resume (not to exceed 2 pages)
- No cover letters please

We will contact you if we see the possibility of a good fit. Thank you for your interest in Ekso Bionics!

CURRENT POSITIONS

- **Senior Electrical Engineer**
  Full time position Posted December 16, 2012
  show details

- **Physical Therapist/Clinical Training Specialist**

Full time position Posted March 20, 2012

show details

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AMANDA

JASON

JERRY

PAUL

SARAH

TAMARA

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Find the nearest Eko suit in your area, and who is using this technology.

EKSO HOPE

Help someone walk again. Learn how Ekso Hope connects donors with clinics.

FAQ

Find answers to the commonly asked questions such as, “Can I walk in Ekso?”

CONTACT US

How can we help you? Here’s how to reach Ekso Bionics.

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LEADERSHIP

MANAGEMENT

Nathan Harding

Co-Founder & CEO

Russ Angold

Co-Founder & CTO

Frank Moreman

Chief Operating Officer

Max Scheder-Bieschin

Chief Financial Officer

Karl Gudmundsson

Vice President of Marketing

Andy Hayes

Managing Director EMEA

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Marilyn Hamilton

Amal Moorad, M.D.

Jack Peurach

Dan Boren

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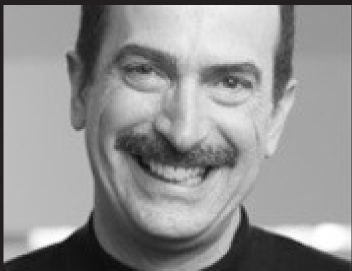
Graham Creasey, M.D.

Hans S. Keirstead, Ph.D.



Tom Kelley

Suzy Kim, M.D.

Daniel Kraft, M.D.

Sherri L. Medina

Akshat Shah, M.D.

EKSO HOPE

Help someone walk again. Learn how Ekso Hope connects donors with clinics.

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BLOG

The blog is currently down for maintenance. Check back soon

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NEWS

BRINK (BLOOMBERG)

FULL STORY

Bloomberg TV's show, Brink highlights where ideas equal industry changing innovation. This episode features Ekso Bionics (at 7:55 sec).

FOX BUSINESS

FULL STORY

CEO Nathan Harding talks about the bionic suit, a robotic exoskeleton that helps paralyzed individuals walk again

FOX NEWS SAN DIEGO

FULL STORY

A wearable robot first used to help soldiers carry heavy loads is now being used to help people with spinal cord injuries walk again.

SLATE

FULL STORY

Could a robotic exoskeleton turn you into a real-life Iron Man?

PC MAGAZINE

FULL STORY

Ekso: A technological marvel that stands out

ENGADGET

FULL STORY

A video interview with Ekso Bionics at Engadget Engaged.

CNN.COM

FULL STORY

"Wearable robot" technology is already being used in real-life

FAST COMPANY

FULL STORY

Ekso Bionics named a top 10 innovator

GOOD MORNING AMERICA

FULL STORY

Bionic Suit Helps Paralyzed Patients Walk Again

INC. MAGAZINE

FULL STORY

Idea: get millions of people out of their wheelchairs

SMART PLANET

FULL STORY

Wearable robots help soldiers lift heavy objects, disabled walk

CNNMONEY.COM

FULL STORY

9 Superhuman Innovations

THE NEW YORK TIMES

FULL STORY

VIDEO: Bionic Suits Aid Paraplegics

THE NEW YORK TIMES

FULL STORY

New Breed of Robotics Aims to Help People Walk Again

ANTENA 3 "EL HORMIGUERO"

FULL STORY

The miracle of the exoskeleton

CNN MARKETPLACE EUROPE

FULL STORY

Bionics: From Hollywood movies to life-changing reality

WELT ONLINE.DE

FULL STORY

Roboter l_sst Gel_hmte wieder laufen

THE GUARDIAN

FULL STORY

Could exoskeletons help disabled people be more active?

NEWS8 WTNH

FULL STORY

Ekso suit makes walking a possibility

RTL HOLLAND

FULL STORY

A beautiful day for Mard de Hond

NOS OP3 NETHERLANDS

FULL STORY

New patients walking in Ekso

DEUTSCHLAND FUNK

FULL STORY

Mit dem Roboter Laufen lernen

WCAX.COM

FULL STORY

Exoskeleton helps paralyzed people walk

DER TAGESSPIEGEL.DE

FULL STORY

Steh auf und geh

HAMBURGER ABENDBLATT

FULL STORY

Der Traum vom Gehen - Roboter im Test

UMBRIA NEWS

FULL STORY

Prosperius Tiberino Institute in Italy receive their first Ekso

TEDXMUSCAT 2012, OMAN

FULL STORY

CEO Eythor Bender presenting at TEDxMuscat with Omani patient walking for the first time

THE DOCTORS

FULL STORY

Tamara Mena in interview with Travis Stork, M.D.

CNN

FULL STORY

The Ekso changes lives

MEDIZIN & TECHNIK

FULL STORY

Technik hautnah

TV2.NO

FULL STORY

Her tar Arne sine frste skritt p 22 r (Arne takes his first steps in 22 years)

CBS DENVER

FULL STORY

Robot helps paralyzed patients walk again

INC.COM

FULL STORY

17 Game Changing Health Start-ups

WFMZ-TV ALLENTOWN, PA

FULL STORY

Rehab center using technology to help paralyzed people walk again

FAST COMPANY

FULL STORY

Ekso's Exoskeletons Let Paraplegics Walk. Now All It Has To Do Is Convince The World They're Necessary

SATURDAY EVENING POST

FULL STORY

"Watch me Walk"

THE ATLANTIC

FULL STORY

Walking 2.0: Ekso Bionics Delivers Its First Commercial Exoskeleton

MEDGADGET

FULL STORY

Ekso Bionics Sells Its First Commercial Exoskeleton

HUFFINGTON POST

FULL STORY

Best TED Talks: 21 Amazing, Inspiring Presentations (VIDEOS)

SINGULARITY HUB

FULL STORY

Ekso Bionics Sells Its First Set of Robot Legs Allowing Paraplegics to Walk

WIRED UK

FULL STORY

FOX NEWS BOSTON

FULL STORY

Wearable robot puts paralysed legs through their paces

Wearable robot helps paralyzed firefighter walk again

USA TODAY

FULL STORY

Robotic devices help paralyzed become more independent

WXYZ ABC DETROIT

FULL STORY

A robotic apparatus being tested in Detroit helps paralyzed firefighter walk again

FOX DETROIT

FULL STORY

Wearable Robot Helps Paralyzed Detroit Firefighter Walk

CBS DETROIT

FULL STORY

Detroit Firefighter Using New Device In Therapy

IEEE SPECTRUM

FULL STORY

Good-bye, Wheelchair, Hello Exoskeleton. This year, the Ekso Bionics exoskeleton for paraplegics hits the market.

TED MED

FULL STORY

Eythor Bender and Ambassador Paul Thacker present at TED MED 2011.

THE ENGINEER

FULL STORY

US researchers create suit that can enable paraplegics to walk. An exoskeleton that allows paraplegics to walk using technology based on military research made its European debut in London last week.

DISCOVER MAGAZINE BLOG

FULL STORY

Exoskeletons Will Be the Eyeglasses of the 21st Century.

FUTUREMED SINGULARITY UNIVERSITY

FULL STORY

CEO, Eythor Bender is interviewed by FutureMed, an executive program from Singularity University.

NEW YORK DAILY NEWS

FULL STORY

NEW YORK TIMES

FULL STORY

Walking again with help from an exoskeleton.

DIE WELT

FULL STORY

Run Despite Paralyzed Legs-A New Robot Make the Impossible Possible.

ABENDZEITUNG, MUNICH

FULL STORY

Eythor Bender has developed a device that allows wheelchair for a walk. "Feels like a big hug says one patient."

GIZMODO

FULL STORY

High-tech exoskeletons allow wheelchair users to stand up and walk.

SAN FRANCISCO BUSINESS JOURNAL

FULL STORY

Fastest Growing Bay Area Private Companies

STERN.DE

FULL STORY

For some wheelchair users seems to be a lifelong dream within reach a new robot make it possible.

WALL STREET JOURNAL

FULL STORY

Meet the real bionic man. Our bionic future is almost here.

SKY NEWS

FULL STORY

Robot Suit Helps Paraplegic Walk Again

DAILY TELEGRAPH

FULL STORY

Paraplegic explains how robotic skeleton made her walk again.

SAT.1 BAYERN

FULL STORY

Paraplegics to stand on their own two feet. New Hope from the U.S.. Walking Robot Ekso celebrates premiere in Germany

BBC

FULL STORY

Paralyzed skier, Amanda Boxtel, walks with an exoskeleton.

CBS THIS MORNING

FULL STORY

(CBS News) Step by step, bionic engineers are transforming lives in ways that barely could have been imagined until recently. Our Cover Story is reported now by Barry Petersen

7X7 MAGAZINE

FULL STORY

Hot 20-2011. Russ Angold and Nathan Harding, eLegs inventors.

THE BOSTON GLOBE

FULL STORY

With device's aid, the paralyzed take steps anew. Rehabilitation facilities test robotic exoskeleton.

WCVB TV BOSTON

FULL STORY

Robotic Legs Allow Paralyzed To Walk. Imagine being paralyzed for years and relying on a wheelchair to get around. Then with the help of robotics, you are walking across a room.

NATIONAL GEOGRAPHIC MAGAZINE

FULL STORY

Pentagon-funded research has enabled the lost to pinpoint their locations, the night blind to see in the dark, and old lovers to keep tabs on each other online. Now it may help paraplegics to walk.

KHON TV CHANNEL 2

FULL STORY

Many spinal cord injury patients already live a full life. But new technology could add to the quality of their lives. Technology is constantly evolving and changing lives.

MAKE ME SUPERHUMAN

FULL STORY

Superhuman capabilities like running faster than a speeding bullet or being more powerful than a locomotive could be available at the push of a button.

SABADO GIGANTE TV

FULL STORY

I have loved Sabado Gigante, the beautifully loud Spanish hour-long TV show, since my college days, trying in vain to perfect my Spanish skills.

60 MINUTES: AUG 7

FULL STORY

Australia's 60 Minutes will profile two stories on Sunday night, August 7 at 8:00 pm. Berkeley Bionics' eLEGS will be highlighted in Amanda's story.

60 MINUTES AUSTRALIA

FULL STORY

"You'll never walk again." How would you feel hearing those words? And how would you go living with them for the rest of your life? Peter Overton met two determined young Australians who refuse to accept the doctor's verdict. Josh Clift and Amanda Boxtel believed there had to be a way to get their legs working again.

KUSA TV CHANNEL 9 NEWS DENVER

FULL STORY

Robotic legs give paralyzed patients new future. It's been five years in development and it looks likes something from the future. It's a wearable robot, or exoskeleton, called E-Legs.

FINANCIAL TIMES

FULL STORY

New bionic legs help paraplegics walk again.

TEDX SAN FRANCISCO

FULL STORY

Berkeley Bionics Merging Technology and the Human Body.

TEDXDU

FULL STORY

Eythor Bender and Amanda Boxtel-Merging technology and the human body.

CNN

FULL STORY

Bionic Device for Wheelchair Users.

BLOOMBERG

FULL STORY

Bender Says Getting eLegs to Market a `Big Challenge'

TED 2011

FULL STORY

Eythor Bender Demos Human Exoskeleton

TV BRASIL

FULL STORY

Program Especial Discovers the eLegs

TIME MAGAZINE

FULL STORY

The 50 Best Inventions of 2010.

CNN LIVE FROM ATLANTA: BIG I WITH ALI VELSHI

FULL STORY

Ali Velshi interviews CEO, Eythor Bender, and Amanda Boxtel.

WIRED MAGAZINE

FULL STORY

Lightweight Exoskeleton Gives Paraplegics New Legs.

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PRESS RELEASES

NATHAN HARDING TO BECOME CHIEF EXECUTIVE OFFICER OF EKSO BIONICS

Ekso Bionics today announced that its board of directors will appoint Nathan Harding as chief executive officer. In addition, Frank Moreman has been elevated to chief operating officer and given the added responsibilities of leading the clinical, sales, and customer service groups. Eythor Bender will be leaving the company.

Download

NEW LEVELS OF AUTONOMY FOR PATIENTS WEARING UPGRADED BIONIC WALKING SUIT "EKSO"

Ekso Bionics today announced that it has begun shipping an upgraded version of Ekso™, the bionic suit that powers patients with spinal cord injuries and pathologies up to get them standing up and walking again. Each Ekso now comes equipped with three new walking modes for progressive rehabilitation options, in addition to EksoPulse™, a wireless networked usage monitor. Patients will have new challenges as they master each level and more control of the suit as they become more adept. Also, Ekso now provides both the patient and the physical therapist with better insights into that patient's headway.

Download

EKSO BIONICS BESTOWED WITH CE MARK

Ekso Bionics, designer and creator of exoskeletons – bionic suits - that physically augment humans, today announced that it has received CE Marking Certification. Henceforth, all medical devices produced by Ekso Bionics will be certified in over 30 European Union and EFTA countries.

Download

EKSO BIONICS IS NAMED A 2012 GOLD EDISON AWARD WINNER

Ekso Bionics, designer and creator of exoskeletons that physically augment humans, announced today they are a Gold Edison Award Winner in the category of "Best New Product, Assistive Devices"

Download

EKSO BIONICS DELIVERS FIRST "EKSO" EXOSKELETON

Ekso Bionics today announced that the first commercial unit of its Ekso exoskeleton was delivered yesterday, on February 14, to Craig Hospital in Denver.

Download

BERKELEY BIONICS BECOMES EKSO BIONICS

Berkeley Bionics, designer and creator of exoskeletons that physically augment humans, has rebranded both the company name and its product line.

Download

BERKELEY BIONICS PARTNERS WITH TEN U.S. REHABILITATION CENTERS

Investigational Studies and Introduction of New Wearable Robot for Wheelchair Users Berkeley Bionics - developer and maker of exoskeletons that augment human strength, endurance and mobility - today announced its partnership with ten of the nation's top physical rehabilitation centers.

Download

EXOSKELETON BY BERKELEY BIONICS ENABLES PARAPLEGICS TO WALK

Berkeley Bionics, developer and maker of bionic exoskeletons that augment human strength, endurance and mobility, today unveiled eLEGS, a wearable, artificially intelligent, bionic device that powers paraplegics up to get them standing and walking.

Download

BERKELEY BIONICS NAMES EYTHOR BENDER CEO

Berkeley Bionics, developer and maker of bionic exoskeletons that augment human strength, endurance and mobility, today announced that Eythor Bender has become its Chief Executive Officer.

MEDIA KIT

To help you prepare the most accurate story about our technology and company, we've prepared these resources for you:

- Our story (with our company timeline)
- Our technology
- Facilities where Ekso™ is in use
- Answers to frequently asked questions
- Product shots and photos of people using Ekso. Please credit Ekso Bionics™ when you use these.
- Video footage of the Ekso suit and the people who use it.

And of course, we want to hear from you! After you've had a look at the above links, please contact us if you have any questions or wish to arrange an interview. Thanks for helping us share our story.

PRIVACY POLICY

What information do we collect?

We collect information from you when you subscribe to our newsletter or fill out a form.

When ordering or registering on our site, as appropriate, you may be asked to enter your: name, e-mail address, mailing address or phone number. You may, however, visit our site anonymously.

What do we use your information for?

Any of the information we collect from you may be used in one of the following ways:

• To improve customer service (your information helps us to more effectively respond to your customer service requests and support needs).

• To send periodic emails to which you've opted in.

Note: If at any time you would like to unsubscribe from receiving future emails, we include detailed unsubscribe instructions at the bottom of each email.

How do we protect your information?

We implement a variety of security measures to maintain the safety of your personal information when you enter, submit, or access your personal information.

We offer the use of a secure server. All supplied sensitive/credit information is transmitted via Secure Socket Layer (SSL) technology and then encrypted into our Payment gateway providers database only to be accessible by those authorized with special access rights to such systems, and are required to?keep the information confidential.

After a transaction, your private information (credit cards, social security numbers, financials, etc.) will not be stored on our servers.

Do we use cookies?

We do not use cookies.

Do we disclose any information to outside parties?

We do not sell, trade, or otherwise transfer to outside parties your personally identifiable information. This does not include trusted third parties who assist us in operating our website, conducting our business, or servicing you, so long as those parties agree to keep this information confidential. We may also release your information when we believe release is appropriate to comply with the law, enforce our site policies, or protect ours or others rights, property, or safety. However, non-personally identifiable visitor information may be provided to other parties for marketing, advertising, or other uses.

California Online Privacy Protection Act Compliance

Because we value your privacy we have taken the necessary precautions to be in compliance with the California Online Privacy Protection Act. We therefore will not distribute your personal information to outside parties without your consent.

Children's Online Privacy Protection Act Compliance

We are in compliance with the requirements of COPPA (Children's Online Privacy Protection Act), we do not collect any information from anyone under 13 years of age. Our website, products and services are all directed to people who are at least 13 years old or older.

Online Privacy Policy Only

This online privacy policy applies only to information collected through our website and not to information collected offline.

Your Consent

By using our site, you consent to our online privacy policy.

Changes to our Privacy Policy

If we decide to change our privacy policy, we will post those changes on this page.

Contacting Us

If there are any questions regarding this privacy policy you may contact us using the information below.

Ekso Bionics
1414 Harbour Way S
Ste 1201
Richmond, CA 94804
USA
CustomerRelations@EksoBionics.com

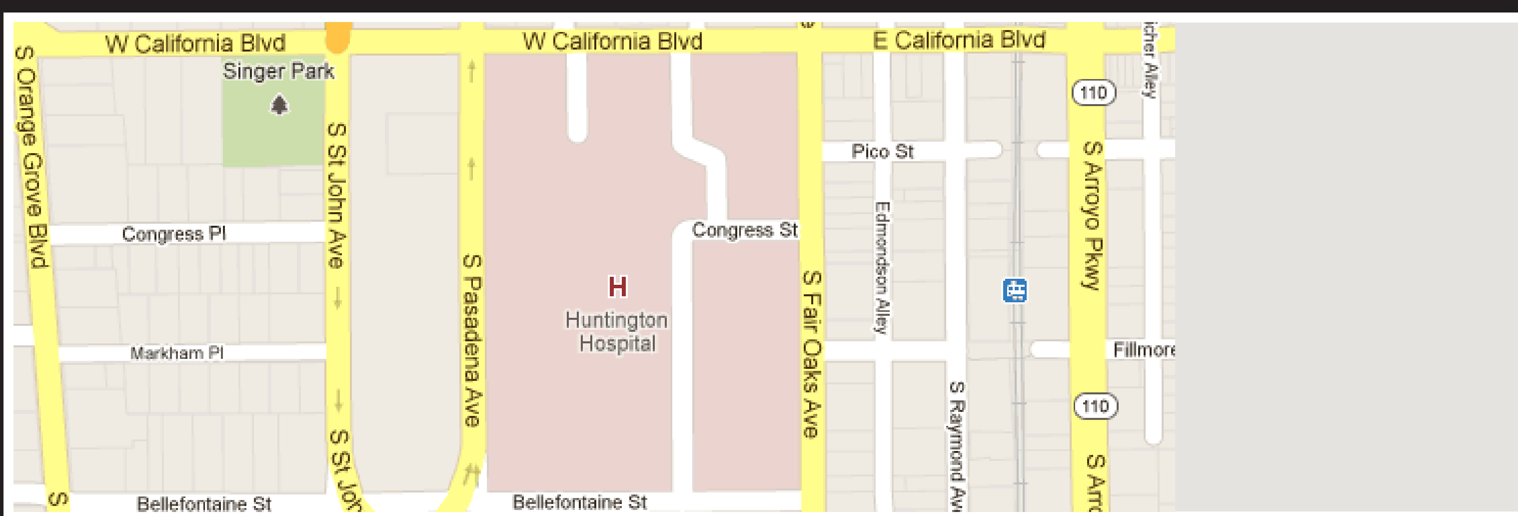
EKSO CENTERS

HUNTINGTON MEMORIAL HOSPITAL

Huntington Memorial Hospital is a 625-bed not-for-profit hospital that is home to the only Level II trauma center in the San Gabriel Valley. In addition to being granted Magnet® status in 2011, Huntington Hospital has been ranked nationally by U.S. News and World Report in two specialties and was named the eighth best hospital in California. Renowned for its programs in neurosciences, cardiovascular services and cancer care, Huntington Hospital is an active teaching hospital with graduate medical education programs in internal medicine and general surgery. Consistent with its mission the hospital provides millions of dollars annually in charity care, benefits for vulnerable populations, health research, education and training, and support programs that may otherwise be absent from the community.

Highlights

- U.S. News & World Report National Ranking: Regional Best Hospital (Los Angeles)



100 West California Blvd
Pasadena, CA 91105
phone: +1.626.397.5000
website: www.huntingtonhospital.com

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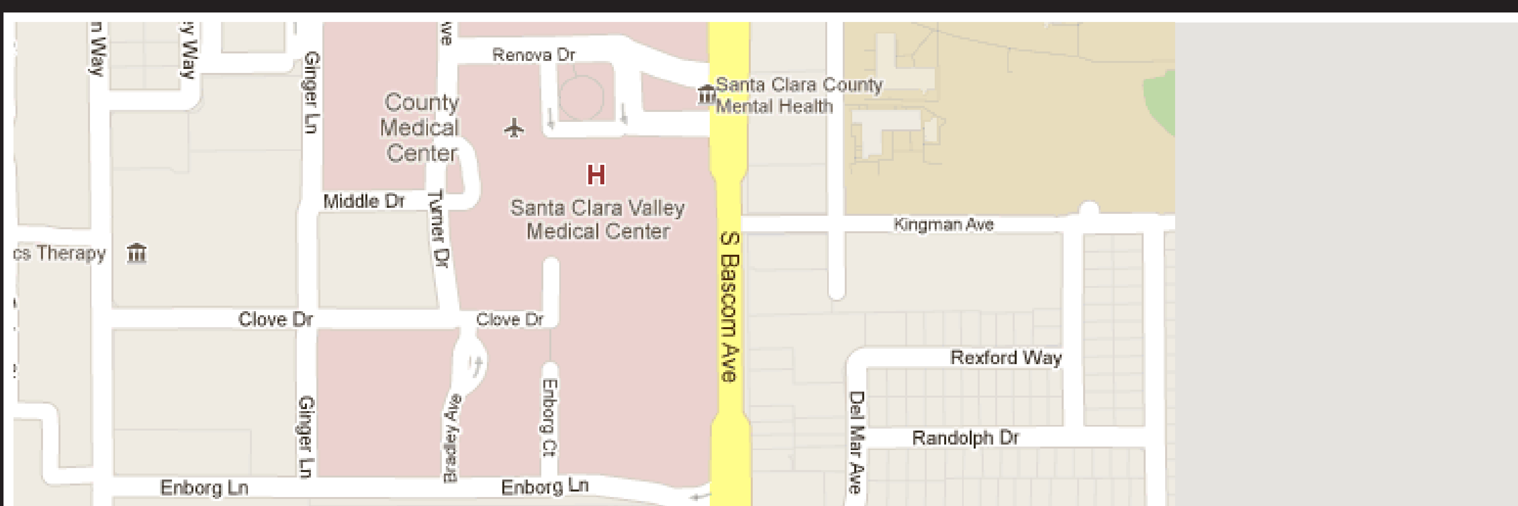
SANTA CLARA VALLEY MEDICAL CENTER

Santa Clara Valley Medical is a major teaching institution with a five-decade tradition of high quality medical education programs. As a teaching hospital, affiliated with Stanford and UC medical schools, the medical center attracts the finest physicians and young medical talent.

Highlights

- U.S. News & World Report National Ranking: High-performing in Rehabilitation
- Ekso investigational trials study participant (2011)



751 S. Bascom Ave
San Jose, CA 95128
phone: +1.408.885.5000
website: www.scvmc.org/

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SCRIPPS MEMORIAL HOSPITAL

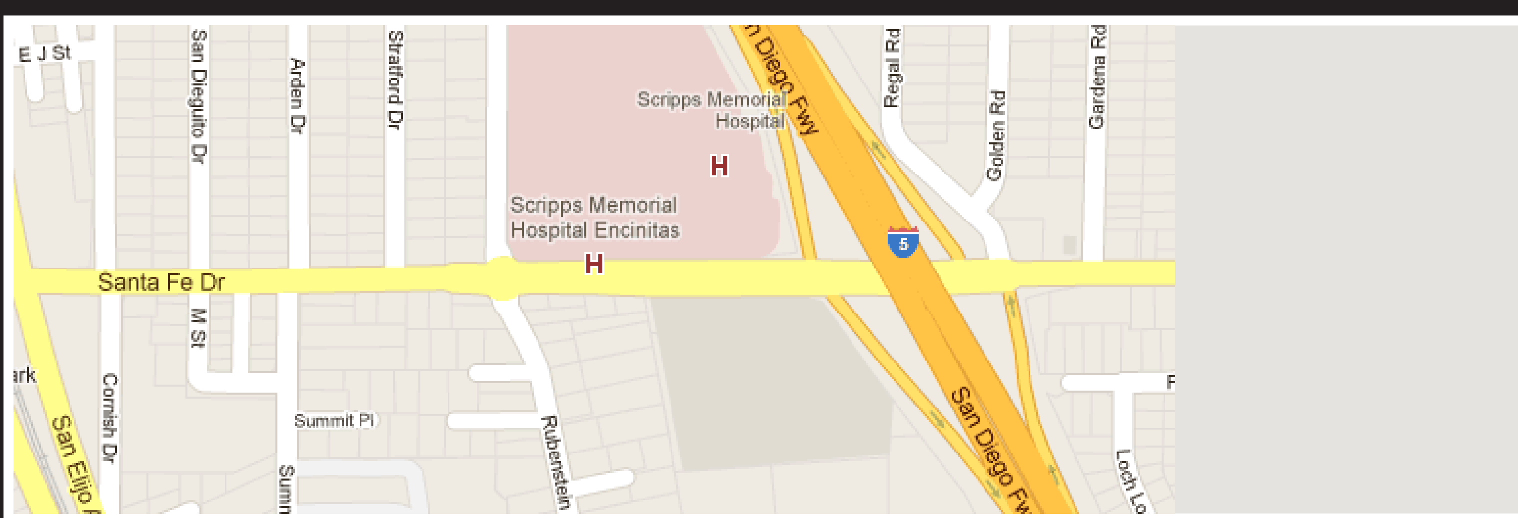
Scripps Health is a $2.5 billion private, nonprofit, integrated health system in San Diego, California that treats a half-million patients annually.

Scripps Memorial Hospital Encinitas provides expert specialty and emergency care in state-of-the-art facilities. Their specialty programs and services include North County's first Primary Stroke Center, a regionally recognized brain injury program, and state-of-the-art imaging center.

A leader in the prevention, diagnosis and treatment of disease, Scripps was named by Thomson Reuters as one ofthe Top 10 health systems in the nation for providing high quality, safe and efficient patient care. On the forefront of genomic medicine and wireless health technology, the organization is dedicated to improving community health while advancing medicine through clinical research and graduate medical education.

Highlights

- Primary Stroke Center designation by The Joint Commission
- STEMI receiving center designation from the American Heart Association
- Commission on Accreditation of Rehabilitation Facilities (CARF) accredited rehabilitation center and brain injury treatment program



354 Santa Fe Drive
Encinitas, CA 92024
phone: +760.633.6501
website: www.scripps.org/

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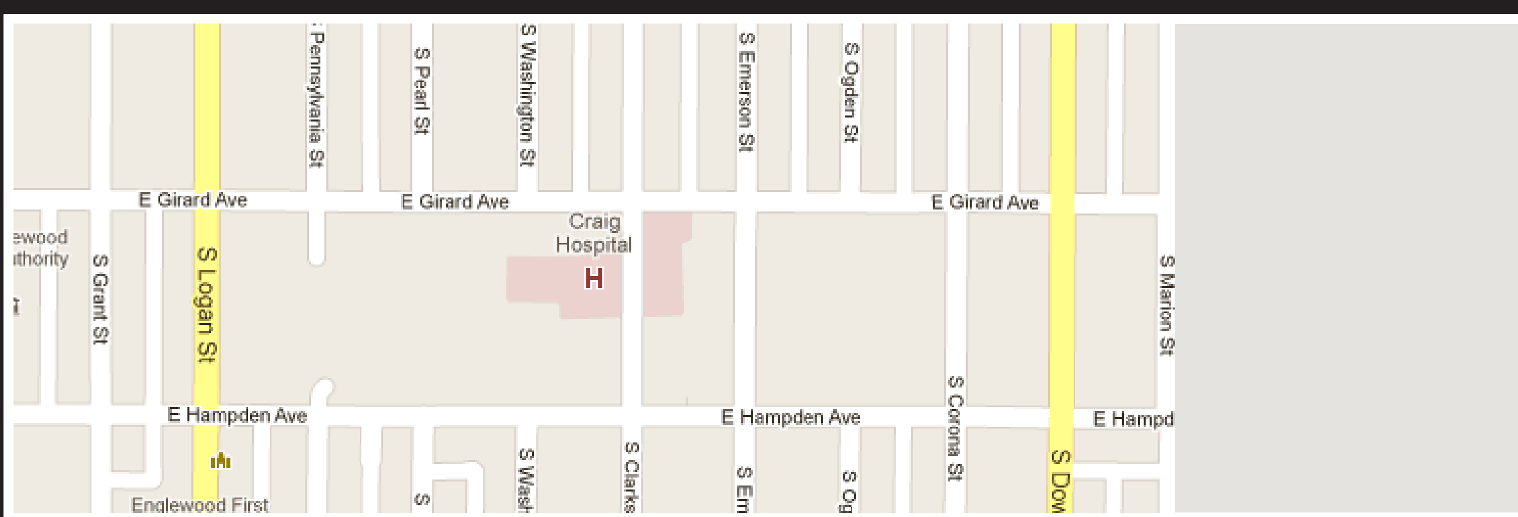
CRAIG HOSPITAL

Craig Hospital is world renowned as a premier center for specialty rehabilitation and research for people with spinal cord injury and traumatic brain injury. Craig Hospital is an acute care and rehabilitation hospital that provides a comprehensive system of inpatient and outpatient medical care, rehabilitation, neurosurgical rehabilitative care, and long-term follow up services. Craig Hospital is designated by the National Institute on Disability by the National Institute on Disability Rehabilitation and Research (NIDRR) as a Model System Center for both spinal cord injury and traumatic brain injury and has been ranked in the top Ten Rehabilitation Hospitals in the nation for 22 consecutive years by U.S. and World Report since the rankings began in 1990.

Highlights

- U.S. News & World Report Ranking: top Ten Rehabilitation Hospitals in the nation for 22 consecutive years
- Spinal Cord Injury Model System Center: Rocky Mountain Regional SCI System (RMRSIS)
- Ekso investigational trials study participant (2011)



3425 South Clarkson
Englewood, CO 80113
phone: +1.303.789.8000
website: www.craighospital.org/

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GAYLORD SPECIALTY HEALTHCARE

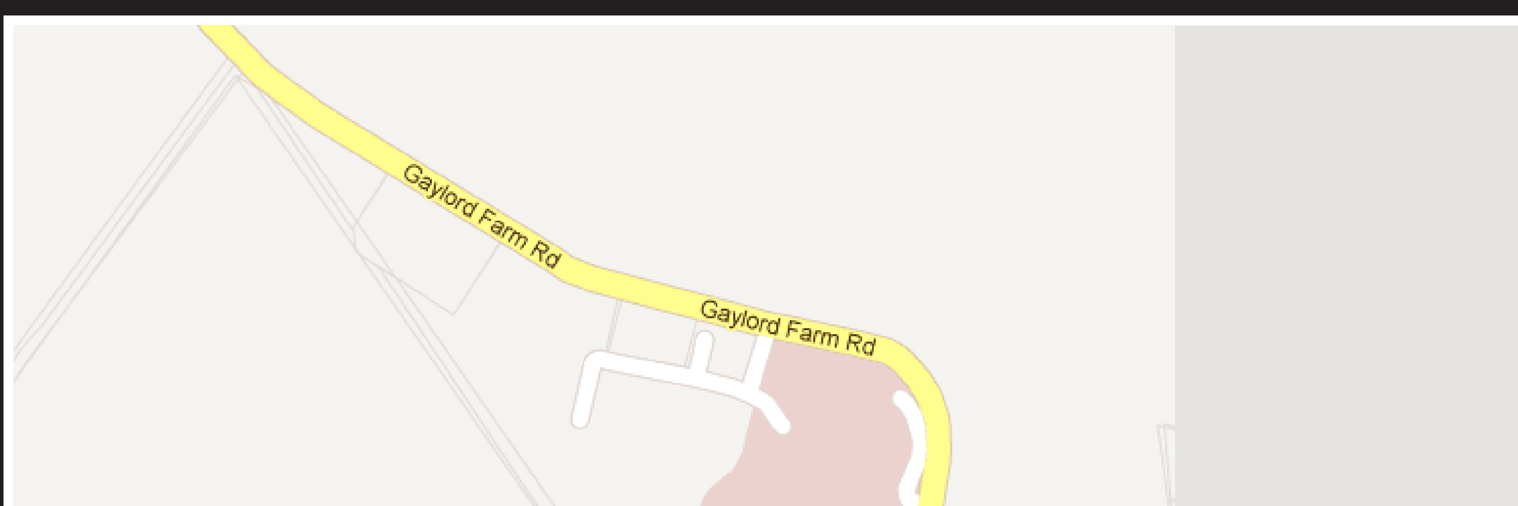
Gaylord's Spinal Cord Injury program focuses on the care and rehabilitation of people who have experienced spinal cord dysfunction from trauma or disease. The program works to restore as much physical ability as possible and help the patient and family cope with the emotional consequences of the patient's injuries.

Because every injury is unique each patient receives an individually tailored treatment plan based on a multidisciplinary combination of medical and therapeutic treatments including:

- Multidisciplinary medical supervision
- Skilled nursing care with certified rehabilitation staff
- An intensive therapy staff, certified as Spinal Cord Injury Specialists and Neurologic Clinical Specialists
- Recreational therapy & adaptive sports programs
- Emphasis on education and support groups

Highlights

- Spinal Cord Injury Model System Center



Gaylord Farm Road

Wallingford, CT 06492
phone: +1.203.284.2800
website: www.gaylord.org/

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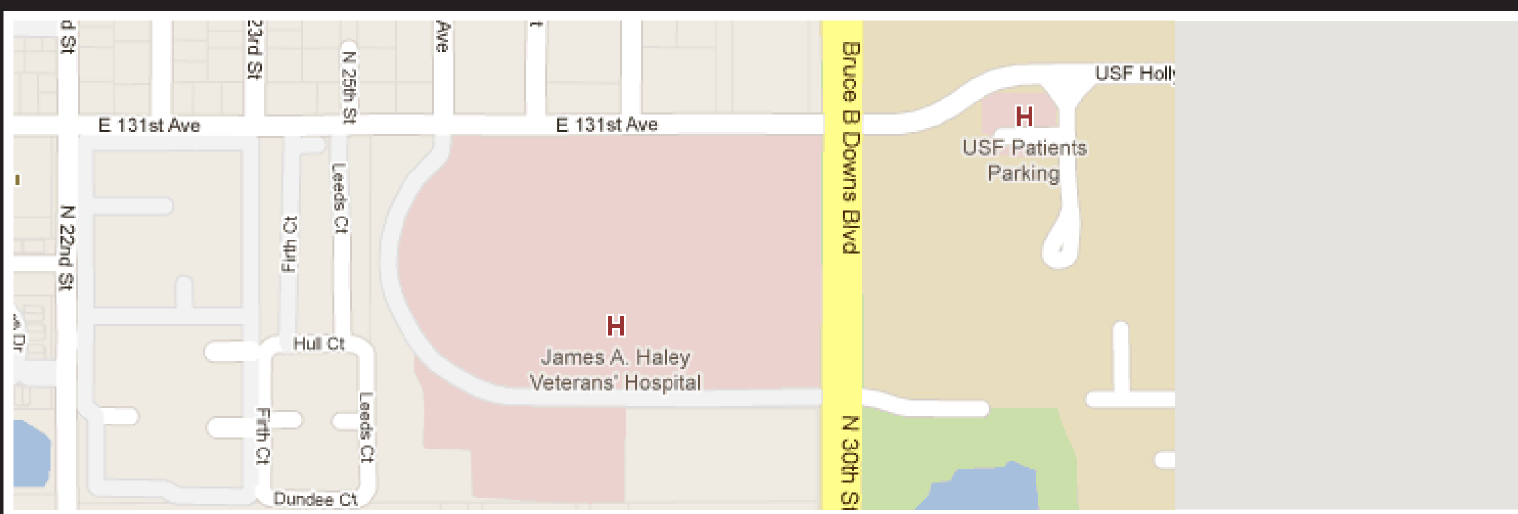
TAMPA VA (JAMES A. HALEY VETERAN'S HOSPITAL)

Since 1972, James A. Haley Veterans' Hospital has been improving the health of the men and women who have proudly served the US military. This hospital is the busiest of four polytrauma facilities in the nation. Services are available to more than 116,000 veterans living in a four-county area of Florida.



13000 Bruce B. Downs Blvd
Tampa, FL 33612
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website: www.tampa.va.gov/

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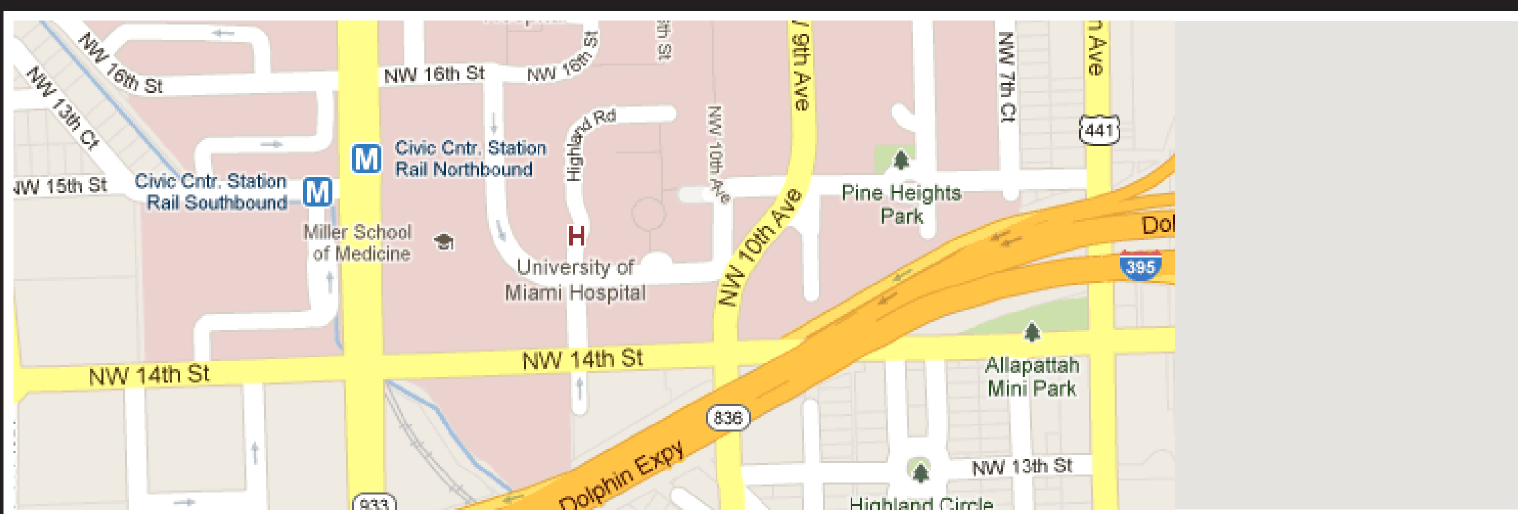
UNIVERSITY OF MIAMI PROJECT

The Miami Project is a comprehensive spinal cord injury research center, and is a designated Center of Excellence at the University of Miami Miller School of Medicine. The Miami Project's international team is housed in the Lois Pope LIFE Center and includes more than 250 scientists, researchers and clinicians who take innovative approaches to the challenges of brain and spinal cord injuries. The Miami Project's Christine E. Lynn Clinical Trials Initiative is designed to take discoveries found to be successful in laboratory studies and fast track them to human studies.



1095 NW 14th Terr.
Miami, FL 33136
phone: +1.305.243.6001
website: www.miamiproject.miami.edu/

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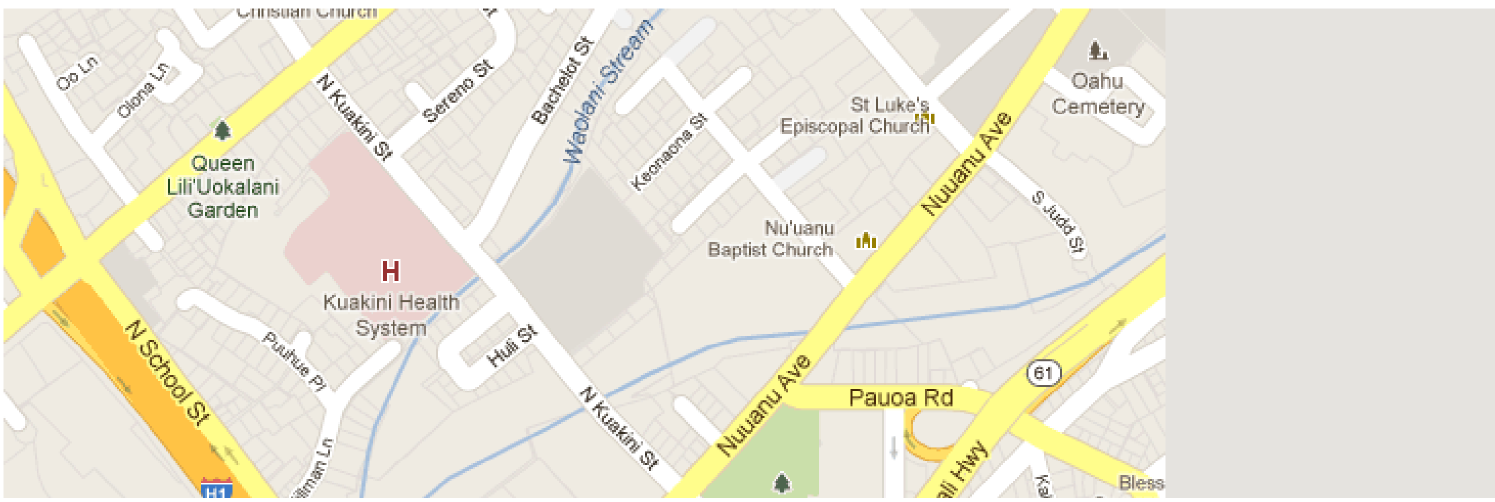
REHABILITATION INSTITUTE OF THE PACIFIC

Rehabilitation Hospital of the Pacific (REHAB) is the only acute-care medical rehabilitation organization serving Hawaii. Each year, REHAB treats more than 5,500 patients recovering from strokes, brain injury, spinal cord injury, orthopedic injuries, sports injuries and those individuals requiring general rehabilitation. Services to patients include physical therapy, occupational therapy, and speech therapy. REHAB is accredited by the Joint Commission as an acute specialty hospital in physical rehabilitation.

Highlights

- Ekso investigational trials study participant (2011)



226 North Kuakini Street
Honolulu, HI 96817
phone: +1.808.544.3310
website: www.rehabhospital.org/

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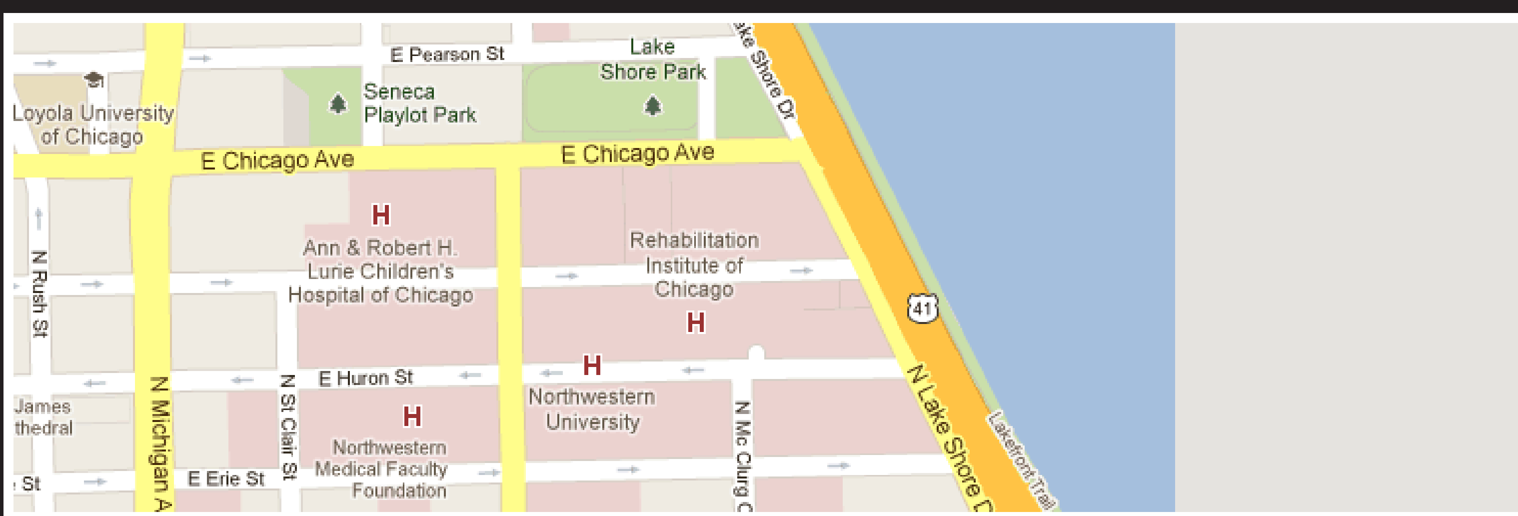
REHABILITATION INSTITUTE OF CHICAGO (RIC)

The Rehabilitation Institute of Chicago (RIC) is the nation's #1 ranked provider of comprehensive physical medicine and rehabilitation care to patients, and is the leader in research and development of the cutting-edge treatments and technologies in its field. RIC has seven, multi-year, multi-million dollar federal research designations awarded and funded by the National Institutes of Health and the Department of Education's National Institute of Disability and Rehabilitation Research in the areas of spinal cord injury, traumatic brain injury, stroke, neurological rehabilitation, outcomes research and rehabilitation engineering research.

Highlights

- U.S. News & World Report Ranking: #1 in Rehabilitation
- Spinal Cord Injury Model System Center



345 E. Superior Street
Suite 1334
Chicago, IL 60611
phone: +1. 312.238.1000
website: www.ric.org

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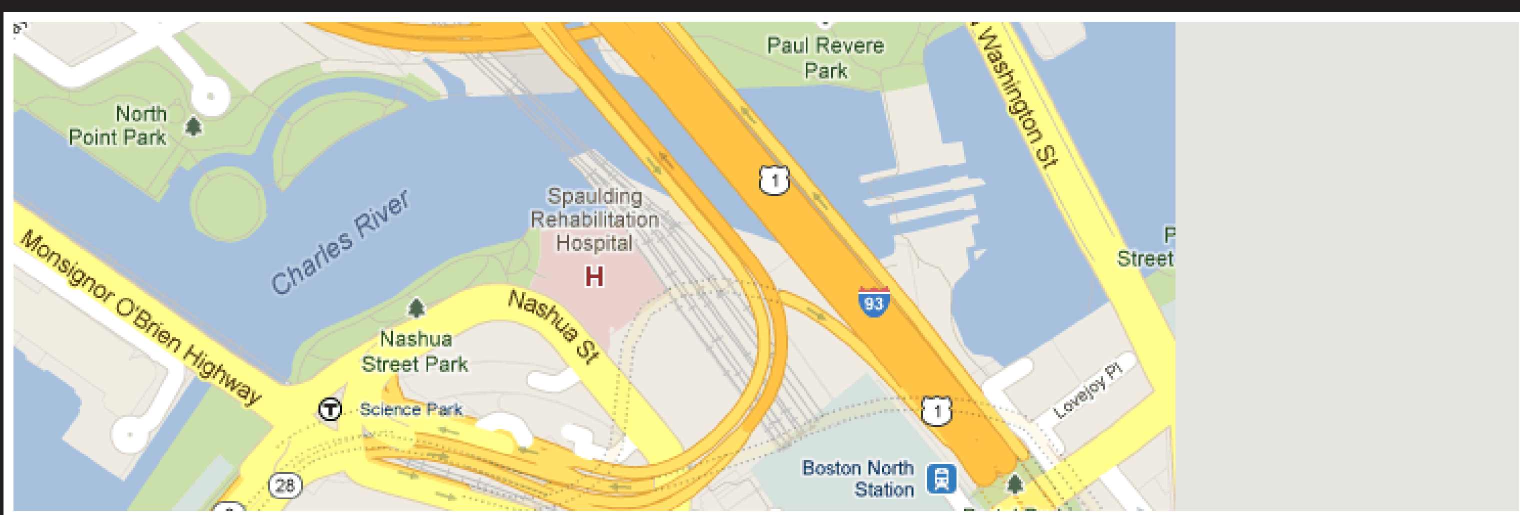
SPAULDING REHABILITATION HOSPITAL

Spaulding Rehabilitation Hospital is one of the largest rehabilitation facilities in the US, providing comprehensive rehabilitation treatment. It is the only rehabilitation hospital in New England continuously ranked since 1995 by U.S. News and World Report in its Best Hospitals survey. A teaching hospital of Harvard Medical School, Spaulding is a member of the Partners HealthCare System. The Spaulding continuum of care also includes collaboration and contract management consultation with rehabilitation facilities throughout the Massachusetts / New Hampshire region.

Highlights

- U.S. News & World Report Ranking: #4 in Rehabilitation
- Ekso investigational trials study participant (2011)



125 Nashua Street
Boston, MA 02114
phone: +1. 617.573.7000
website: www.spauldingrehab.org/

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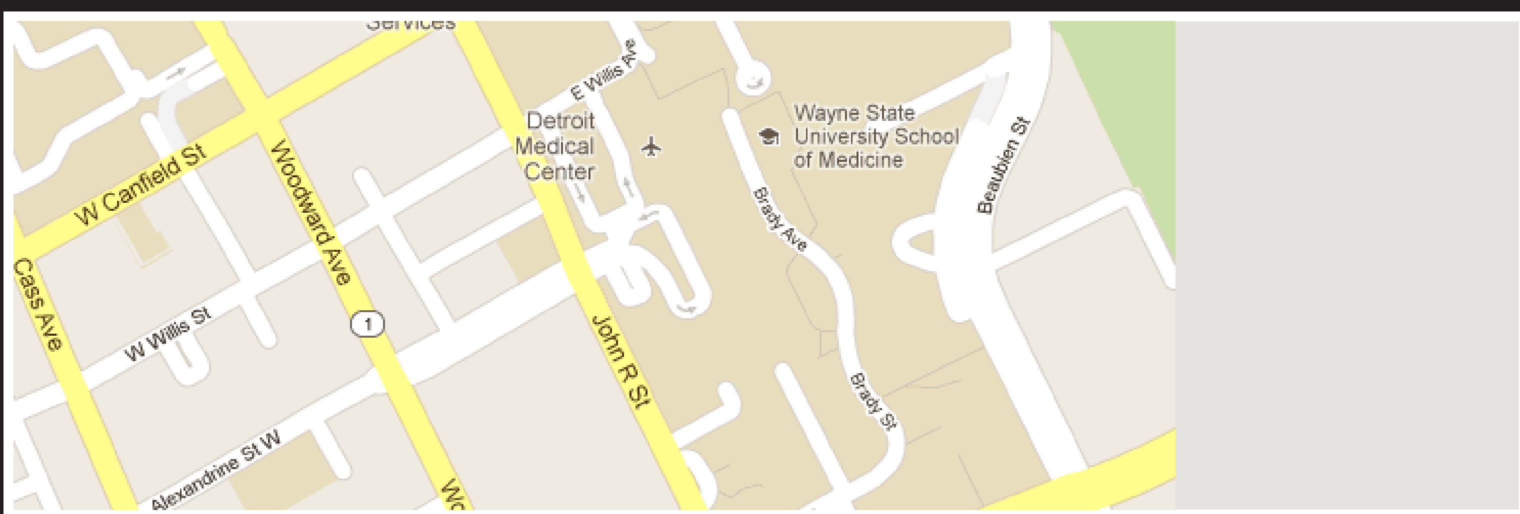
REHABILITATION INSTITUTE OF MICHIGAN

Rehabilitation Institute of Michigan (RIM) delivers a full spectrum of comprehensive services and programs for individuals with spinal cord injuries, brain injuries, stroke, cerebral palsy, musculoskeletal disorders, low back problems, amputations, geriatric conditions, work-related injuries, sports injuries and other medical conditions requiring physical rehabilitation. RIM's Center for SCI Recovery®, is one of the first hospital-based programs of its kind in the U.S., to provide a long-term, high-intensity, non-traditional activity-based therapy program that utilizes innovative exercise techniques to optimize recovery.

Highlights

- Ekso investigational trials study participant (2011)



3990 John R Street
Detroit, MI 48201
phone: +1. 313.745.1203
website: www.rimrehab.org/

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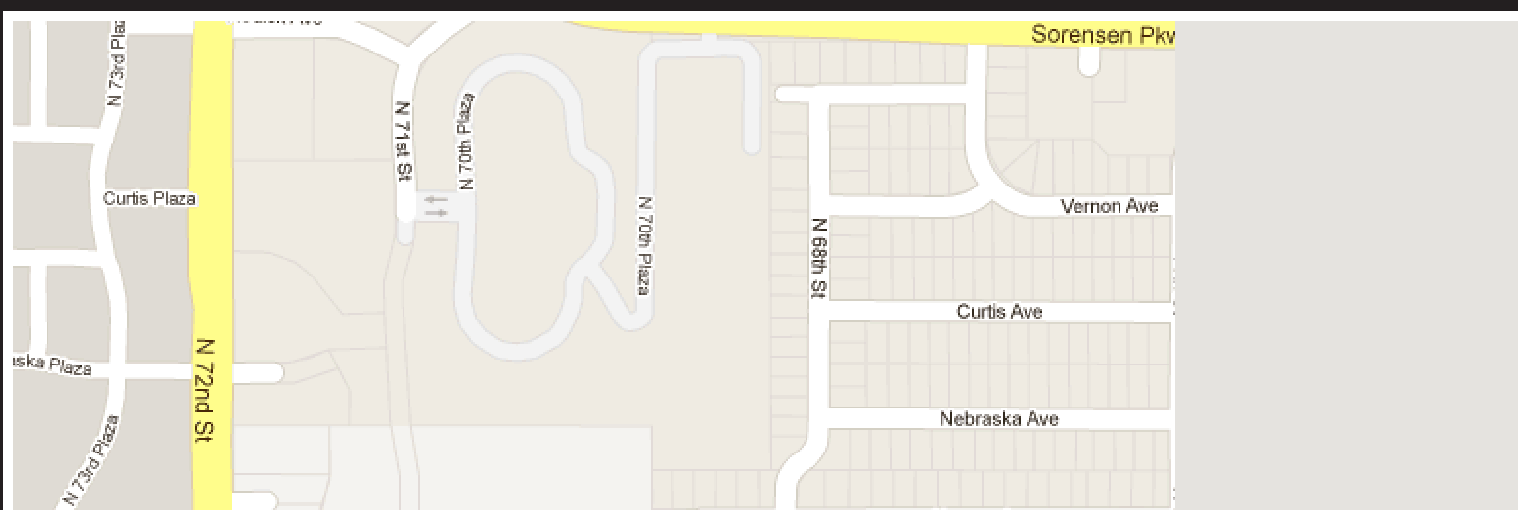
QUALITY LIVING, INC. (QLI)

Good rehabilitation services improve function. Great rehabilitation services rebuild lives. QLI has become one of the nation's premier post-hospital centers for brain and spinal cord injury rehabilitation by embracing the concept that great rehabilitation is more than just the science of physical recovery – it is the art of rebuilding a life.

The combination of QLI's proprietary Tri-Dimensional Rehabilitation® program and the unparalleled quality of our staff and culture make QLI's program powerfully effective. We use our extensive resources and expertise to help our clients reach their individual goals as we work tirelessly to restore purpose and pleasure to a life that has been devastated by a catastrophic event.



6404 North 70th Plaza
Omaha, NE 68104
phone: +402.573.3700
website: www.qliomaha.com/

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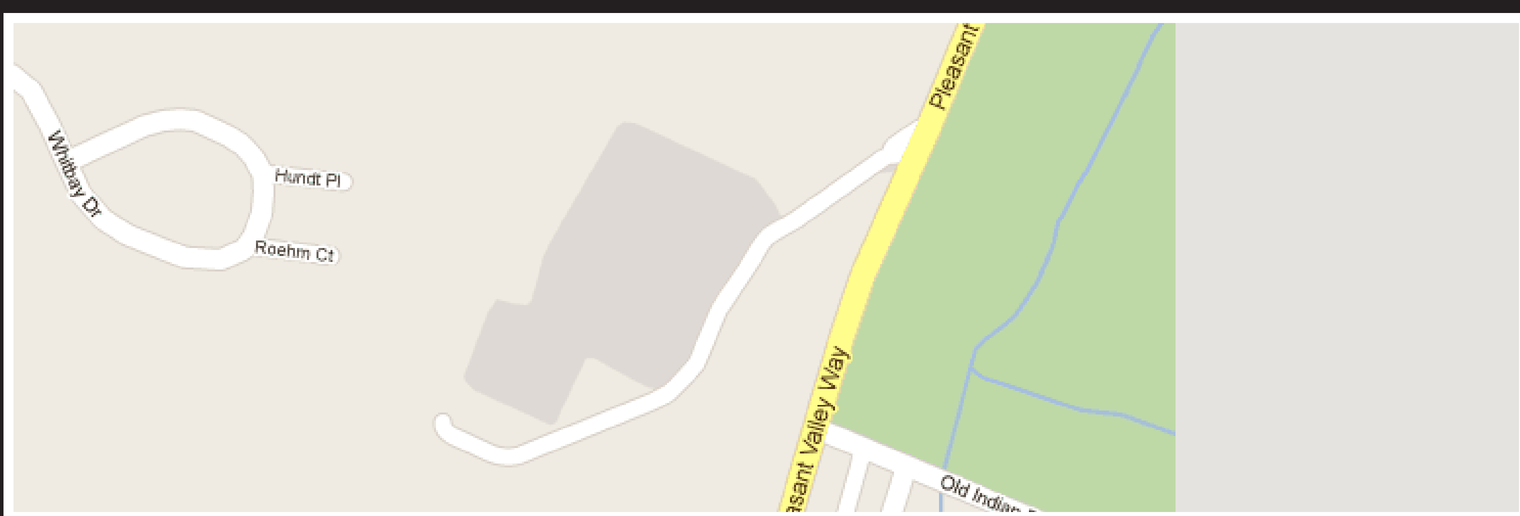
KESSLER FOUNDATION

Kessler Foundation is dedicated to improving the lives of people with physical and cognitive disabilities caused by stroke, multiple sclerosis, injuries to the brain and spinal cord, and other chronic conditions. The Foundation's approach is twofold - supporting rehabilitation research through the Kessler Foundation Research Center and preparing individuals for the workplace through the Kessler Program Center. Kessler Foundation Research Center's laboratories collaborate with Kessler Institute for Rehabilitation ensuring that research projects prioritize the needs of people undergoing rehabilitation for physical disabilities.

Highlights

- U.S. News & World Report Ranking #2 in Rehabilitation
- Spinal Cord Injury Model System Center
- NeuroRecovery Network Center (NRN)
- Ekso investigational trials study participant (2011)



1199 Pleasant Valley Way
West Orange, NJ 07052
phone: +1 973.324.8362
website: kesslerrehabilitationcenter.com/

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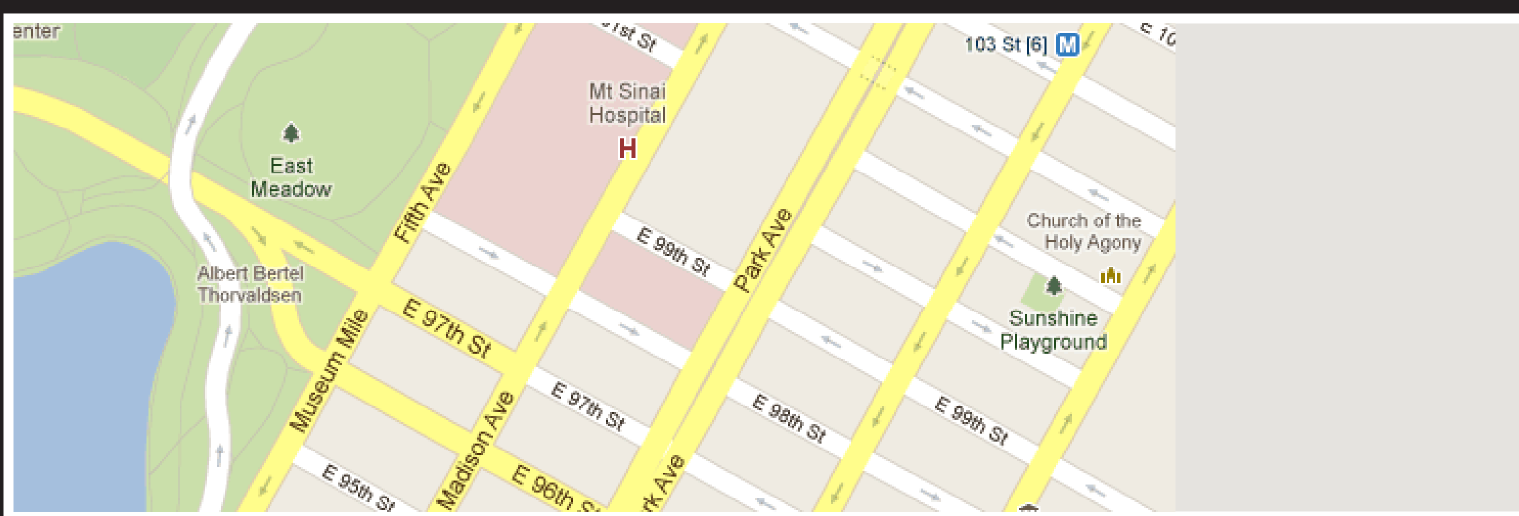
MOUNT SINAI HOSPITAL

The Mount Sinai Hospital is renowned for its achievements in medical research and is a leader in advanced technologies. A regional center for spinal cord and brain injury rehabilitation, Mount Sinai has one of the most comprehensive and innovative rehabilitation programs in the country. U.S. News & World Report ranks their programs in geriatrics, digestive disorders, neurology and neurosurgery, ear-nose-and-throat, and heart disease among the top 20 nationally. The Mount Sinai Hospital is part of The Mount Sinai Medical Center, which also includes Mount Sinai School of Medicine.

Highlights

- U.S. News & World Report Ranking: Mount Sinai Medical Center #16 in Rehabilitation
- Spinal Cord Injury Model System Center
- Ekso investigational trials study participant (2011)



1425 Madison Ave.
NYC, NY 10029
phone: +1. 212.241.6500
website: www.mountsinai.org/

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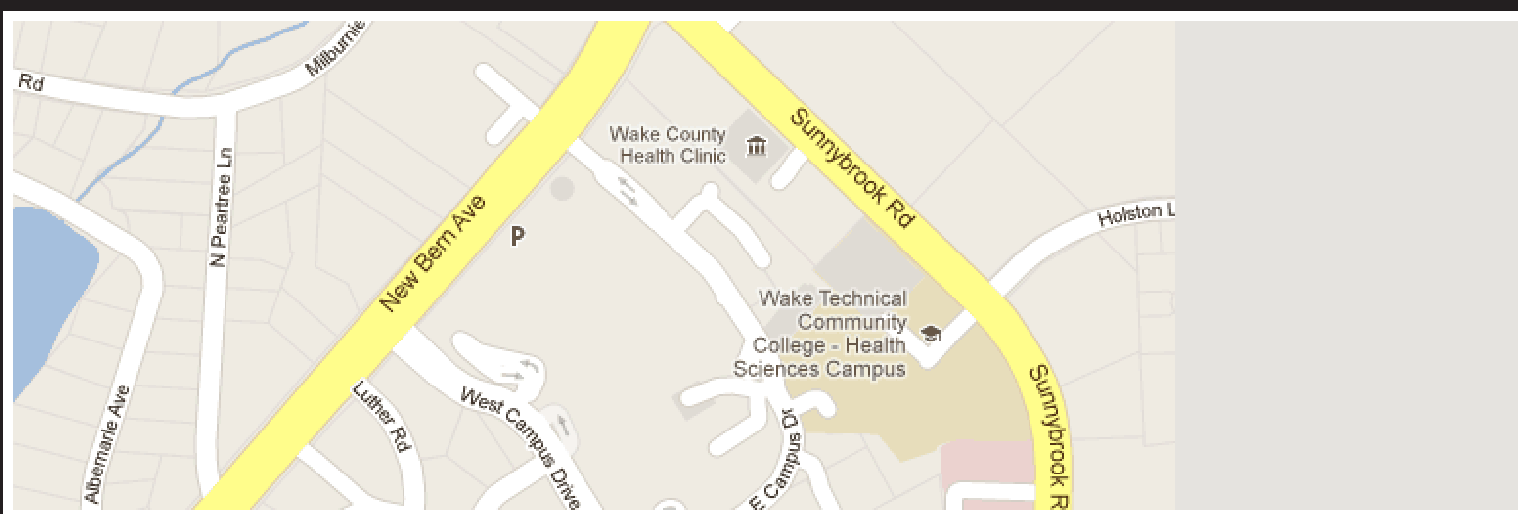
WAKEMED REHABILITATION HOSPITAL

WakeMed Health & Hospitals is a health system which includes 60 touchpoints with Centers of Excellence in rehabilitation, cardiac and vascular care, women's and children's services, trauma, orthopaedics and neurosciences. WakeMed's Rehabilitation Hospital is the first, largest and most comprehensive facility of its kind in the area. Its inpatient and outpatient/day treatment programs are CARF accredited for a spinal cord system of care. The WakeMed Spinal Cord Injury Program begins with WakeMed Trauma Services then transitions through our acute care hospital, inpatient rehabilitation hospital, outpatient day treatment program and SCI fitness programs.



3000 New Burn Ave
Raleigh, NC 27610
phone: +1. 919.350.7876
website: www.wakemed.org/

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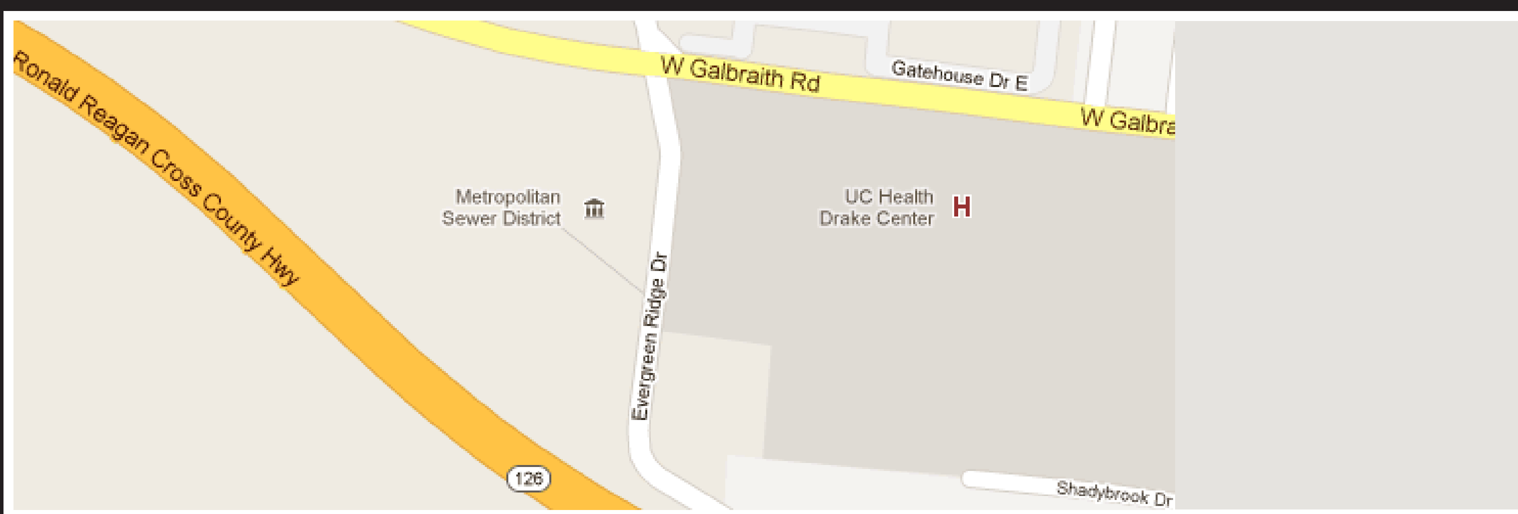
UNIVERSITY OF CINCINNATI HEALTH - DRAKE CENTER

Drake Center, a member of UC Health, is the region's premier provider of long-term acute care offering a complete range of inpatient and outpatient services including medically complex care, ventilator weaning/pulmonary care and diagnostic services, skilled nursing, assisted living, wellness services and research.



151 West Galbraith Rd.
Cincinnati, OH 45216
phone: +1. 513.418.2500
website: drakecenter.uchealth.com/

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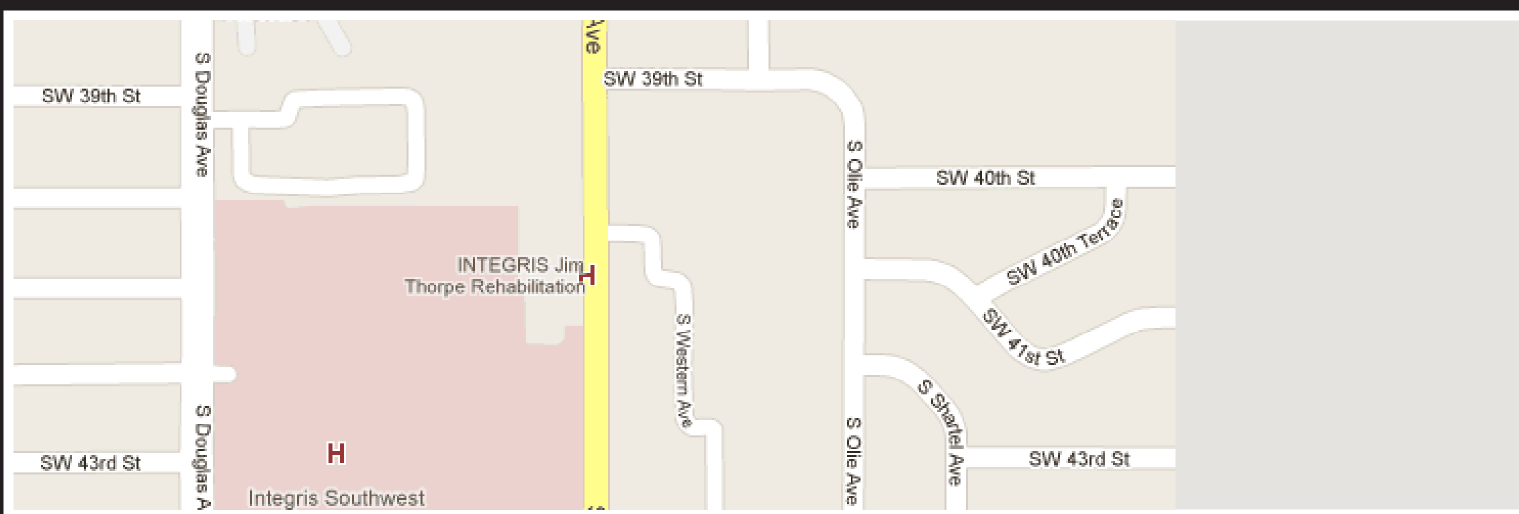
INTEGRIS JIM THORPE REHABILITATION HOSPITAL

INTEGRIS Jim Thorpe Rehabilitation is Oklahoma's foremost system of inpatient, outpatient, and community-based rehabilitative care for children and adults with acquired brain injury (traumatic brain injury, stroke and brain tumors), spinal cord injury, amputee or orthopedic conditions. Through team-based personal care, patients benefit from the expertise of physicians, therapists, nurses, psychologists, case managers, social workers and others specially trained in rehabilitation.



4219 South Western
Oklahoma City, OK 73109
phone: +1 405.644.5200
website: integrisok.com/jim-thorpe-rehabilitation-oklahoma-city

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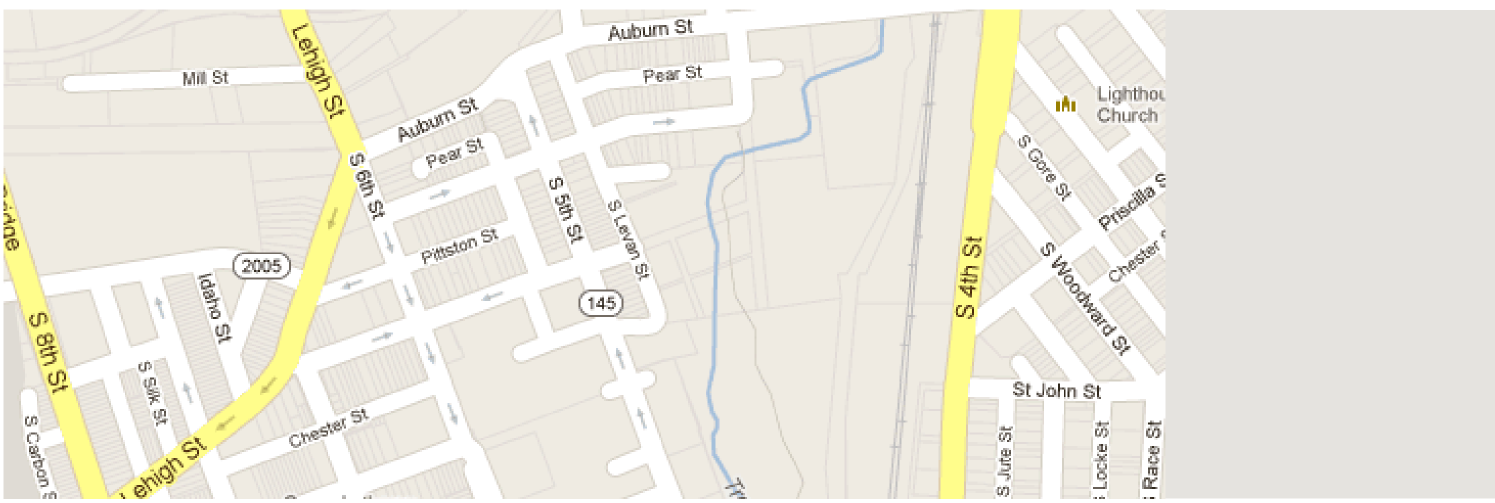
GOOD SHEPHERD REHABILITATION NETWORK

Good Shepherd Rehabilitation Network is a nationally recognized rehabilitation leader, offering a continuum of care for people with physical and cognitive disabilities and specializing in assistive and rehabilitation technology. More than 60,000 people come to Good Shepherd each year for specialized programs in stroke, orthopedics, brain injury, spinal cord injury, pediatrics, amputation and more.

Good Shepherd uses technology along with expert hands-on care throughout their network. They offer an impressive inventory of life-changing assistive and rehabilitation technologies. These devices, combined with hands-on therapy, help patients achieve independence and functional improvement.

Highlights

- Ekso investigational trials study participant (2011)



850 S. 5th Street
Allentown, PA 18103
phone: +1. 610.776.3100
website: goodshepherdrehab.org

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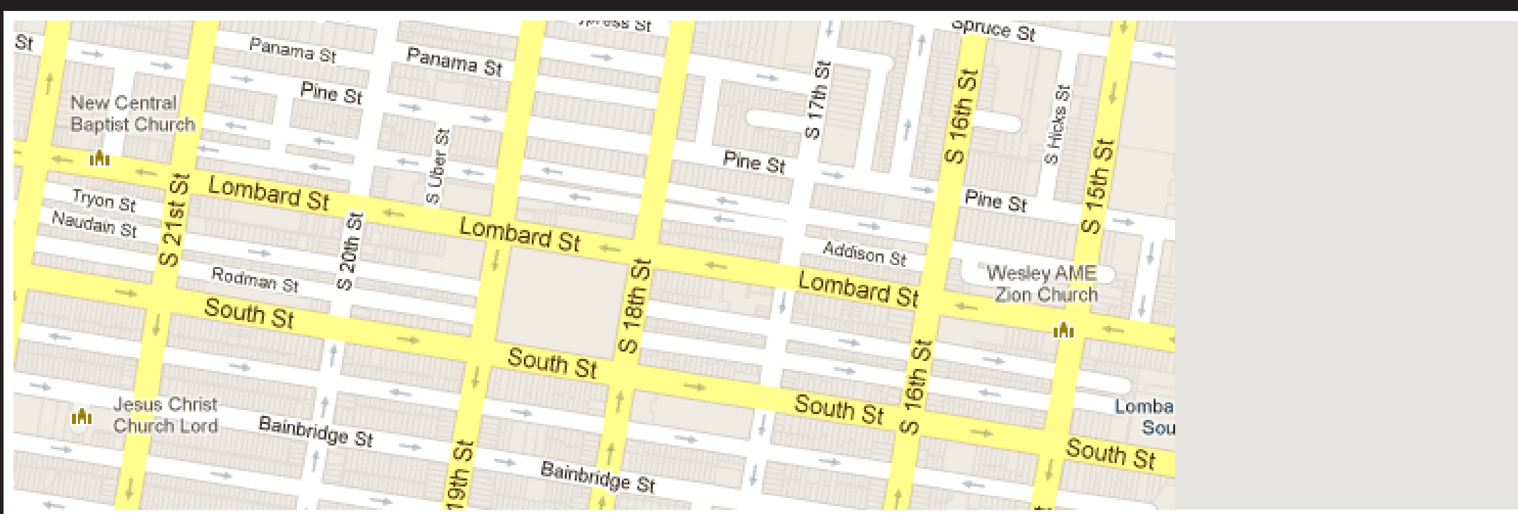
GOOD SHEPHERD, PENN PARTNERS

Good Shepherd Penn Partners brings together two nationally respected healthcare organizations (Good Shepherd Rehabilitation Network and Penn Medicine) to provide the region with a continuum of post-acute care that includes inpatient and outpatient rehabilitation and a long-term acute care hospital. Combining the respected research and clinical expertise of Penn Medicine with GSRN's tradition of evidence-based rehabilitation care resulted in the optimization of post-acute care in the region. With similar core values, the two organizations were able to come together to align post-acute care throughout the Penn Medicine system.



1800 Lombard St
Philadelphia, PA 19146
phone: +1.215.893.2500
website:

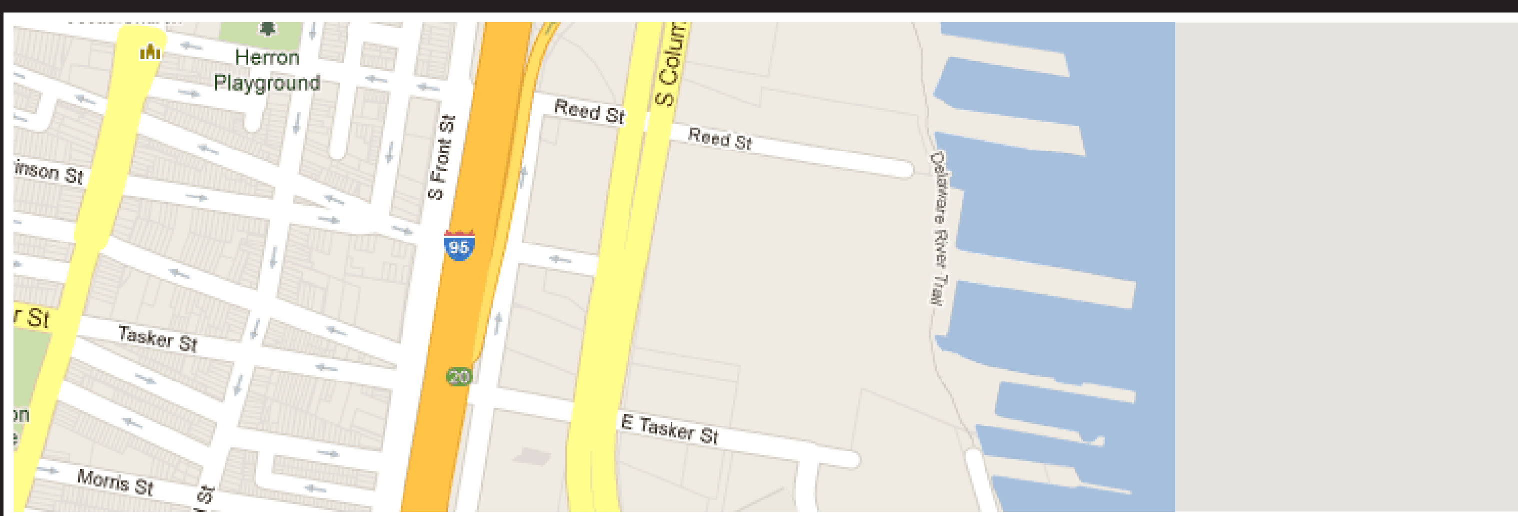
EKSO CENTERS

MAGEE REHABILITATION

Magee Rehabilitation is one of 14 federally designated Regional Spinal Cord Injury Centers. Inpatient and outpatient services provide programs for people with spinal cord injury, brain injury, stroke, amputation, and orthopedic injuries. Magee is accredited by CARF and The Joint Commission and ranks as one of US News and World Reports "Best Hospitals." Magee is also a founding member of the Christopher and Dana Reeve Foundation NeuroRecovery Network.

Highlights

- U.S. News & World Report Ranking: Ranked 16th in the nation for rehab hospitals
- Spinal Cord Injury Model System Center



1500 S Columbus Blvd
Philadelphia, PA 19147
phone: +1.215.587.3000
website: www.mageerehab.org

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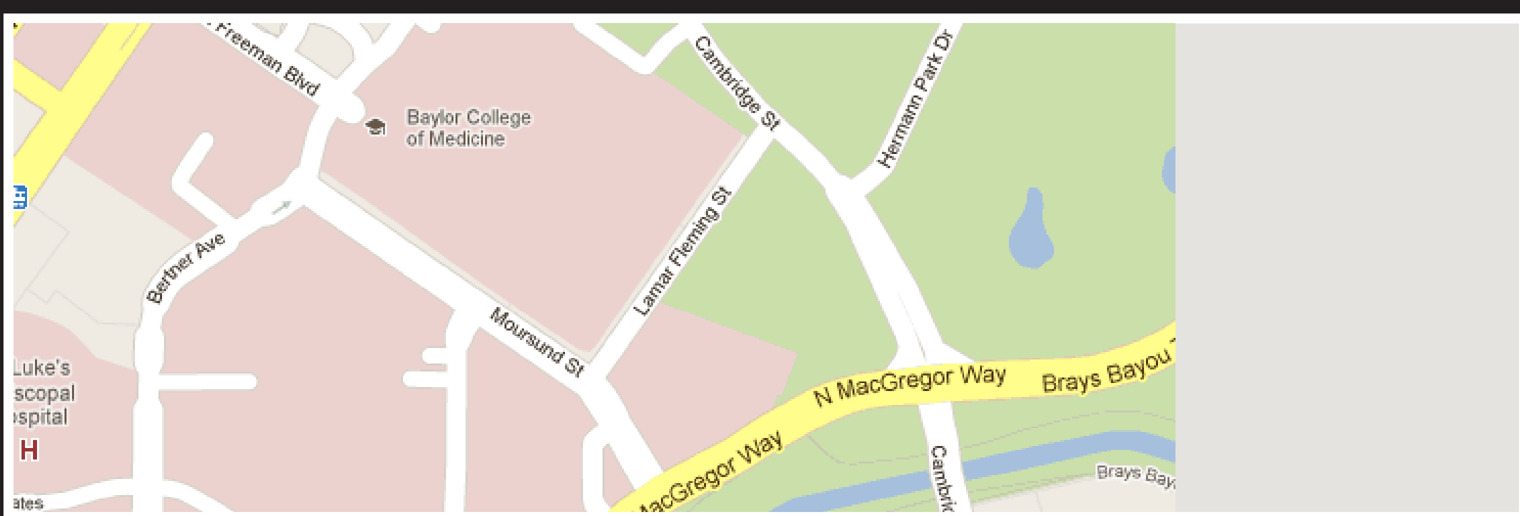
TIRR MEMORIAL HERMANN (THE INSTITUTE OF REHABILITATION AND RESEARCH)

Memorial Hermann is the largest not-for-profit healthcare system in Texas and serves the greater Houston community through 11 hospitals, a vast network of affiliated physicians and numerous specialty programs and services. Memorial Hermann's affiliated physicians tirelessly search for better ways to diagnose and treat patients while harnessing the latest technologies and employees embrace a culture of innovation. TIRR's high standards of care have resulted in numerous awards, including the prestigious National Quality Healthcare Award from the National Quality Forum in 2009 and being named one of America's top hospitals by U.S. News & World Report.

Highlights

- U.S. News & World Report Ranking: #5 in Rehabilitation
- Spinal Cord Injury Model System Center
- NeuroRecovery Network Center (NRN)
- Ekso investigational trials study participant (2011)



1333 Moursund
Houston, TX 77030
phone: +1 713.799.5000
website: www.memorialhermann.org/locations/tirr/

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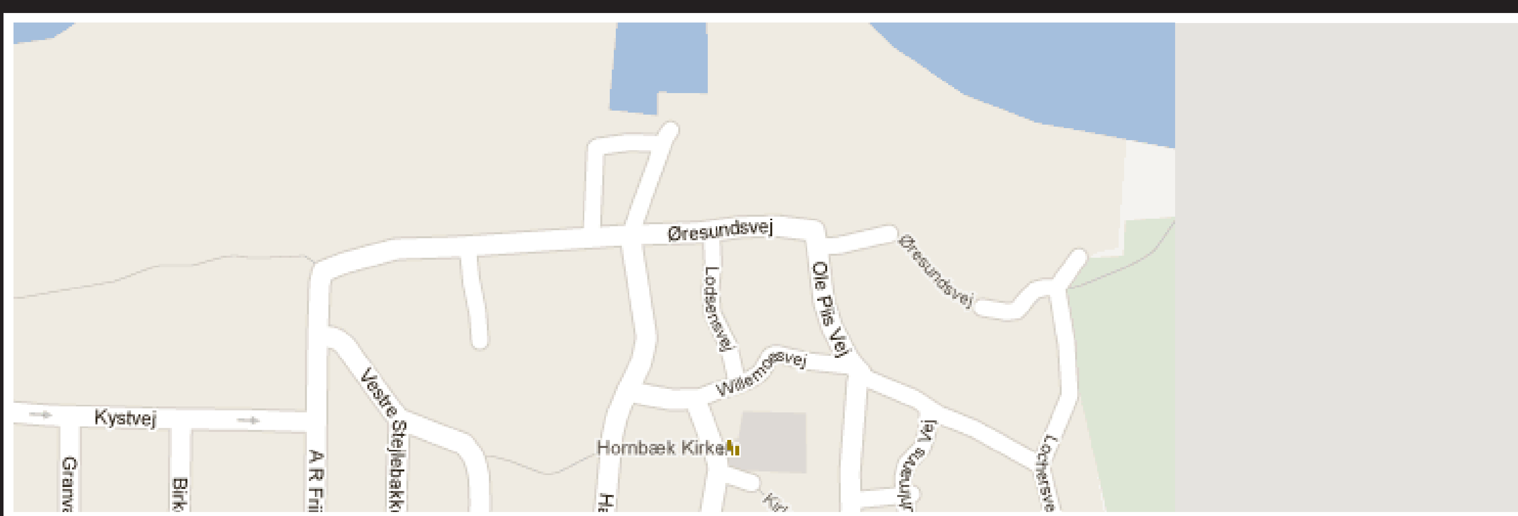
GLOSTRUP HOSPITAL

Glostrup Hospital is a specialized hospital that is organized under the Capital Region of Denmark. The hospital is specialized in diseases in the brain, back and eyes and in specialized rehabilitation. 2,400 people are employed at the hospital. Glostrup Hospital has a strong research environment with 20 professors and senior researchers and its own research center.

The Department of Spinal Cord Injuries is the larger of the two centers in Denmark performing multidisciplinary treatment and rehabilitation of individuals with traumatic and non-traumatic spinal cord lesions.

The Department of Spinal Cord Injuries aims at treating and rehabilitating patients with spinal cord lesions to enable these patients to become as independent as possible. Patients with spinal cord injuries are followed throughout life via outpatient or inpatient check ups.



Havnevej 25
Department of Spinal Cord Injuries, Glostrup Hospital
3100, Hornbæk
phone: +45 3545 1350
website: www.glostruphospital.dk)

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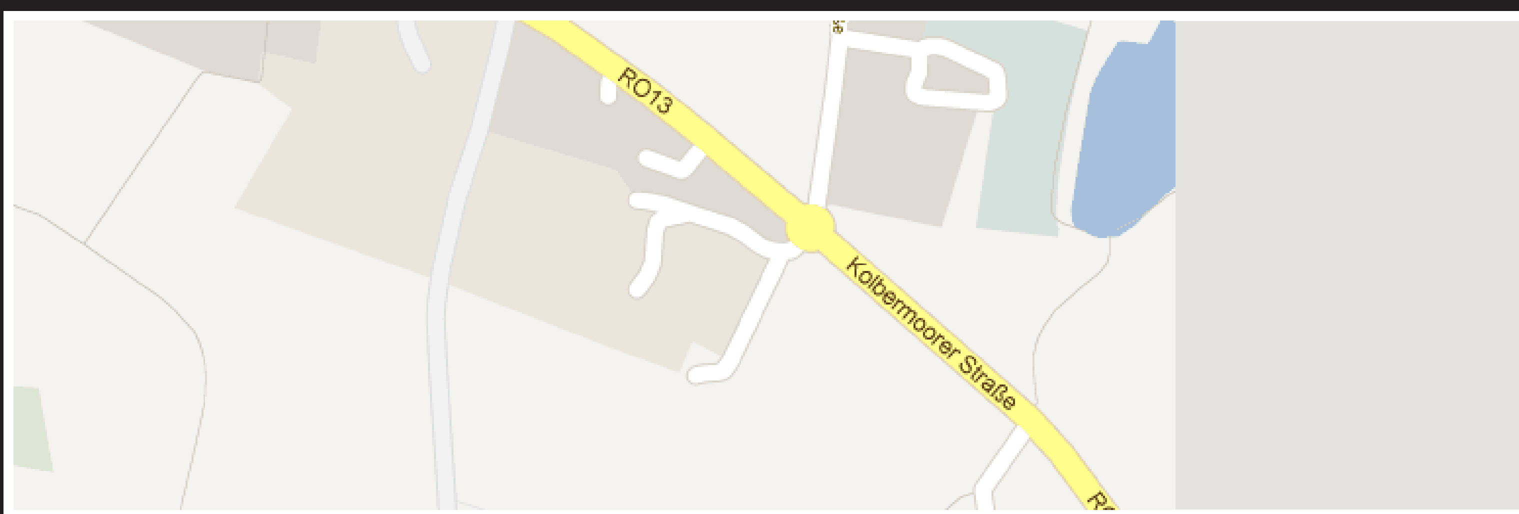
SCHÖN KLINIK BAD AIBLING

Schon Klinik Bad Aibling is an internationally accredited hospital for neurology. From the accident and emergency unit with its own intensive care to rehabilitation via modern therapy thespecialist clinic offers a comprehensive medical diversity under one roof. Their physicians and staff treat their patients, who often need around-the-clock care, with heart and empathy. They are not only specialised in brain injuries, they also engage in research projects to develop and apply innovative technical methods and therapeutic concepts.



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83043, Bad Aibling
phone: +49.8061.903.0
website: www.schoen-kliniken.com/ptp/kkh/aib/

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ISTITUTO PROSPERIUS

The Prosperius Institute is host to a meaningful synergy between public and private structures including the four stages of the rehabilitative activity provided for by the Ministry of Health. Here the global care of patients is not a formula, but a complex therapeutic choice. The multidisciplinary approach is combined, being essential to an individual's rehabilitation. Tiberino is a point of reference for rehabilitative medicine, from the immediate postoperative stage to the complete functional recovery.

Via Carlo Forlanini 5
06019, Umbertide, Perugia
phone: +39 75 941-7979
website: www.prosperius.it/

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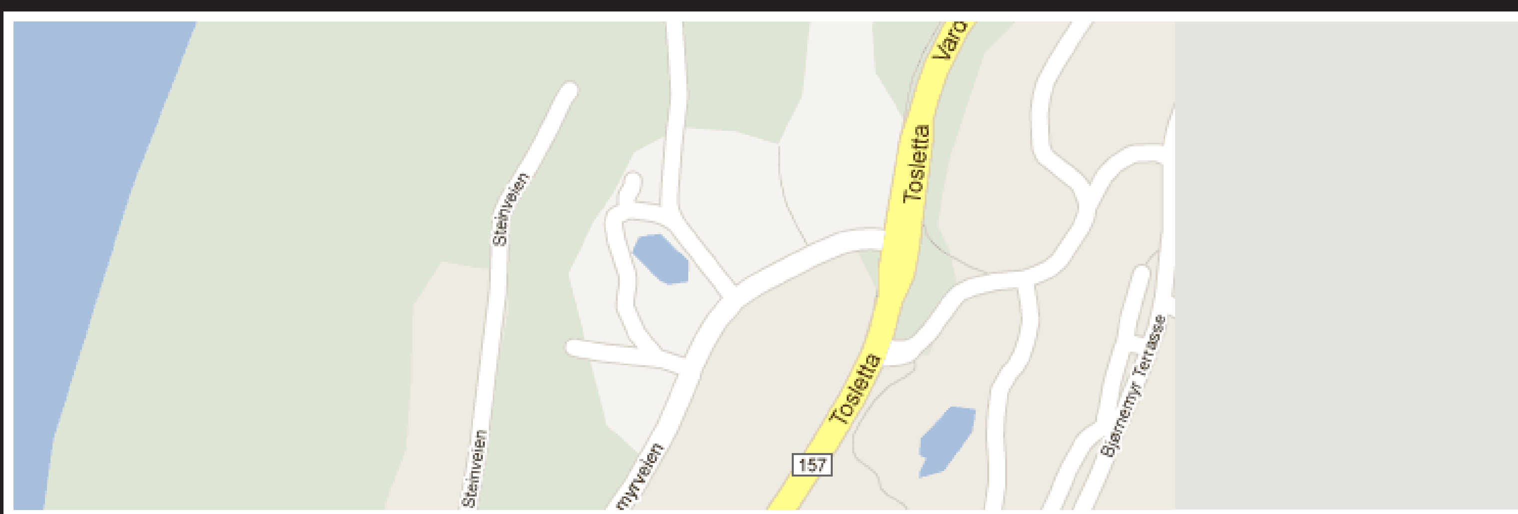
SUNNAAS HOSPITAL

Sunnaas Hospital is Norway's largest specialist hospital in the field of medical rehabilitation. Geographically situated in three locations - Nesodden, Askim and Oslo, with a total capacity of 161 beds.

In addition to the actual rehabilitation process, training and advising patients and relatives and conducting research are important activities at Sunnaas. Sunnaas Hospital is one of eleven medical health institutions in South-Eastern Norway Regional Health Authority. The hospital has its own User Committee to assist in ensuring the protection of the rights and interests of patients and relatives.



Bjørnemyrveien 11
1450, Nesodden
phone: +47 66 96 90 00
website: www.sunnaas.no

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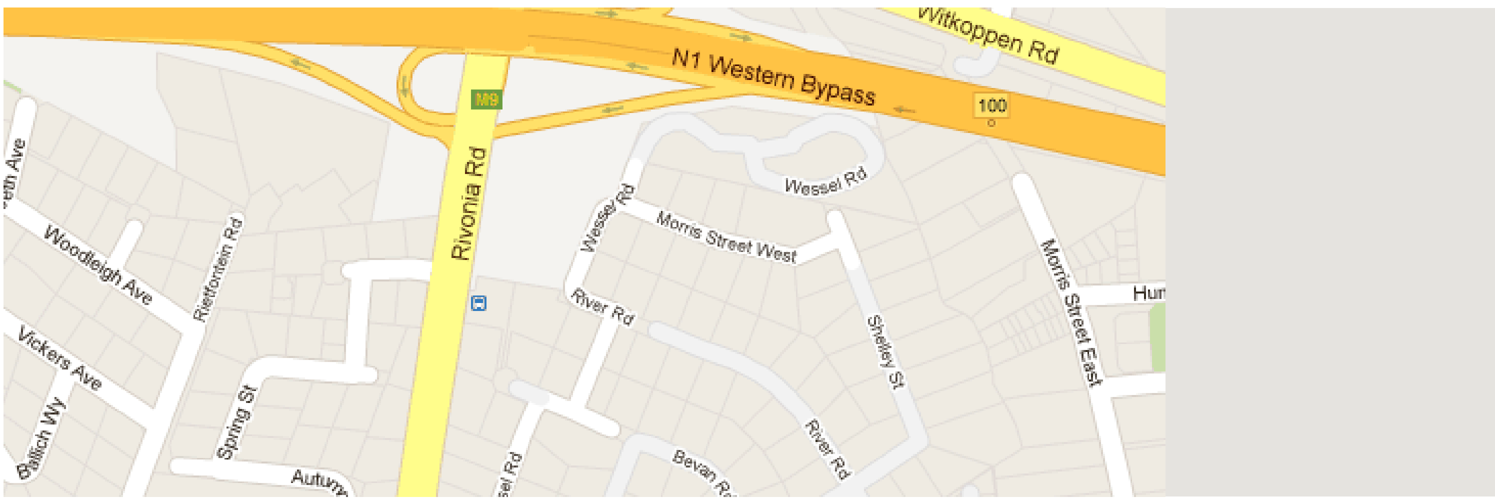
JUST WALK BIONICS

Just Walk Bionics is an advanced rehabilitation centre, offering people with lower extremity paralysis due to a Spinal Cord injury, Multiple Sclerosis or Guillain Barré syndrome a chance to stand up and walk again, with the aid of Ekso. In addition, Just Walk Bionics in association with J & K Biokineticists, provides a non-traditional exercise-based therapy to individuals suffering from spinal cord injuries and other neurological disorders to maximize their recovery after suffering a debilitating injury.



33 Wessel Road, Rivonia, Sandton
Finch House - Ground Floor, Rivonia Gardens
2000, Gauteng
phone: +27 71 462 6643
website: www.justwalkbionics.co.za/

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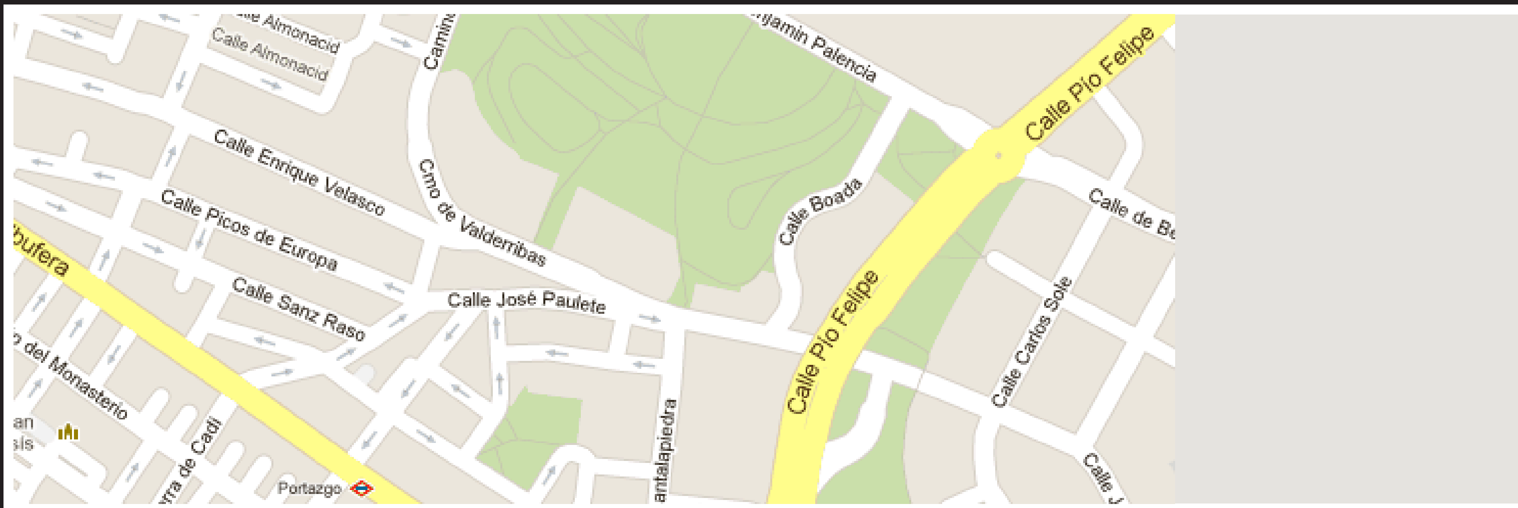
FUNDACION DEL LESIONADO MEDULAR (FLM)

Fundacion del Lesionado Medular (the Foundation of Spinal Cord Injuries or FLM)'s main objective is to "Achieve the greatest possible level of life normalization for people with spinal cord injuries (SCI) in order for them to reach their full re-integration into society through comprehensive rehabilitation." FLM's Integral rehabilitation strives to achieve specific objectives aimed at allowing the SCI patient to reach his/her full incorporation in the working world, as well as to maximize the level of integration in the surrounding physical and social environment.ccomprehensive rehabilitation program strives to achieve specific objectives for SCI aimed at allowing the patient to reach their full incorporation in the working world, and to maximize the level of integration in the surrounding physical and social environment.



Valderribas Road, 115
28038, Madrid
phone: +34.91.777.55.44
website: www.medular.org

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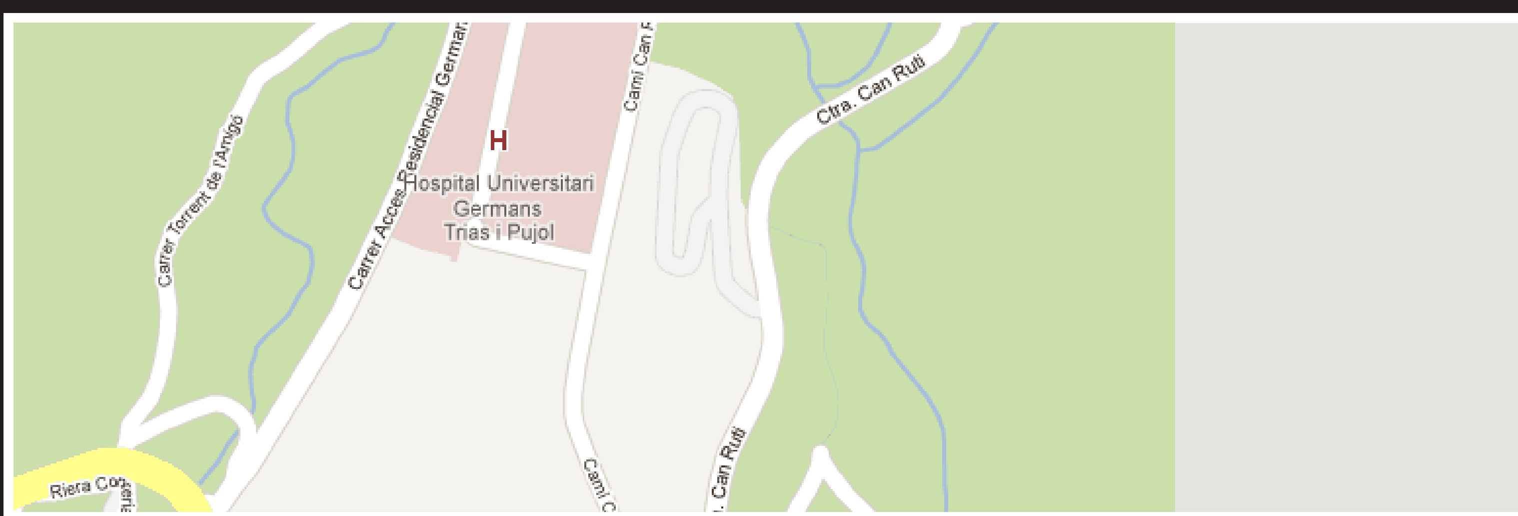
INSTITUT GUTTMANN

Institut Guttmann is an integrated part of the National Health System and is the referring hospital in Spain for the medical treatment and rehabilitation of people with spinal injuries, acquired brain damage or any other serious neurological disability.

Institut Guttmann hallmark is its ability to generate new knowledge and innovative techniques as well as its own therapeutic procedures for neurorehabilitation, making it one of the global leaders in its field. It also provides expert personal, health and social care for individuals with disabilities and their families.

Their educational and research activities, through the University Institute of Neurorehabilitation, make Guttaman a Centre of Knowledge recognized in the area of neuroscience in general, and neurorehabilitation and technologies applied to personal independence in particular.



Cami de Can Ruti, s / n
08916 , Badalona
phone: +34.93.497.77.00
website: www.guttmann.com

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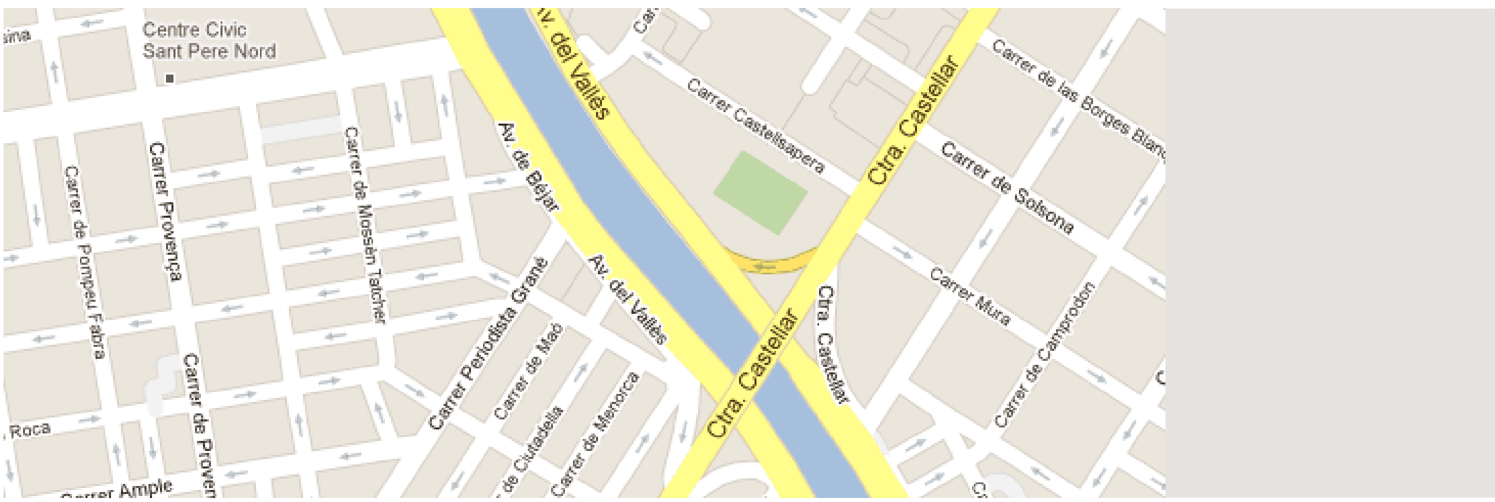
STEP BY STEP FOUNDATION

Step by Step Foundation (SbyS) is dedicated to the recovery of people suffering from neurological disease affecting the central nervous system, especially in the case of spinal cord injuries and stroke victims. SbS Foundation presents a new working model in the field of spinal cord injury treatment, the cornerstone of which is the development of an exercise programme designed to maintain and improve patients' physical condition, thus preparing themselves for the arrival of solutions that medical science may achieve in the future.



Carrer Dolors Aleu 19-21
3° 3ª/ Carrer Indústria 55
08908, Barcelona
phone: + 34.93.223.16.63
website: www.fundacionsbs.org

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SENIOR ELECTRICAL ENGINEER

The Company

Ekso Bionics is an exciting East Bay startup inventing technology to help people rethink physical limitations and achieve the remarkableWe are pioneers in the field of exoskeletons, designing and creating some of the most forward-thinking and innovative solutions to augment human mobility and capabilityWorking on these complex systems produces numerous interesting and unusual technical problems, and we are looking for new team members to help solve themIf you want to work on serious hardware that goes beyond ordinary mechatronics applications, this is for you! Ekso Bionics YouTube videos: http://www.youtube.com/user/eksobionics

The Area

Electrical Engineering The electrical team engages in a blend of exciting electronics research and design for manufactureBe prepared to apply your product development experience to something that makes a positive difference for peopleAlso be prepared to make friends, be challenged, learn, and grow, as these are integral to Ekso Bionics' and EE team culturePassionate, energetic individuals are encouraged and welcome!

The Role

Senior Electrical Engineer Colleagues would rate you a top pick when in need of an experienced electrical engineer who is super sharp, resourceful, innovative, and has hands-on skill with a variety of electronic systemsSo come join our world-class electrical team and apply your expertise across the spectrum from system architecture to board layout, bring up, and solving all manner of design challengesWork with sensors, embedded processors, FPGAs, motor drives, high capacity smart batteries, and moreLeverage and grow your teamwork and leadership skills, and have fun with usPosition reports to the Director of Electrical Engineering.

Responsibilities

- Design novel, reliable, and economical electronics for robotic exoskeletons.

- Perform schematic capture and board layout.
- Assemble and debug prototype hardware.
- Transition designs to manufacturing.
- Utilize company's quality management and gated product development systems.
- Provide technical and professional leadership to less experienced team members.
- Contribute actively to an engineering culture of creativity, discipline, and greatness

Minimum Qualifications

- BSEE from an outstanding engineering school
- 6+ years doing digital and analog design on shipping products
- Solid EE skillset that includes architecture, design, and analysis
- Skilled with microcontrollers, FPGAs, data converters, and op amps
- Skilled with PCB schematic and layout CAD
- Very hands-on and skilled with assembly, including SMT soldering
- Passionate, "can do" attitude
- US citizenship

Preferred Qualifications

- MSEE or PhD from an outstanding engineering school
- 10+ years doing EE design work on shipping products
- Experience designing FDA regulated medical devices
- Skilled with Altium Designer
- Highly skilled with 32-bit embedded processors
- Highly skilled with FPGAs
- Highly skilled with analog design
- Experienced at RF design
- Experienced at SolidWorks
- Experience designing motor control and/or power electronics
- Generous and patient teacher and mentor

CURRENT POSITIONS

- **Senior Electrical Engineer**
  Full time position Posted December 16, 2012
  show details
- **Physical Therapist/Clinical Training Specialist**

Full time position Posted March 20, 2012

show details

PHYSICAL THERAPIST/CLINICAL TRAINING SPECIALIST

POSITION SUMMARY:

We are currently seeking successful and motivated Physical Therapist / Clinical Training Specialist candidates who will be responsible for providing training and education to current and future Ekso Bionics customers while facilitating use of our product in healthcare settings. This includes initial and ongoing training visits as needed at customer sites. S/he will ensure competent and safe operation of Ekso devices by all physical therapists at customer sites. The activities needed to support these objectives include, while not limited to: improving the quality, efficiency, and productivity of the physical therapy/clinical team, facilitating patient use of our products directly and through others, complying with Ekso Bionics quality management system, making presentations to current and future customers, supporting the design and development of future products, and the development and support of clinical training with Ekso Bionics customers. The successful candidate will be a licensed Physical Therapist with experience treating patients in a neurological rehabilitation setting and reports directly to and receives direction and delegation from the Clinical Director, as part of the clinical team.

ESSENTIAL JOB FUNCTIONS/RESPONSIBILITIES:

Travel to current and future customer locations to provide new or ongoing training for all Ekso Bionics mobility related devices across the United States

- Travel days expected to be approximately 75% of work days in a month
- Manage own travel schedule and logistics
- Comply with Ekso Bionics Clinical Competency and Training Outline to complete education and training
- Communicate timely and effectively with all members of Clinical Team and Engineering Teams

- Report status of training weeks
- Collect feedback from customers and circulate to Clinical and Engineering Teams
- Notify Clinical Director with concerns for site competency immediately
- Notify Engineering Team and Clinical Director with concerns for device function immediately
- Work with Ekso Bionics Clinical team members to carryout required training
- Maintain efficiency and quality of Clinical training provided to customers
- Travel to current and future customer locations to provide in-services and demonstrations
- Represent Ekso Bionics at conferences
- Research current articles related to gait, robotics and other areas important to Ekso Bionics
- Clinical development of all mobility related devices
- Research and Development in Company headquarters or remotely as scheduled with Clinical Director in support of engineering design and development or other clinical related activities
- Performs other duties as required

POSITION SKILLS / REQUIREMENTS:

Successful candidates meet the following skills, abilities and requirements:

- Must be a licensed physical therapist with at least four (4) years of experience treating in an inpatient and/or outpatient rehabilitation setting, with at least a two (2) year focus in spinal cord injury (SCI) rehabilitation or other neurological conditions.
- Must have thorough understanding of and demonstrated experience working with spinal cord injuries or other neurological conditions at all levels, risks and complications associated with diagnosis, and experience gait training in a population experiencing spinal cord injury or other neurological conditions.
- Have exceptional physical evaluation skills.
- Experience as a Clinical Instructor to physical therapy student(s) or other applicable healthcare instruction.
- Additional experience in neurological rehabilitation and teaching rehabilitation professionals preferred.
- Must speak and understand fluent English.
- Comfortable using tools to adjust devices (Similar to wheelchair adjustment skills).
- Provides excellent verbal and written communication to various team members in a timely manner. Requires affective communication to convey, develop and implement ideas to various customers and teams.

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  Full time position Posted December 16, 2012
  show details

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  Full time position Posted March 20, 2012

show details

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Chances are Amanda has done more in her wheelchair than most ever will. Despite sustaining a permanent spinal cord injury skiing, she has amassed an impressive list of accomplishments - not for a person with a disability, for anyone.

"While my spinal cord injury took away my ability to walk, it didn't take away my ability to dream. I'm turning my dream into my reality one baby step at a time."

It's a statement that's hard to argue with. From establishing adaptive ski programs all over the world, to being named CO Ski Country Athlete of the Year, to carrying the Olympic Torch, to organizing disabled rafting expeditions, and conducting research in Antarctica, it's all in a day's work for Amanda.

"It's not what happens to you, but how you embrace the changes that take place and who you become."

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NAME: Jason

AGE: 34

DATE OF INJURY:

Refuses to be defined by it

Jason has always lived life on his own terms. After a horrific motorcycle accident left him paralyzed from the chest down and doctors told him he would never walk again, Jason thought otherwise.

"I knew I would walk again - there was never a doubt in my mind, it was just a matter of time."

Despite his condition, Jason is working with us on finding a way to do just that. His involvement in the development of Ekso not only paves the way for others in similar situations to follow suit but silences the skeptics that told Jason he would have to live the rest of his life in a chair.

"I've never given up hope to what most people would call the impossible."

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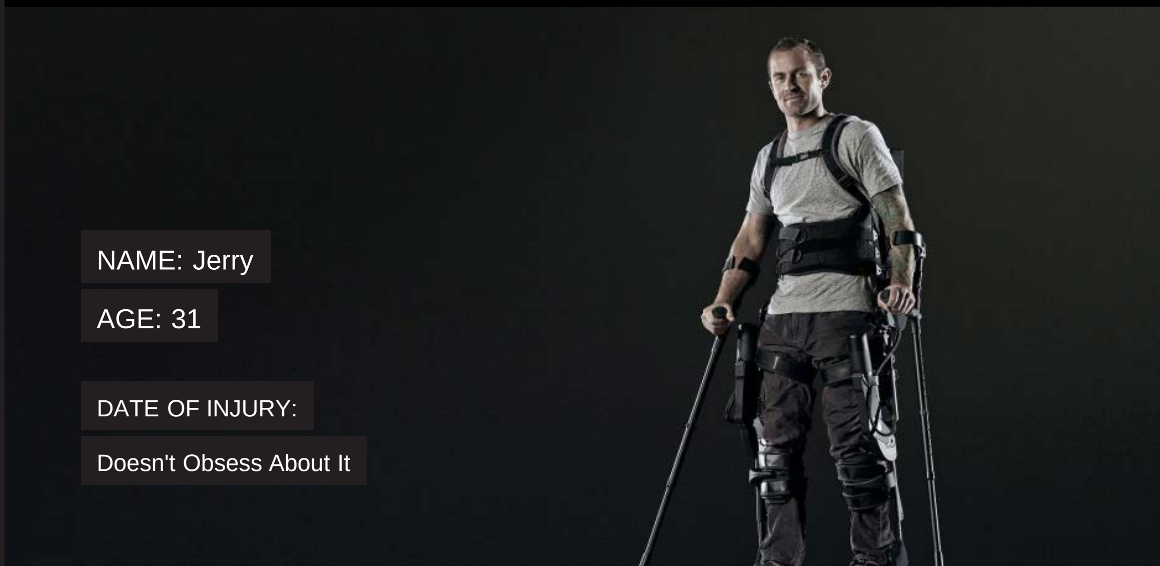

NAME: Jerry

AGE: 31

DATE OF INJURY:

Doesn't Obsess About It

It would've been easy for Jerry to stay angry. Living his dream in San Diego he was surfing everyday, hiking with his dog and enjoying the pride that comes from starting his own business as a general contractor. And then a weekend getaway with his girlfriend turned into six days in the ICU and five weeks in a rehabilitation facility.

Jerry broke his sixth cervical vertebrae and pinched his spinal cord doing something he'd done countless times before - diving into a swimming pool. Jerry's life changed in an instant. What hasn't changed is the way he's chosen to live it.

"After a few months of being sad and feeling sorry for myself, I realized that I was affecting everybody around me in a negative way. So one day I decided to just live my life and be happy and figure out new ways to do the things that I loved to do."

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NAME: Paul

AGE: 37

DATE OF INJURY:

Whatever

Paul aka "Thax" pushes himself. Hard. It got him a gig playing pro hockey and a great job in finance after that. It also got him into snowmobiles. Never one to compromise, Thax followed his passion and ditched the 401k in favor of freestyle snowmobile glory (he also decided to set a world record by jumping his sled 301 feet).

Sadly pushing himself hard also broke Thax's ribs, collapsed his lung and crushed some of his vertebras during a practice session.

While his back may have been broken, his attitude remains unscathed and Thax continues to push his optimism to the extreme.

"My attitude on life has not changed one bit. I am as upbeat as ever. This is just a change we will have to modify a few things for to get back to the normal day to day."

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Unapologetic stubbornness is a trait that gets most people into trouble. But thankfully Sarah's not most people and it's getting her out of it.

"I am literally, without a doubt, the most stubborn and feisty individual on this planet! When people say I can't do something or I should just give up, it's my stubborn will and tenacity that pushes me to keep on going."

True to her word, when doctors told her the independence she cherished so much was going to be a thing of the past after she was hit by a drunk driver on the way to visit her parents, Sarah knew better.

"My doctor had no idea who he was dealing with when he met me! That good old stubbornness of mine kicked into full drive and every day, no matter how down or depressed I was feeling, I refused to let anyone tell me what I couldn't do with my future."

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NAME: Tamara

AGE: 25

DATE OF INJURY:

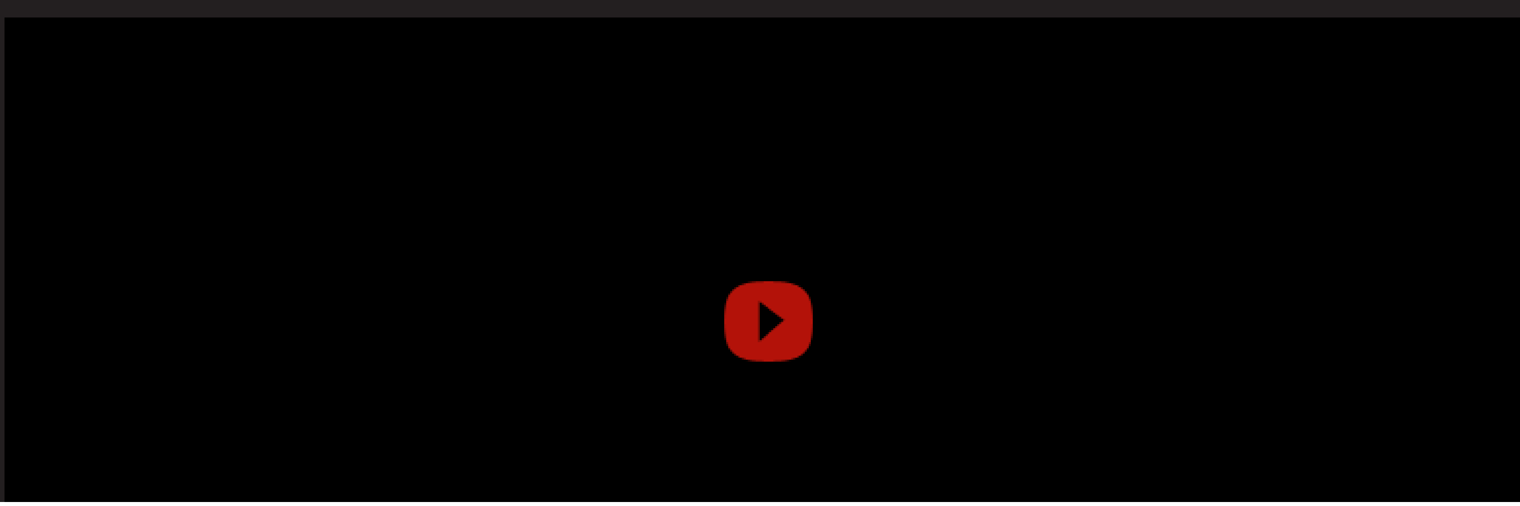
Would rather focus on inspiring people

Tamara is the face of determined optimism. Born and raised in Mexico, Tamara moved to the United States dreaming of the day she would graduate college. When she was paralyzed after the taxi she was in struck a horse, Tamara could have easily given up on that dream. She didn't.

"I was determined to finish what I had started. It was never a matter of if but more so a matter of when."

Tamara graduated with the highest honors and is using her communications degree to inspire and advocate for people living with any type of disability.

"I feel the greater need to leave my mark in this world by helping people become warriors and survivors, not victims. My body was paralyzed but in the process I freed my mind and chose NEVER to give up."



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LEADERSHIP

PROFILE

Nathan Harding

Co-Founder & CEO

Nathan is the co-inventor of the company's core exoskeleton technology. His technical and leadership skills were honed working at the Department of Energy, Carnegie Mellon's Field Robotics Center, Berkeley Process Control, and the Berkeley Robotics and Human Engineering Laboratory. Nathan holds six patents and has another eight pending.

Nathan received his bachelor's degree in Mechanical Engineering and Economics from Carnegie Mellon University in Pittsburgh and his master's in Mechanical Engineering from the University of California, Berkeley.

MANAGEMENT

Nathan Harding

Co-Founder & CEO

Russ Angold

Co-Founder & CTO

Frank Moreman

Chief Operating Officer

Max Scheder-Bieschin

Chief Financial Officer

Karl Gudmundsson

Vice President of Marketing

Andy Hayes

Managing Director EMEA

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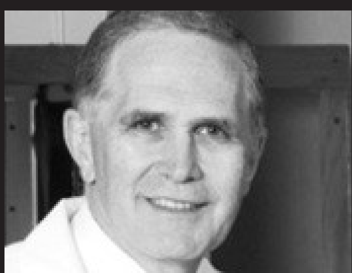

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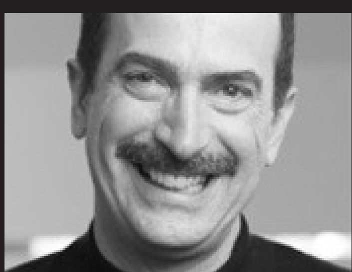
Hans S. Keirstead, Ph.D.



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Daniel Kraft, M.D.

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LEADERSHIP

PROFILE

Russ Angold

Co-Founder & CTO

Russ works closely with the Lockheed Martin Corporation, licensing Ekso technology to further develop the HULC$_{TM}$ exoskeleton for military use. Formerly Vice President of Engineering, Russ provided many of the concepts that shape today's current designs as well as those of the ExoHiker$_{TM}$, ExoClimber$_{TM}$ and HULC$_{TM}$.

Before Ekso Bionics, Russ held various engineering positions at Rain Bird Corporation, Berkeley Process Control and the Irrigation Training and Research Center in San Luis Obispo, California.

Russ has a bachelor's degree in BioResource and Agricultural Engineering from California Polytechnic State University, San Luis Obispo. He is a California registered Professional Mechanical Engineer and has two granted patents and another seven pending.

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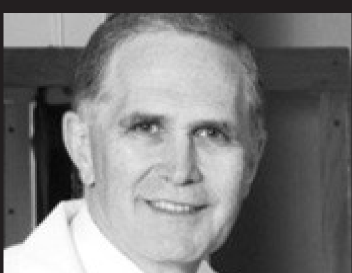

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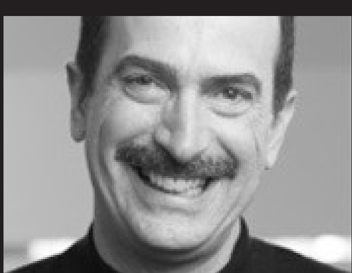

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LEADERSHIP

PROFILE

Frank Moreman

Chief Operating Officer

Frank has fifteen years of leadership experience in the semiconductor, aerospace, medical device and telecommunications industries.

Prior to joining Ekso Bionics in 2011, he held several senior executive positions, including COO of Sieger Engineering and Head of the Semiconductor and Industrial Division of Sanmina-SCI. Frank also led several companies to increased sales and improved operations by a keen focus on the customer experience from the first sales contact to the after sales technical support.

Frank has a degree in Mechanical Engineering from the United States Naval Academy.

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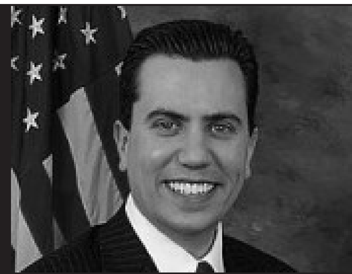

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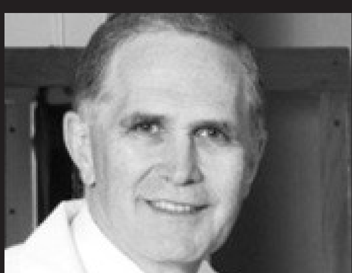

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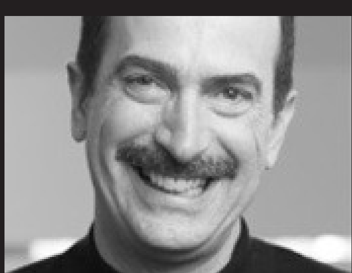

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LEADERSHIP

PROFILE

Max Scheder-Bieschin

Chief Financial Officer

Max is the ideal CFO, having served as a managing director of Deutsche Bank in Frankfurt, Germany and of ING BHF Bank in Frankfurt and New York. He was also a principal at Fredericks Michael & Co. in New York.

Prior to joining Ekso Bionics, Max was involved in early stage electric vehicle manufacturing. He founded and served as CEO of Barefoot Motors and was president of ZAP.

Max received his bachelor's degree in Economics from Stanford University and attended the Master's of Accounting program at NYU.

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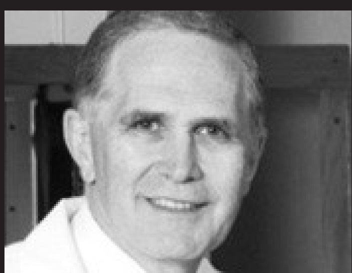

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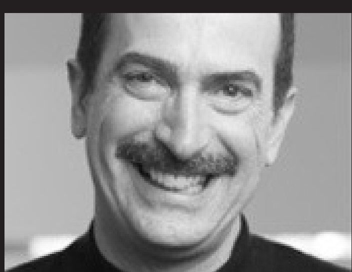

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Karl Gudmundsson

Vice President of Marketing

Besides his background in physical therapy, Karl brings over a decade of internationally marketing medical devices to Ekso Bionics. Prior to Ekso, Karl worked with industry leading prosthetic and orthopedic manufactures Ossur and Biomet.

Karl has a bachelor's degree in Physical Therapy from the University of Iceland and an MBA from the Rady School of Management at UCSD.

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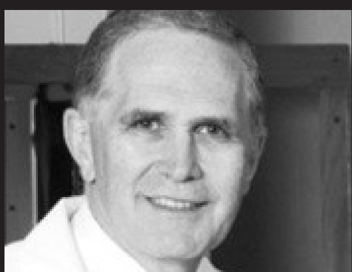

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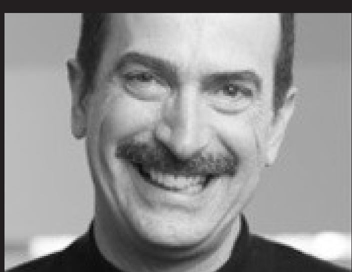

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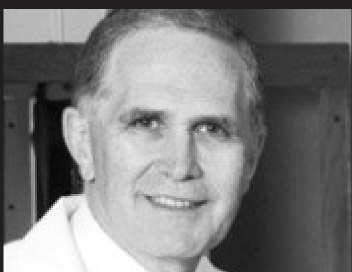

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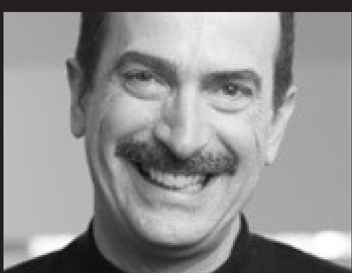

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Scott Banister

Scott has built his career by identifying new markets and shaping innovative products for them. In 1995, he identified search engines as a significant advertising medium and invented the first products to automate marketing across multiple search engines, ultimately creating the bid-for-placement business model used by GoTo/Overture (and now Google AdWords) and serving as VP Ideas at GoTo-incubator Idealab. As an initial investor and Director at PayPal, he was a co-inventor of the 'email payments' product now widely used on eBay. In 2000, Scott saw opportunity in the unbounded growth of email traffic, co-founding IronPort Systems and serving as CTO. Scott's other private equity investments include Zappos, LiveOps, Facebook, Slide, and Causes.com.

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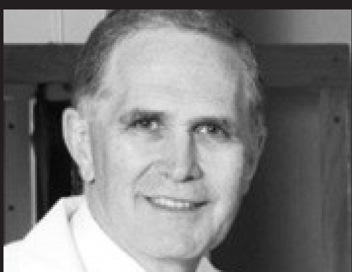

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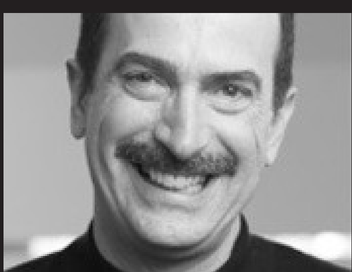

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Michael Fawkes

Michael Fawkes has had an extensive career with Hewlett Packard, serving in numerous senior financial and operational roles from 1979-2007. Most recently, Mike was Senior Vice President, heading up Global Operations for HP's $29 billion Imaging & Printing Group (IPG). His duties also included ownership for HP's worldwide Supply Chain, Logistics, Consumer Support, and Environmental Organizations. Previous positions included Vice President of IPG's Supply Chain Operations, Vice President of Worldwide Operations for HP's Consumer Business Organization, and Vice President of HP's EMEA Inkjet Printing Business, located in Barcelona, Spain.

Mike currently serves as an Independent Director for Saba Software, a NASDAQ listed company. At SABA, Mike serves as the Chairman of the Governance Committee and also serves on the Audit Committee. He has previously served on the boards of several companies, including Klipsch Audio, Tesla Motors, Switch Lighting and Cornice.

Mike is a Certified Public Accountant and holds a bachelor's degree in accounting and a master's degree in finance from the University of Iowa.

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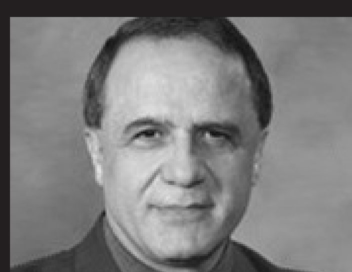

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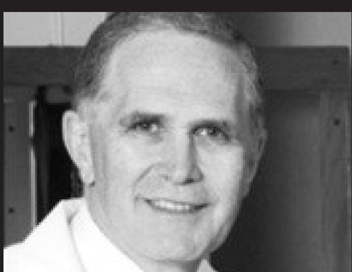

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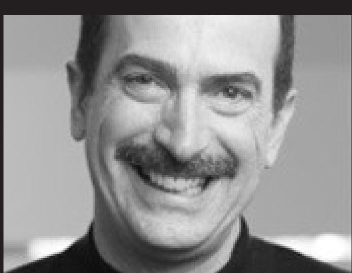

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Marilyn Hamilton

Marilyn has a career full of diverse experiences ranging from teaching high school, to sports champion, business and non-profit entrepreneur, speaker, consultant and director on boards. Marilyn, and two fellow glider pilots, started a company designing customized ultra-lightweight wheelchairs. The Quickie was born, and instantly revolutionized the mobility industry. After selling Quickie to Sunrise Medical, she stayed on as a Global VP for Sunrise Medical in various roles until 2007. She immediately launched Envision, a professional speaking and business consulting company and in 2009 StimDesigns LLC, an early stage Neurotechnology company. In the non-profit world Marilyn founded: Winners on Wheels – a coed-scouting program for children in wheelchairs; co-founded Discovery Through Design – raising awareness and funds for spinal cord injury research and paralyzed women's health; and served as a founding board member and currently serves as emeritus board member of The California Endowment – charged with advancing the healthcare of underserved populations in California. Marilyn is currently an advisory board member of the Eunice Kennedy Shriver National Institute of Child Health and Human Development at the National Institute of Health; a member of the Committee of 200 Women Business Leaders; Cody Unser First Steps Foundation; Randy Snow Push Forward Foundation; and Activities4All Foundation.

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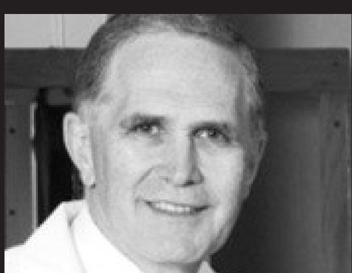

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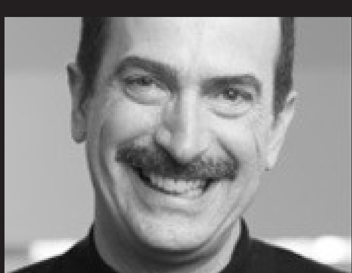

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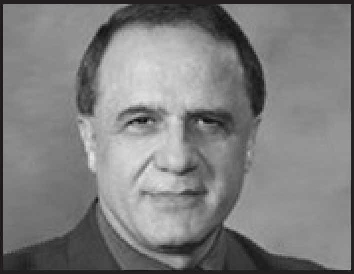

Amal Moorad, M.D.

Dr. Moorad has twenty five years of experience as a physician specializing in Physical Medicine, Occupational Medicine, and Internal Medicine. He is Medical Director for INTEGRIS Jim Thorpe Acute Rehabilitation and Outpatient Services and board member for a number of organizations, including the INTEGRIS Center for Mind, Body and Spirit which seeks, not only to address the physical dimensions of health and illness, but the mental, emotional, social and spiritual dimensions as well. Dr. Moorad was also previously Vice Chair of the American Medical Rehabilitation Providers Association; a trade organization who's focus is on collective advocacy -- working to advance the field of medical rehabilitation and to support the medical rehabilitation needs of persons with disabilities.

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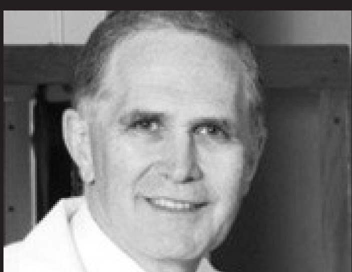

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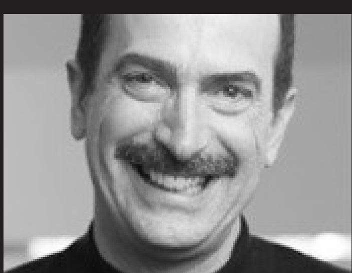

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Jack Peurach

Jack is SunPower's executive vice president of research and development, where he is responsible for all aspects of SunPower's PV cell, module, and systems research and product development. Prior to this role, Jack led the research and development efforts of PV Systems, PV Modules, and the Advanced Product Development groups. Prior to SunPower's acquisition of PowerLight, Jack was PowerLight's vice president of product development, where he drove systems product strategy and development for product execution and management, and built a pipeline for a number of new products. Earlier in his career, Jack was a strategy consultant for Mercer Management Consulting and director of engineering at Berkeley Process Control, Inc. He holds a Bachelor of Science degree in mechanical engineering from Michigan State University, a Master of Science degree in mechanical engineering from the University of California, Berkeley, and a Master of Business administration, finance and entrepreneurship from the Wharton School, University of Pennsylvania.

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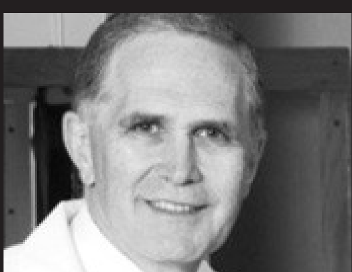

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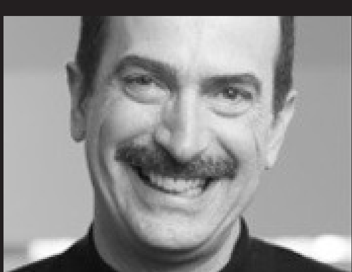

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Dan Boren

Dan Boren currently serves as President of Corporate Development for the Chickasaw Nation. In his role he works with existing businesses within the Nation's portfolio as well as engaging in economic diversification for the Nation.

Dan has also served on the Oklahoma House of Representatives and as Caucus Chairman; the first freshman state lawmaker to ever receive this honor. In 2004, Dan was elected to the U.S. House of Representatives from Oklahoma's 2nd Congressional District. He served on the House Resources Committee, and as the Ranking Member of the Subcommittee on Indian and Alaska Native Affairs. He also served as a member of the Financial Services and Armed Services Committees. Dan was appointed by the Speaker of the House to the House Select Committee on Intelligence which conducts Congressional oversight of the entire Intelligence Community.

Dan continues his dedication to service with roles on several boards, including the Jasmine Moran Children's Museum, the National Rifle Association, FATE (Fighting Addiction Through Education), the Joe Foss Institute, Seminole State College Educational Foundation and the Children's Hospital Foundation.

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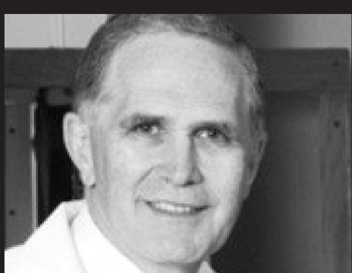

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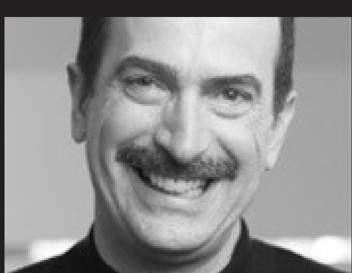

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Kel Bergmann, CPO

Certified Prosthetist/Orthotist and Managing Principal of SCOPe Treasurer for the California Orthotics and Prosthetics Association (COPA)

Kel Bergmann serves on the Board of Directors for AOPA, DAC, COPA and is on the DMERC Advisory Committee. As part of his commitment to education he co-authored "Spinal Orthoses in the Management of Spinal Trauma" which as appeared in both Spine by Rothman & Simeone and Spine Trauma by Levine, Eismont, Garfin & Zigler. Kel specializes in adult rehabilitation though he has had great success working with all populations.

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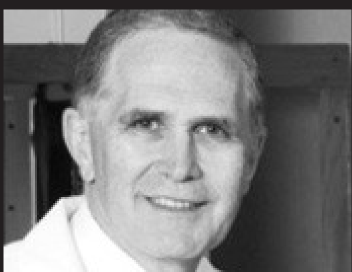

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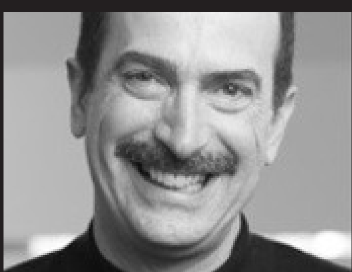

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PROFILE

Nancy Byl, PT, PhD, FAPTA

Professor and Chair Emeritus, University of California, San Francisco, Department of Physical Therapy and Rehabilitation Science
Co-director of the Graduate Programs in Physical Therapy
Administrative director of the Peter Ostwald Health Program for Performing Artists

Nancy has received a number of prestigious honors and is a member of several professional societies, such as the American Physical Therapy Association, American Public Health Association, American Hand Society and the International Association of Pain.

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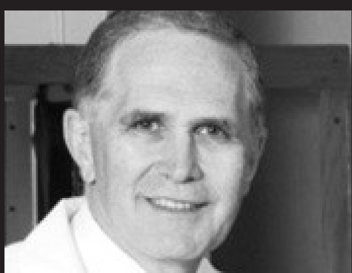

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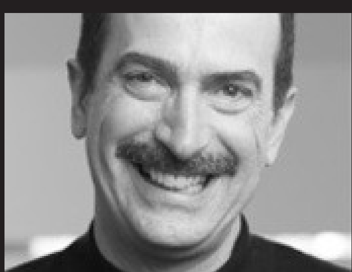

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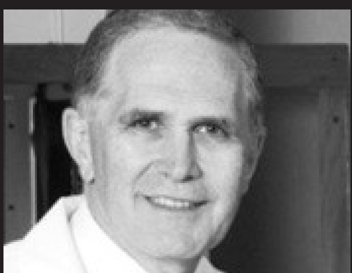

Graham Creasey, M.D.

Chief, Spinal Cord Injury Service, VA Palo Alto Medical Center
Professor of Spinal Cord Medicine at Stanford University

Dr. Creasey trained in trauma surgery and has specialized in spinal cord injuries since 1980. His interests are in restoring function after paralysis using bioengineering and biotechnology.

He led a multi-center clinical trial of an implanted pacemaker for restoring bladder, bowel and sexual function after spinal cord injury, resulting in FDA approval of the device. He is Medical Director of the Stanford Partnership for Spinal Cord Injury and Repair.

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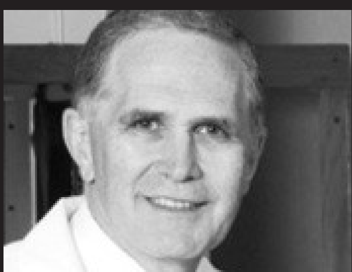

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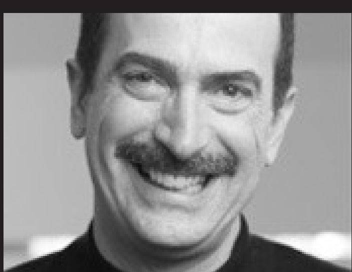

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Hans S. Keirstead, Ph.D.

Professor of Anatomy and Neurobiology, Founder of the Sue and Bill Gross Stem Cell Research Center Reeve-Irvine Research Center, University of California, Irvine Vice Chancellor of Academic Development at UDECOM (University of Community Development, in French) situated in Guinea, Africa. He is also Chairman of California Stemcell.

In 2004, Hans Keirstead led his team of researchers at UC Irvine to successfully develop a human embryonic stem cell derived treatment for acute spinal cord injuries in rats. That treatment was recently approved by the FDA for clinical trials in humans with acute spinal cord injuries. The trial, which will be carried out by Geron Corporation, marks the first human embryonic stem cell trial ever approved in the U.S. Dr. Keirstead was awarded the Distinguished Assistant Professor of UCI Award. He is also the recipient of the UCI Innovation Award for innovative research leading to corporate and clinical development.

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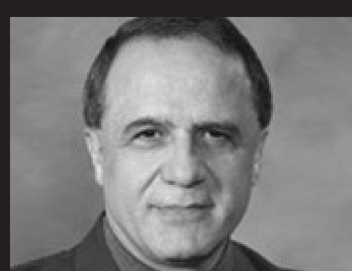

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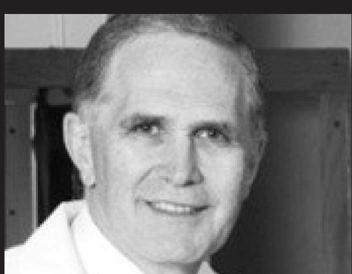

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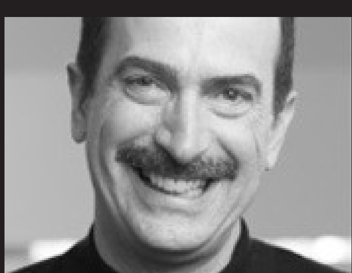

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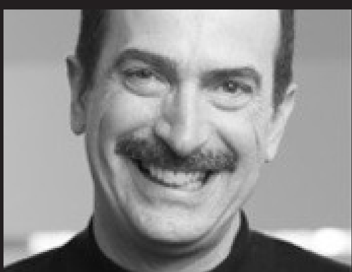

Tom Kelley

General Manager, IDEO

Tom Kelley is IDEO's general manager. IDEO is an award-winning global design firm that takes a human-centered design-based approach to help organizations innovate and grow. With his brother, IDEO founder and chairman David Kelley, Tom helped manage the firm as it grew from 20 designers to a staff of more than 500 people. Tom shares IDEO's philosophy and methodology with the world through speaking engagements and two best-selling books, The Art of Innovation (2001) and *The Ten Faces of Innovation (2005)*.

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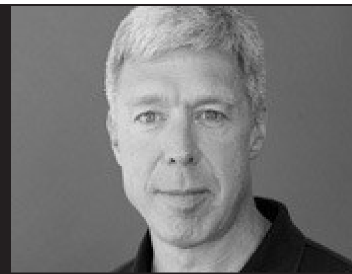

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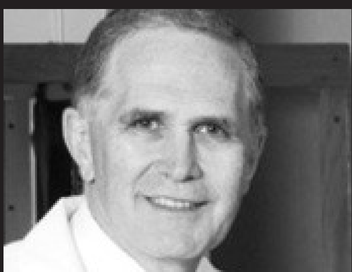
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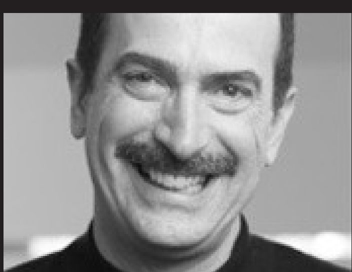
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PROFILE

Suzy Kim, M.D.

Assistant Clinical Professor, Depts. Orthopedic Surgery and PM&R
Medical Director, Acute Spinal Cord Injury Program, UC Irvine Medical Center, Scientific Liaison, Reeve-Irvine Research Center

After receiving a Bachelor of Arts in Psychology from the University of California, Berkeley, Dr. Kim received her medical degree from University of Southern California. She then completed her residency training at the top ranked Rehabilitation Institute of Chicago. As a board certified physician in Physical Medicine & Rehabilitation and one of 500 U.S. physicians with subspecialty board certification in Spinal Cord Injury (SCI) Medicine, Dr. Kim has been invited to give expert presentations at national conferences and international symposiums for SCI, while recognized with numerous awards for training resident physicians. As the lead investigator, Dr. Kim's research interests focus on exercise-based rehabilitation involving core strengthening and developing outcome measures in neuroplasticity for future clinical trials. She remains active in the SCI community as an Ambassador for the Christopher and Dana Reeve Foundation for minority community outreach programs and as an Advisory Board member for the Challenged Athletes Foundation's mentoring program. Combining her own athletic interests as an adaptive surfer and tri-athlete, Dr. Kim will serve as the Team Physician for the 2011 U.S. Paralympics Track & Field team.

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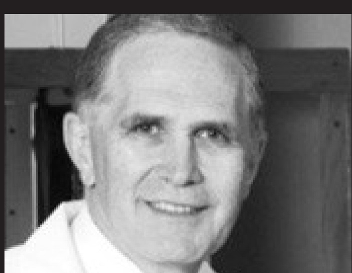

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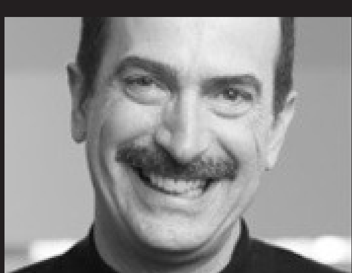

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Daniel Kraft, M.D.

Daniel Kraft, M.D. is an NIH funded faculty member affiliated with Stanford. He was on clinical faculty with the UCSF pediatric bone marrow transplantation service and serves as the medicine track chair for Singularity University where he is also executive director for the FutureMed executive program.

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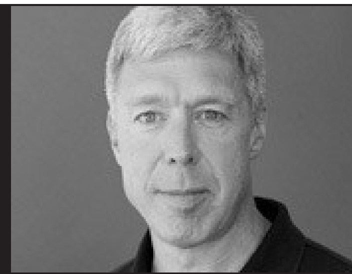

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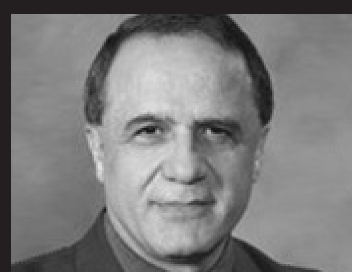

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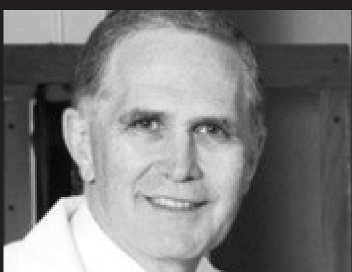

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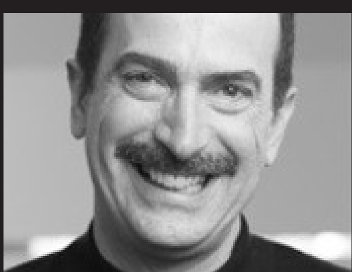

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Sherri L. Medina

Sherri L. Medina served as the President and Chief Executive Officer of CareMeridian LLC. She was named 1994 "Entrepreneur of the Year" in healthcare in Orange County (California) and received a "Women in Business Award" from the Orange County Business Journal in 1996.

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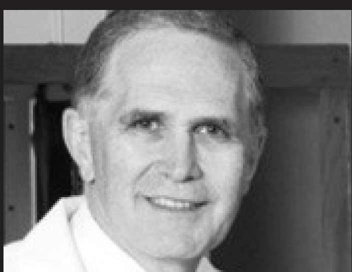

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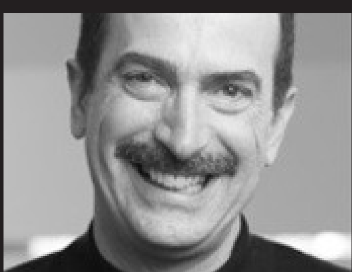

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Akshat Shah, M.D.

Chief of Spinal Cord & Orthopedic Rehabilitation, Santa Clara Valley Medical Center, Assistant Clinical Professor (Affiliated), Department of Orthopaedics, Stanford University School of Medicine Associate Residency Director (SCVMC), Physical Medicine and Rehabilitation, Stanford University School of Medicine

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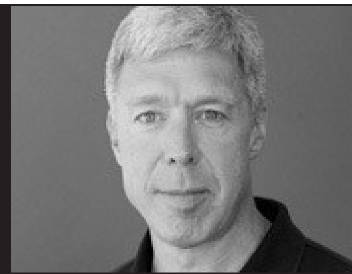

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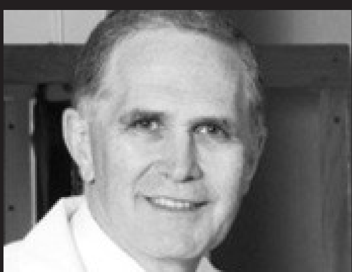

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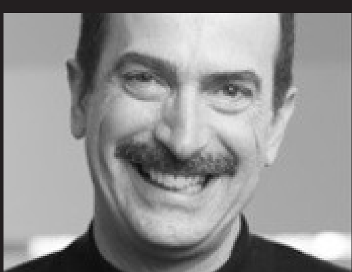

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First mind-controlled bionic leg a 'groundbreaking' advance

Barbara Mantel, NBC News

4 hours ago

Video: Zac Vawter lost his leg in a motorbike accident. He is now part of a ground breaking research study testing a thought controlled bionic leg.

After losing his lower right leg in a motorcycle accident four-and-a-half years ago, 32-year-old Zac Vawter has been fitted with an artificial limb that uses neurosignals from his upper leg muscles to control the prosthetic knee and ankle. The motorized limb is the first thought-controlled bionic leg, scientists at the Rehabilitation Institute of Chicago reported Wednesday in The New England Journal of Medicine.

"This is a groundbreaking development," says lead author Levi Hargrove, a biomedical engineer and research scientist at RIC. "It allows people to seamlessly transition between walking along level ground and going up and down stairs and slopes."

Until now, only thought-controlled bionic arms have been available to amputees.

When Vawter thinks he wants to move his leg, the brain signal travels down his spinal chord and through

Brian Kersey / AP

On Oct. 25, 2012 Zac Vawter, fitted with an experimental "bionic" leg, climbed the 103 flights to the top of Willis Tower in Chicago.

peripheral nerves and is picked up by electrodes in the bionic leg. Unlike robotic models currently on the market, the prosthesis allows a normal, smooth gait no matter the incline. Although the cost hasn't been determined, a version could be available to the more than one million Americans with leg amputations within three to five years, the Chicago scientists said.

“It makes a phenomenal difference,” says Vawter, a software engineer from Yelm, Wash., whose right leg was amputated through the knee in 2009 after he crashed his motorcycle. Aware of the institute's work on bionic arms, Vawter and his surgeon contacted Hargrove and the team developing the pioneering prosthesis. For nearly three years ending in October, 2012, Vawter would travel to the institute periodically.

Vawter would remove his mechanical leg, slip into the bionic one, and run through a set of experiments the scientists devised, suggesting improvements and providing feedback on what was working and what was not.

Now, after multiple revisions to the leg’s software and two major revisions to the leg’s mechanics, Vawter says he can walk up and down stairs the way he did before the accident. With his mechanical leg, Vawter says, “My sound leg goes up every step first, and I’m just dragging the prosthetic leg along behind me.” But with the bionic leg, “I go leg over leg,” he says. “The bionic leg listens to the various signals from my nerves and responds in a much more natural way.”

Some current prosthetic legs are purely mechanical, like Vawter’s; others are robotic and have a motor, a computer, and mechanical sensors that detect how much weight is being put on the prosthesis and the position of the knee. These allow people to walk well but don’t allow people to seamlessly ascend or descend stairs with a normal gait or to reposition their leg while sitting without manually moving it. The thought-controlled bionic leg is much more sophisticated. In additional to mechanical sensors, it has two motors, complex software, and a set of electrodes - essentially antennae - in its socket that pick up the tiny electrical signals that muscles in the upper leg generate when they contract.

Two electrodes pick up signals from the hamstring muscle, where the nerves that had run through Vawter’s lower leg were redirected during the amputation. “So when Zac is thinking about moving his ankle, his hamstring contracts,” says Hargrove.

NBC News

With the bionic leg, “I go leg over leg,” says Vawter. “The bionic leg listens to the various signals from my nerves and responds in a much more natural way.”

More electrodes pick up signals from other muscles in the residual limb. The complex pattern recognition software contained in the on-board computer interprets these electrical signals from the upper leg as well as mechanical signals from the bionic leg and “figures out what Zac is trying to do,” says Hargrove.

The U.S. Army’s Telemedicine and Advanced Technology Research Center funded the Chicago study with an $8 million grant to add neural information to the control systems of advanced robotic leg prostheses. Devising a thought-controlled bionic leg has been more challenging than a thought-controlled bionic arm, says Hargrove.

That's because the motors must be powerful enough to provide the energy to allow someone to stand and push along -- and they must be small. Also, the computer control system must be safe.

“If there is a mistake or error that could cause someone to fall, that could be potentially catastrophic, and we want to avoid that at all costs,” says Hargrove.

The leg is a prototype so Vawter cannot take it home. Error rates in the software are small but need to be made smaller, says Hargrove and the leg itself needs to be made quieter and lighter. In addition, prolonged use can produce chafing where the residual limb contacts the electrodes in the bionic leg’s socket.

The ultimate cost of the final product is unknown, says Hargrove, although upper extremity prostheses range from $20,000 to $120,000. "We are leveraging developments in related industries to make sure we use low-cost components whenever possible," Hargrove told NBC News.

Careful engineering will make it affordable. His goal is to restore “full ability” to all patients, especially the elderly. “This could mean the difference between living in their home longer and having to go to a nursing home,” says Hargrove.

Men's Health Health

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The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Robotic Leg Control with EMG Decoding in an Amputee with Nerve Transfers

Levi J. Hargrove, Ph.D., Ann M. Simon, Ph.D., Aaron J. Young, M.S., Robert D. Lipschutz, C.P., Suzanne B. Finucane, M.S., Douglas G. Smith, M.D., and Todd A. Kuiken, M.D., Ph.D.

N Engl J Med 2013; 369:1237-1242 | September 26, 2013 | DOI: 10.1056/NEJMoa1300126

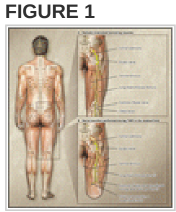
The clinical application of robotic technology to powered prosthetic knees and ankles is limited by the lack of a robust control strategy. We found that the use of electromyographic (EMG) signals from natively innervated and surgically reinnervated residual thigh muscles in a patient who had undergone knee amputation improved control of a robotic leg prosthesis. EMG signals were decoded with a pattern-recognition algorithm and combined with data from sensors on the prosthesis to interpret the patient's intended movements. This provided robust and intuitive control of ambulation — with seamless transitions between walking on level ground, stairs, and ramps — and of the ability to reposition the leg while the patient was seated.

MEDIA IN THIS ARTICLE

Video

Control of Robotic Prosthesis.

FIGURE 1



Natively Innervated and Surgically Reinnervated Residual Thigh Muscles.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

This article was updated on September 26, 2013, at NEJM.org.

We thank the electronics team at the Center for Bionic Medicine, Rehabilitation Institute of Chicago, for technical support.

SOURCE INFORMATION

From the Center for Bionic Medicine, Rehabilitation Institute of Chicago (L.J.H., A.M.S., A.J.Y., R.D.L., S.B.F., T.A.K.), and the Department of Physical Medicine and Rehabilitation, Northwestern University (L.J.H., A.M.S., R.D.L., T.A.K.), Chicago, and the Department of Biomedical Engineering, Northwestern University, Evanston (A.J.Y., T.A.K.) — all in Illinois; and the Department of Orthopaedic Surgery, University of Washington, Seattle (D.G.S.).

Address reprint requests to Dr. Hargrove at the Center for Bionic Medicine, Rehabilitation Institute of Chicago, 345 E. Superior St., Rm. 1309, Chicago, IL 60611, or at l-hargrove@northwestern.edu.

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InnovationNewsDaily Staff

First video taken with Google Glasses shared

Google
Screen grab from video taken with Google Glasses.

Google has publicly unveiled new photos and the first video from the real view of their augmented reality glasses prototype. The images show what the wearer sees while reading a newspaper, catching a football in the backyard and helping a smiling child play on the jungle gym.

Such views don't necessarily represent anything people haven't seen before with head-mounted portable cameras. But they do hint at how Google Glasses could enable many people beyond geeky life-casters to capture a diverse array of moments in their lives — the video shows the bouncy viewpoint of the Google Glasses wearer doing flips on a trampoline.

Google
One of the still photos taken with Google Glasses.

Google tech lead Max Braun showed off the photos and video at the Google + Photographer's Conference on May 23.

The Internet search giant has yet to show off real images or photos of how the glasses could seamlessly integrate virtual information with what a person sees in the real world. Its earlier unveiling of "Project Glass" included a concept video that imagined a wearer getting social calendar reminders and map directions in his field of view.

Still, many members of the public still seem enthusiastic about just having a pair of glasses with a small camera attached. One of the top comments on the YouTube video of the trampoline jumping simply stated "Shut up and take my money!"

The most popular comment of all had a perhaps tongue-in-cheek suggestion for using the Google Glasses — "Good for POV [point-of-view] porn."

Google Glasses video, presented at Google+ Photography Conference.

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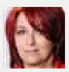

Helen A.S. Popkin

Will Google glasses make you more annoying than sidewalk texters?

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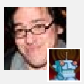
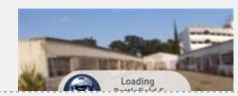


Matthew Hawkins via Ingame

What gaming with Google Glasses might look like



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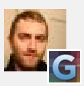

Devin Coldewey via Gadgetbox

Google Glass gets demonstrated on camera in interview

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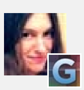

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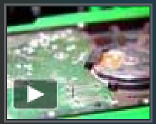

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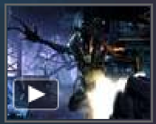

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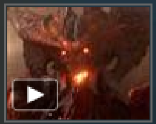

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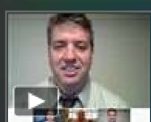

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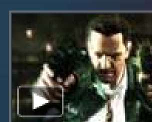

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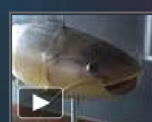

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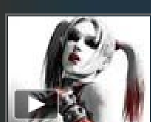

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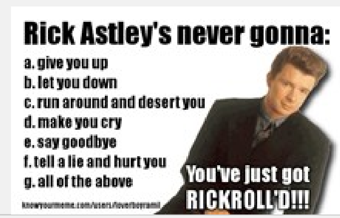

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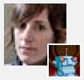

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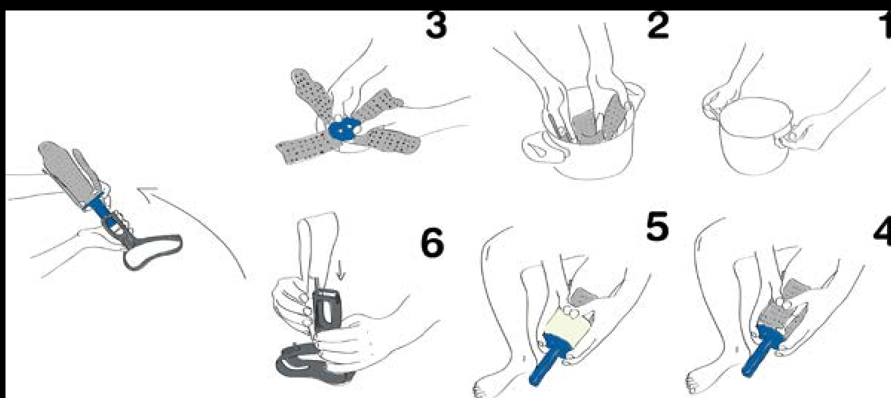
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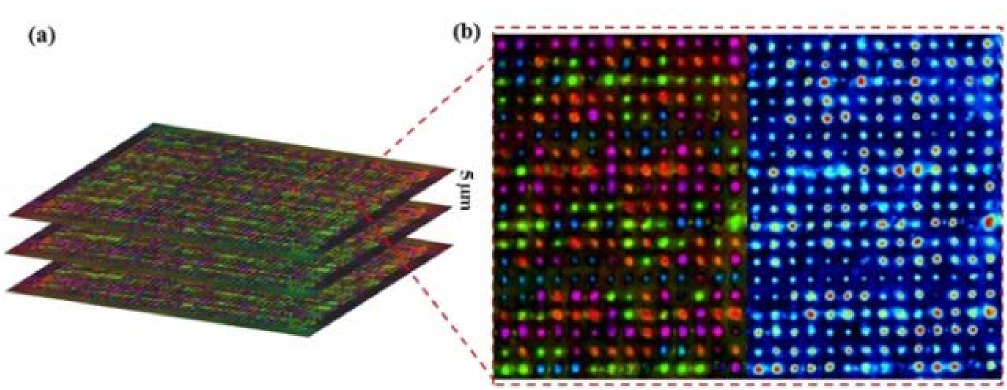
Five-dimensional glass memory can store 360TB per disc, rugged enough to outlive the human race

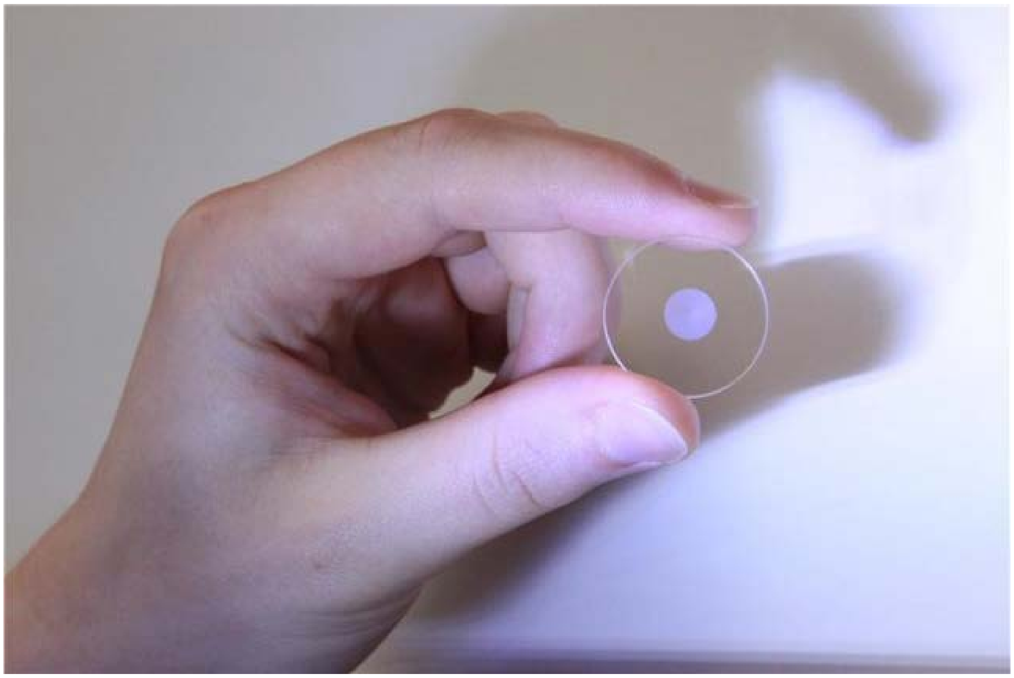
By Sebastian Anthony on July 10, 2013 at 10:57 am | 28 Comments



Scientists at the University of Southampton in the UK have succeeded in creating five-dimensional (5D), ultra-high-density storage on standard silica glass discs that, unlike DVDs or Blu-rays, seem to be capable of storing data for an unlimited period of time without a reduction in data integrity. The scientists say that 5D optical storage could allow for densities as high as 360 terabytes per disc, and unless you crush it in a vice, these discs are so non-volatile that data stored on them should “survive the human race.”

At first glance, five-dimensional storage might sound a bit like pseudoscience — but, in this case, the data really is stored on five different dimensions (surfaces, planes). There are the usual two dimensions (width, height) provided by a piece of silica glass, and depth is provided by writing at three different depths (layers) within the glass. The fourth and fifth dimensions are provided by nanostructuring the surface of the glass, so that it refracts and polarizes light in interesting ways.

To record data, spots are imprinted on the glass (pictured below) using a femtosecond laser. A femtosecond laser, in this case, produces bursts of laser light that last for just 280 femtoseconds (280 quadrillionths of a second). These spots, thanks to the nanostructuring of the surface, and some hologram cleverness, are capable of recording up to three bits of data in two "dimensions." By varying the focus of the laser, the team are able to create layers of dots that are separated by five micrometers (0.005mm) in the z-axis (the third dimension). Then, by simply moving the laser horizontally and vertically, these tri-bits can be stored in two more dimensions, bringing the total to *5D*. The image at the top of the story helps illustrate this concept.



To read these spots, an optical microscope that's capable of untangling the polarized light reflected by the three-bit spots is used. There's no word on whether these silica glass discs can be rewritten, but the research paper [PDF] makes it sound like this is a write-once-read-many (WORM) storage method.

As you can imagine, storing a tri-bit in a single dot, and then storing these dots in a three-dimensional medium, allows for utterly insane storage densities. The researchers say that 360 terabytes could be stored on a single 5D disc — by comparison, quad-layer Blu-ray discs that store just a single bit per pit have a total capacity of 128 *gigabytes*, or almost 3,000 times less. The best hard drive technology, heat-assisted magnetic recording (HAMR), which will soon make its way into commercial drives, will max out at around 20 terabytes per disc.

Furthermore, the scientists report that their glass discs are thermally stable at temperatures up to 1000 degrees Celsius, and the imprinted spots don't seem to degrade over time. This led Peter Kazansky, the group's supervisor, to pipe up with this particularly memorable/questionable soundbite: "It is thrilling to think that we have created the first document which will likely survive the human race. This technology can secure the last evidence of civilisation: all we've learnt will not be forgotten."

Moving forward, the University of Southampton is now looking for industry partners to commercialize this technology. Obvious applications include archival storage, where the management of huge repositories of tapes and hard drives is expensive, complex, and time-consuming business. Eventually, assuming the complex laser/microscope setup can be miniaturized, these discs might offer an upgrade path from DVDs and Blu-rays.

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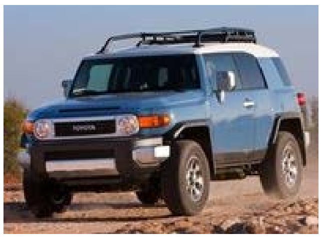

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Fertile Green: Green Facilitates Creative Performance

Personality and Social
Psychology Bulletin
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Stephanie Lichtenfeld[1], Andrew J. Elliot[1,2], Markus A. Maier[1], and Reinhard Pekrun[1]

Abstract

The present research sought to extend the nascent literature on color and psychological functioning by examining whether perception of the color *green* facilitates creativity. In four experiments, we demonstrated that a brief glimpse of green prior to a creativity task enhances creative performance. This green effect was observed using both achromatic (white, gray) and chromatic (red, blue) contrast colors that were carefully matched on nonhue properties, and using both picture-based and word-based assessments of creativity. Participants were not aware of the purpose of the experiment, and null effects were obtained on participants' self-reported mood and positive activation. These findings indicate that green has implications beyond aesthetics and suggest the need for sustained empirical work on the functional meaning of green.

Keywords

green, creativity, performance, color, hue

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Color is a ubiquitous stimulus in our perceptional world. Given this ubiquity, one might anticipate that a large body of systematic research would be present on the influence of color perception on affect, cognition, and behavior. Surprisingly, research on color effects is sparse, especially relative to empirical work on color physics and color physiology (Fehrman & Fehrman, 2004; Whitfield & Wiltshire, 1990). More surprising still is that until quite recently, the research conducted in this area has lacked conceptual depth (e.g., being atheoretical or based on broad statements regarding wavelength and arousal) and methodological rigor (e.g., failing to control for lightness and chroma in testing the influence of hue; see Elliot & Maier, 2007; Valdez & Mehrabian, 1994).

In the past few years, however, there has been a surge of research activity on the influence of color, specifically hue, on psychological functioning, and this work has attended to the aforementioned weaknesses. That is, recent research has begun to offer precise conceptual statements linking color to meaning and associated affect, cognition, and behavior, and has used carefully controlled experimental designs and materials. A few studies have examined color preferences (Franklin, Bevis, Ling, & Hurlbert, 2010; Hurlbert & Ling, 2007; Maier, Barchfeld, Elliot, & Pekrun, 2009), focusing on a variety of different color stimuli. Other research has shown that color can function as a meaning-laden prime in certain contexts, influencing perceivers' motivation and action without awareness. This research has focused on the color red, using other colors such as white, gray, blue, and green as achromatic or chromatic controls. For example, red has been shown to carry the meaning of sex and romance in heterosexual person perception, leading men and women to view members of the opposite sex as more attractive and sexually desirable (Elliot et al., 2010; Elliot & Niesta, 2008; Niesta Kayser, Elliot, & Feltman, 2010). A pressing question, at present, is whether color effects of this nature are restricted to red or whether other hues also have implications for psychological functioning.

In the present research, we focus on the color green and examine its influence on creativity. Our central hypothesis is that perceiving green prior to a creativity task fosters creative performance, and we put this hypothesis to test in a series of four experiments. Our hypothesis is grounded in a broad analysis of the meaning of green.

The Meaning of Green

Green is an additive primary color with strong associations across time and culture. In English, and many other languages

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across the globe, the etymological root of green is "grow," especially "tangibly growing things" ("Green"; *Oxford English Dictionary*, 1989; Hutchings, 2004). Scholars believe that this widespread linguistic connection between green and grow emerged from the universal experience of observing the green of grass, herbs, and fresh vegetation that grows out of the ground (Wierzbicka, 1990).

Historically, green has been used to symbolize concepts closely related to growth, such as fertility, life, and hope. In ancient Egypt, Greece, Rome, and India, green was the color of several god figures representing vegetation, fertility, and rebirth (Chamberlin, 1968; Matthews, 2001), and green emerged in each of the major monotheistic religions as a symbol of life, hope, and resurrection (Allen, 1936; Mahnke, 1996; Jacobs & Jacobs, 1958). In northern and central Europe, green gowns were commonly worn in pagan ceremonies and festivals during springtime to convey the coming renewal and emergence of life (Chamberlin, 1968; Peterson & Cullen, 2000). Likewise, until the Middle Ages, for women in Europe, Anatolia, India, and many other areas of the world, green was commonly used as the color of wedding dresses and adornments (e.g., belts, ribbons) to symbolize the hope of fertility (Becker, 2000; Wasserfall, 1999). In the art, literature, and folklore of the Middle Ages, green was linked to characters representing life, fertility, and renewal (Basford, 1978; Cameron, 1936; Gage, 1999). In contemporary times, many languages link green to vegetation and the environment. A "green thumb," for instance, is an excellent gardener, "going green" means becoming more environmentally aware, and "greener pastures" are (perceived as) a new and better place.

Quality empirical research on green associations is sparse. A few studies have presented participants with color words and/or adjectives and had participants provide free associations. In these studies, green has been linked to nature, restfulness, peace, and positive evaluation (Adams & Osgood, 1973; Clarke & Costall, 2008; Grieve, 1991). Studies that have presented participants with color samples and had participants provide free associations have invariably been flawed, due to a failure to properly control for lightness and chroma in examining associations to hue. This methodological problem renders this work uninterpretable (see D'Andrade & Egan, 1974; Valdez & Mehrabian, 1994). Moller, Elliot, and Maier (2009) used a reaction time methodology to examine implicit links between red, competence-relevant words, and general positive and negative words, with green serving as a control color. The lightness and chroma properties of color were held constant; only hue was allowed to vary. The data linked green to success-relevant, but not general positive, words. Elliot, Feltman, and Maier (2011) used this same reaction time methodology and rigorous control of nonhue color properties but focused on green per se and its associations with growth-relevant words, both concrete (e.g., sprout, bud) and abstract (e.g., flourish, develop). The data revealed an implicit link between green and both types of growth-relevant words, indicating that green is associated with psychological growth and mastery, as well as physical growth.

It is possible that the historical uses and current associations with green are entirely due to societal learning. However, it is also possible that the link between green, growth, and associated concepts is grounded, in part, in our biological heritage. Specifically, for our early ancestors living on the Savanna, a distant patch of green would represent fresh vegetation and, implicitly, a water source. Those who oriented and engaged in approach behavior toward green would have had greater access to the nutrition and sustenance needed for survival, and would thus have been more likely to procreate (for related arguments regarding natural landscapes in general, see Hartmann & Apaolaza-Ibáñez, 2010; Orians & Heerwagen, 1992; Ulrich, 1993). As such, selection processes may have set in place a predisposition to perceive green as an appetitive signal of growth.

Of course, societal and biological accounts of the green-growth link need not be mutually exclusive but may operate in a joint fashion (for similar reasoning regarding *red*, see Elliot, Maier, Moller, Friedman, & Meinhardt, 2007). That is, the societal uses of green may not be random but may derive from a biologically based predisposition to perceive green as a signal of growth. These societal uses of green may not only reinforce a biologically engrained meaning of green but may also extend it from the concrete notion of vegetative growth and life to the more abstract, psychological notions of development and mastery.[1]

In sum, both historically and currently, green appears to carry the meaning of growth, in both concrete (physical growth) and abstract (psychological growth) manifestations. This green-growth link is undoubtedly rooted in societal learning that may itself be grounded in an evolutionarily engrained predisposition.

The Influence of Green

The controlled experimental research on color effects that has included green has tended to use it as a chromatic control in examining red effects. This research has focused primarily on analytical performance and heterosexual attraction, and has not revealed any influence of viewing green on these (and related) variables. That is, green has consistently been shown to yield null effects relative to other chromatic and achromatic controls (e.g., Elliot et al., 2007; Elliot & Niesta, 2008). Research on green and creativity, our focal interest herein, has yet to be conducted.

Creativity is consensually defined as the generation of ideas or products that are both novel and of value (Amabile, 1983; Sternberg & Lubart, 1999). Creativity is critical to both survival and prosperity; it advances science and technology, provides pleasure in arts and entertainment, and facilitates the effective and enjoyable navigation of daily life (Nijstad, De Dreu, Rietzschel, & Baas, 2010; Runco, 2005). Research on creativity has documented many different situational and person-based factors that contribute to creative output (for reviews, see Baas, De Dreu, & Nijstad, 2008; Hennessey & Amabile, 2010; Ma, 2009; Mumford, 2003; Runco, 2004; Simonton, 2003). In the present research, we examine green as a situational prime that influences creative performance.

A well-established finding in the creativity literature is that positive, approach-based motivational states are beneficial for creative performance. Research has shown that experiencing positive affect (Hirt, Melton, McDonald, & Harackiewicz, 1996; Isen, Daubman, & Nowicki, 1987), focusing on potential positive outcomes (Friedman & Förster, 2001; 2005), engaging in approach-relevant motor actions (e.g., arm flexion; Cretenet & Dru, 2009; Friedman & Förster, 2000, 2002), and possessing approach-oriented traits (e.g., extraversion; De Dreu, Nijstad, & Baas, 2011; Feist, 1998; Furnham & Bachtiar, 2008) facilitates creative output. Appetitive states signal a benign, safe environment in which perceptional and cognitive processing is open, inclusive, and risk tolerant, and one can freely explore procedures and alternatives in an unconstrained manner (Friedman & Förster, 2010; Schwarz & Bless, 1991). Such states are known to stimulate and support creativity (Ashby, Isen, & Turken, 1999; Carson, Peterson, & Higgins, 2005; Friedman & Förster, 2005; Mednick, 1962; Nijstad et al., 2010; Winkielman, Schwarz, Fazendeiro, & Reber, 2003).

As noted earlier, green is associated with growth, not only physical growth but also psychological growth such as development and mastery. Accordingly, green may serve as a particular type of appetitive cue that evokes mastery-approach striving (i.e., striving for improvement and task mastery; Elliot, 1999) in creativity contexts; mastery-approach striving has been shown to foster innovation and creative performance in prior research (Gong, Huang, & Farh, 2009; Hirst, Van Knippenberg, & Zhou, 2009; Janssen & Van Yperen, 2004).

Performance on creativity tasks may be distinguished in terms of quantity and quality (De Dreu, Baas, & Nijstad, 2008; Hirt, Levine, McDonald, Melton, & Martin, 1997). Quantity refers to the number of responses generated, regardless of their creativity, whereas quality refers to the divergence and uniqueness of the responses that are generated, that is, creativity per se (Friedman & Förster, 2002; Hirt et al., 1997). Research has repeatedly shown that appetitive cues in performance contexts foster creativity per se without necessarily influencing the number of responses generated (Friedman & Förster, 2002; Roskes, De Dreu, & Nijstad, 2011). Likewise, we have no reason to expect that green will influence the number of responses generated per se, so we posit that green will enhance the creativity, but not necessarily the amount, of response output.

In addition, we predict that any influence of green on creativity observed in our experiments will take place subtly, outside of conscious awareness. Friedman and Förster (2010) recently coined the term *implicit affective cue* to refer to stimuli that activate hospitable or hostile appraisals of the current environment (and accompanying appetitive or aversive perceptual-cognitive processes) and do so without producing any explicit, conscious feeling state. Such cues are presumed to exert an influence on behavior without the perceiver's awareness. One of three programs of research reviewed by Friedman and Förster (2010) to illustrate the concept of the implicit affective cue is the aforementioned research on the color red. In the present research, we posit that green, like red, can serve as an implicit affective cue. Specifically, we predict that perceiving the color green facilitates creativity and does so without the perceivers' awareness.

Experiment 1

Experiment 1 examined the effect of green, relative to white, on creative task performance. We predicted that participants in the green condition would exhibit more creativity than those in the white condition.

Method

Participants. A total of 69 (36 male, 28 female, 5 unspecified) individuals participated in the experiment. Participant ethnicity was as follows: 6 Caucasian, 1 African American, 54 Asian, 3 Hispanic, and 5 unspecified. In this and all subsequent experiments, we were careful to exclude any color-deficient individual who participated in a chromatic condition. The mean age of participants was 27.84 years with a range of 19 to 43. Individuals received US$0.20 for their participation.

Design, procedure, and materials. Participants were randomly assigned to one of two between-subjects conditions: the green condition or the white condition. Sex and age effects are sometimes evident in creativity research (for reviews see, Baer, 2008; Ma, 2009). Accordingly, in this and all subsequent experiments, we tested for sex and age differences in preliminary analyses and retained these variables as covariates in final analyses when they were significant or marginally significant (see Judd & Kenny, 1981).

Experiment 1 was conducted over the World Wide Web using Amazon's popular crowdsourcing platform, Mechanical Turk (http://www.mturk.com). Participants were informed that they would take part in several different studies. On the first screen of the focal study herein, participants were presented with a black study number placed in a rectangle in the middle of the screen. The rectangle was either colored green or left uncolored (i.e., white); a standard green was selected for the color manipulation (it was not possible to establish the precise parameters of the green color, given that each participant viewed it on a different computer screen).

After viewing the cover page, participants were asked to complete a creativity task for 2 min. Following the creativity task, participants were given a short questionnaire that contained demographic items, as well as questions that asked participants to report the color they saw on the first page of the experiment and that probed for participants' awareness of the purpose of the experiment.[2]

Creativity task. Participants completed the unusual uses task (Guilford, 1967), which has been used in prior research to assess creativity (Baas, De Dreu, & Nijstad, 2011; Friedman & Förster, 2001). In the task, participants write down as many different creative ways to use an object as possible, in this case a tin can. They are told that their ideas should be neither typical nor impossible.

Two coders rated each idea generated by participants for creativity, with creativity being defined as an idea that is uncommon, remote, and clever (1 = *not creative at all*, 5 = *very creative*), following Guilford's classic criteria of originality (Wilson, Guilford, & Christensen, 1953). One person coded all responses, and the other coded 30% of the responses (De Dreu & Nijstad, 2008: Kohn, Paulus, & Choi, 2011); both coders were blind to participants' experimental condition. Interrater agreement was good following criteria as per Cicchetti & Sparrow (1981; intraclass correlation, ICC[1] > .62).

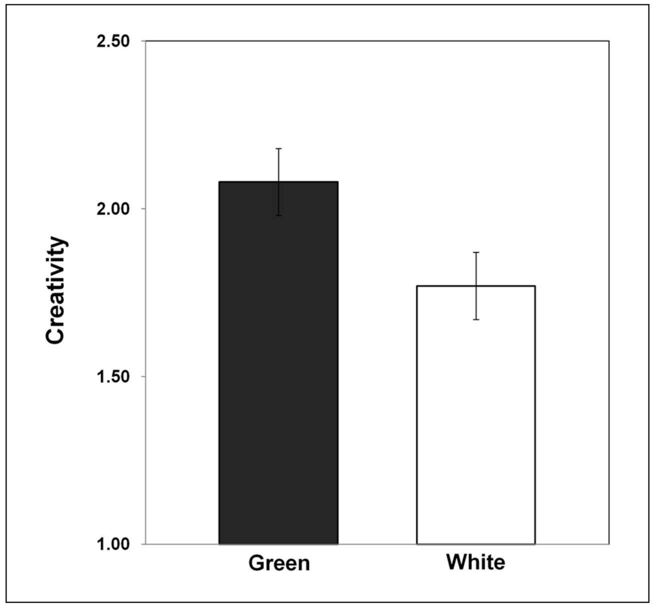

Figure 1. Creativity as a function of color in Experiment 1
Note: Standard errors are indicated by vertical lines.

Results and Discussion

Preliminary analyses revealed no sex or age effects on creativity or the number of responses generated (Fs < 0.23, ps >.63). Therefore, we did not include sex or age in the final analyses.

An independent-samples t test examining the influence of color condition on creativity revealed a significant color effect, $t(67) = 2.12$, $p < .05$, $d = .52$. Participants in the green condition exhibited more creativity than did those in the white condition (see Figure 1 for means by color condition). An independent-samples t test examining the influence of color condition on the number of responses yielded a null effect ($t = 0.10$, $p = .92$).

A chi-square test of independence was calculated to determine whether participants' color reports corresponded to their color condition. The analysis yielded a significant effect, $\chi^2(1, N = 66) = 10.95$, $p < .01$, indicating that participants were indeed cognizant of the color on the first screen of the experiment. In the awareness probe, however, not a single participant correctly guessed the purpose of the experiment.

In sum, the results supported our predictions. Participants who viewed the color green prior to engaging in a creativity task exhibited more creativity than did those who viewed white. No differences were observed for overall response output. Participants were able to correctly report the color they saw, but remained unaware of the purpose of the experiment.

Experiment 2

In Experiment 2, we changed several features of the experimental procedure. First, we changed the control color from white to gray. We used gray as the contrast to green because gray is the only achromatic control that can be equated to green on lightness. Moreover, we changed the venue of the experiment from an online setting to a real-world classroom setting. Finally, we changed the manipulation in that we presented the word *Ideas* on the cover page of the task.

Method

Participants. A total of 35 (5 male, 30 female) college students in Germany voluntarily participated in the experiment. All participants were Caucasian. The mean age of participants was 19.94 years with a range of 17 to 26.

Design, procedure, and materials. Participants were randomly assigned to one of two between-subjects conditions: the green condition or the gray condition. Participants were tested in small groups by an experimenter blind to participants' condition and the experimental hypothesis. At the beginning of the experiment, the experimenter provided participants with a description and illustration of the creativity task. To minimize any threat or pressure that participants might experience, the experimenter sought to create a relaxing atmosphere with no mention of creativity, testing, or performance.

After the description of the task, participants were provided with the experimental materials in a white two-ring binder. The manipulation was similar to that used by Elliot et al. (2007). The first page in the binder was a cover page, which was a piece of white paper with the word *Ideas* in black ink in 48-point font placed on a 5.15 in. long × 7.33 in. wide rectangle in the middle of the page. The rectangle was colored either green or gray; the colors in the manipulation were selected using the International Commission on Illumination

LCh color model. This model defines color space in terms of three parameters: lightness, chroma, and hue (LCh; Fairchild, 2005). A spectrophotometer was used to select colors equated on lightness (green: LCh[52.4/60.2/155.9], gray: LCh[52.8/–/289.5])—"Equated" in this context means functionally equivalent (within 1.0 unit; Stokes, Fairchild, & Berns, 1992). As gray is an achromatic color, chroma is not a relevant parameter in this experiment.

The experimenter informed participants that the first page in the binder should contain the word *Ideas* and then instructed them to open the binder to this page. The experimenter remained blind to color condition by turning away from participants as they checked the page. Participants were exposed to the color for approximately 2 s, and then they were asked to turn the page and complete the task. When 2.5 min had elapsed (time was monitored surreptitiously with a stopwatch to avoid evoking evaluative pressure), the experimenter told participants to turn the page and answer a brief questionnaire. This questionnaire contained demographic items as well as questions that asked participants to report the color they saw on the first page and that probed for participants' awareness of the purpose of the experiment. At the end of the experiment, participants were debriefed, thanked, and dismissed.

Creativity task. We administered a subtest of the Berlin Intelligence Structure (BIS) test (Jäger, Süß, & Beauducel, 1997), which has been used in prior research to assess creativity (Reuter et al., 2005; Weis & Süß, 2007). In this task, participants draw as many different objects as they can from a geometric figure during the allotted time period.

The creativity of participants' responses was independently coded by two individuals who rated the number of distinct categories that were generated (Jäger et al., 1997). One person coded all responses, and the other coded 30% of the responses; both coders were blind to participants' experimental condition. Interrater agreement was ICC[1] > .90, which is good to excellent according to Cicchetti and Sparrow's (1981) criteria.

Results and Discussion

Preliminary analyses revealed no sex or age effects on creativity or the number of responses generated (Fs < 0.54, ps > .46). Therefore, we did not include sex or age in the final analyses.

An independent-samples t test examining the influence of color condition on creativity revealed a significant color effect, $t(33) = 2.00$, $p = .05$, $d = .70$. Participants in the green condition exhibited more creativity than did those in the gray condition (see Figure 2 for means by color condition). An independent-samples t test examining the influence of color condition on the number of responses yielded a null effect ($t = 0.81$, $p = .42$).

A chi-square test of independence was calculated to determine whether participants' color reports corresponded to their color condition. The analysis yielded a significant effect, $\chi^2(1, N = 35) = 10.21$, $p < .01$, indicating that participants were indeed cognizant of the color on the first page of the task. In the awareness probe, however, not a single participant correctly guessed the purpose of the experiment.

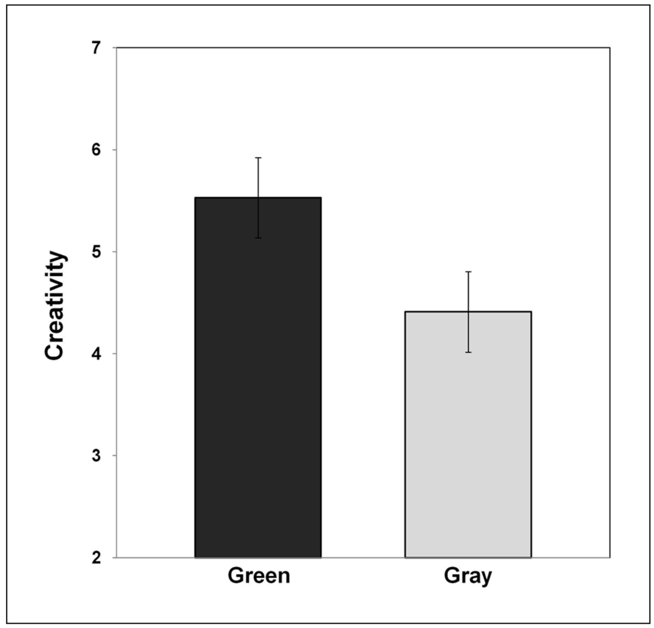

Figure 2. Creativity as a function of color in Experiment 2
Note: Standard errors are indicated by vertical lines.

In sum, the results supported our predictions. Participants who viewed the color green prior to engaging in a creativity task exhibited more creativity than did those who viewed gray. No differences were observed for overall response output. Participants were able to correctly report the color they saw, but remained unaware of the purpose of the experiment.

Experiment 3

In Experiment 3, we added two features to the Experiment 2 methodology. First, we included a chromatic color, red, as well as an achromatic color, gray, as a contrast for green. Gray affords control of the lightness property of color, whereas red (or any other chromatic color) affords control of both the lightness and chroma properties of color in examining the effect of hue. We selected red as the chromatic contrast because red, like green, is an additive primary color, and red and green are opposite colors in several well-established color models (Fehrman & Fehrman, 2004). Furthermore, red is an interesting contrast color because it has been shown to be an aversive cue that has negative implications for analytical performance (Elliot, Maier, Binser, Friedman, & Pekrun, 2009; Maier, Elliot, & Lichtenfeld, 2008). Aversive cues have also been shown to have negative implications for creativity, presumably because they produce narrow, rigid perceptual-cognitive processing that is antithetical to creative performance (Friedman & Förster, 2000, 2001, 2002). Accordingly, we predicted that green would facilitate creativity relative to red and gray, and that red would undermine creativity relative to gray.

Second, in Experiment 3 we included assessments of participants' mood and positive activation to see if color influenced variation on these explicit measures. In line with prior color research (see Elliot & Maier, 2007) and consistent with the view of color as an implicit affective cue (Friedman & Förster, 2010), we anticipated that the predicted effects of color on creativity would emerge without showing any influence on participants' conscious affective states.

Method

Participants. In all, 33 (29 male, 4 female) high school students in Germany voluntarily participated in the experiment. All participants were Caucasian. The mean age of participants was 16.82 years with a range of 16 to 18.

Design, procedure, and materials. Participants were randomly assigned to one of three between-subjects conditions: the green condition, the red condition, or the gray condition. The general procedure for the experiment was the same as that used in Experiment 2. The experiment differed from Experiment 2 in that an additional, chromatic contrast color was used and additional items were included on the post-task questionnaire to assess conscious affective experience.

The colors for the manipulation were selected using the same procedure used in Experiment 2. The chromatic colors were equated on lightness and chroma, and the chromatic and achromatic colors were equated on lightness (green: LCh[52.4/60.2/155.9], red: LCh[53.4/60.2/22.5], gray: LCh[52.8/–/289.5]).

Creativity task. As in Experiment 2, we used a subtest of the BIS test (Jäger et al., 1997) to assess creativity. Again, the creativity of responses was independently coded by two individuals blind to participants' experimental condition. Interrater agreement was good to excellent based on Cicchetti and Sparrow's (1981) criteria (ICC[1] > .80).

Mood. Mood was assessed with Friedman and Förster's (2001) single-item measure ("How do you feel right now?") using a 1 = *very bad* to 9 = *very good* scale.

Positive activation. Positive activation was assessed with the five-item General Activation subscale (e.g., "How vigorous did you feel while solving the creativity task?") of Thayer's (1986) Activation–Deactivation Adjective Check List. Participants responded on a 1 = *not at all* to 5 = *very strongly* scale ($\alpha = .76$).

Results and Discussion

Preliminary analyses did not reveal age effects on any dependent variable (Fs < 0.57, ps > .45), so age was not included in the final analyses. Preliminary analyses indicated that sex was a marginally significant or significant predictor of creativity ($F = 3.43$, $p < .10$) and number of responses ($F = 4.52$, $p < .05$; women exhibited higher values in each instance); therefore, sex was included as a covariate in the final analyses with these variables.

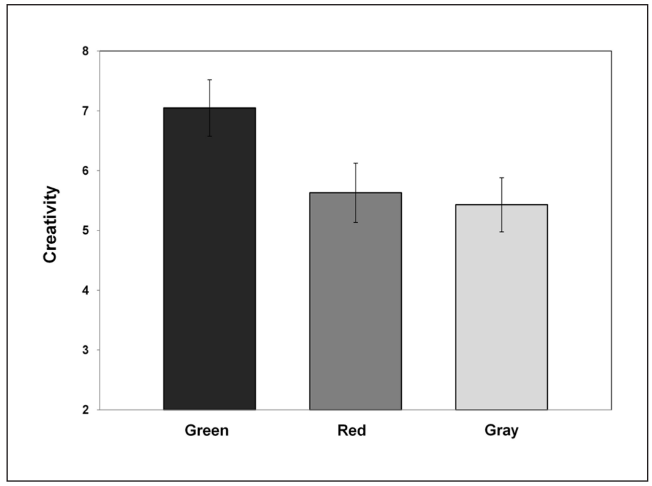

Figure 3. Creativity as a function of color in Experiment 3 (means are adjusted for sex)
Note: Standard errors are indicated by vertical lines.

A unifactorial (color condition: green vs. red vs. gray) between-subjects ANCOVA was conducted on creativity. The analysis revealed a significant effect of color condition on creativity, $F(2, 29) = 3.51$, $p < .05$, $\eta^2_p = .20$ (see Figure 3 for means by color condition). Planned comparisons were then conducted to determine the precise nature of the effect. The analyses revealed that participants in the green condition exhibited more creativity than did those in the red condition, $t(29) = 2.07$, $p < .05$, $d = .77$, and the gray condition, $t(29) = 2.47$, $p < .05$. $d = .92$. Participants in the red and gray conditions displayed comparable levels of creativity, $t(29) = 0.30$; $p > .76$.

The same ANCOVA was then conducted on the number of responses generated. This analysis indicated that color condition did not have a significant effect on the overall number of responses ($F = 2.34$; $p = .11$). ANOVAs on mood and positive activation also failed to yield significant effects of color condition (Fs < 0.38, ps > .68).

A chi-square test of independence was calculated to determine whether participants' color reports corresponded to their color condition. The analysis yielded a significant effect, $\chi^2(4, N = 33) = 60.27$, $p < .01$, indicating that participants were indeed cognizant of the color on the first page of the task. In the awareness probe, however, not a single participant correctly guessed the purpose of the experiment.

In sum, the results for green supported our predictions. Participants who viewed the color green prior to engaging in a creativity task exhibited more creativity than did those who viewed red or gray. Surprisingly, red did not undermine creativity, relative to gray; possible reasons for this null effect will be considered in the general discussion section. No differences were observed for participants' overall number of responses. Participants were able to correctly report the color they saw, but remained unaware of the purpose of the experiment. Furthermore, null effects on mood and positive activation suggest that color had no influence on participants' conscious affective experience.

Experiment 4

In Experiment 4, we made two changes to the Experiment 3 methodology. First, we included a different chromatic color, blue, as a contrast to green. Like red, blue affords control of both the lightness and chroma properties of color in examining the affect of hue, and, like green and red, blue is an additive primary color. However, in contrast to green and red, blue does not have a rich, consistent symbolic history (Pastoureau, 2001; Wolf, 2007). Furthermore, although the primary etymological root for blue in English, sky, carries positive connotations (De Vries, 2004; Gage, 1999; Wierzbicka, 1990), the figurative and colloquial meanings of blue across languages are decidedly mixed in valence (e.g., faithful, dependable, high quality, but also sad, obscene, drunk; Allan, 2009; "Blue"; *Oxford English Dictionary*; Heller, 2004). The few available studies on blue associations that have either properly controlled for nonhue properties or used semantic stimuli have likewise revealed a mix of positive and negative connotations (pleasant, calm, but also sad, cold; Adams & Osgood, 1973; Clarke & Costall, 2008; Valdez & Mehrabian, 1994). Psychological theorizing on blue shows a similar divide, with some positing that blue carries a negative meaning (sadness) that prompts careful, aversive processing (Soldat & Sinclair, 2001), and others positing that blue carries a positive meaning (openness) that prompts exploratory, appetitive processing (Mehta & Zhu, 2009). Empirical support for both of these opposing proposals has been reported (including research linking blue to enhanced creativity; see Mehta & Zhu, 2009), but nonhue properties of color were not properly controlled in this work.[3] In light of this mixed portrait for blue, it seems wise to take a conservative stance (i.e., to posit neither a positive nor a negative effect). Accordingly, we predicted that green would facilitate creativity relative to blue and gray, and that blue and gray would exhibit no difference.

Second, in Experiment 4 we used a different creativity task, the instances task of Wallach and Kogan (1965). Conceptually replicating the prior experiments with another approach to creativity assessment would help demonstrate the generalizability of the green effect.

Method

Participants. A total of 65 (30 male, 35 female) high school students in Germany voluntarily participated in the experiment. All participants were Caucasian. The mean age of participants was 16.48 years with a range of 15 to 18.

Design, procedure, and materials. Participants were randomly assigned to one of three between-subjects conditions: the green condition, the blue condition, or the gray condition. The general procedure for the experiment was the same as that used in Experiments 2 and 3. The experiment differed from the prior experiments in that a different chromatic contrast color was used and a different creativity task was used.

The colors for the manipulation were selected using the same procedure used in the prior experiments. The chromatic colors were equated on lightness and chroma; the chromatic and achromatic colors were equated on lightness (green: LCh[57.8/50.3/153.1], blue: LCh[57.1/50.9/285.3], gray: LCh[57.7/–/273.4]).

Creativity task. We administered Wallach and Kogan's (1965) instances task, which has been used in prior research to assess creativity (Hattie, 1980; Runco & Charles, 1993). In this task, participants are asked to generate as many instances as they can for four different categories (e.g., things that are round). Participants are given 2 min to respond for each category.

The creativity of participants' responses was independently coded by two individuals who rated each response ("How creative is this response?") on a 1 = *not creative* to 5 = *very creative* scale (for a similar rating procedure, see Bechtoldt, De Dreu, Nijstad, & Choi, 2010). One person coded all responses, and the other coded 30% of the responses; both coders were blind to participants' experimental condition. Interrater agreement was good to excellent based on Cicchetti and Sparrow's (1981) criteria (ICC[1] > .74). The ratings were used to calculate an average creativity score for each participant (i.e., the summed ratings divided by the total number of ratings).

Mood. As in Experiment 3, mood was assessed with Friedman and Förster's (2001) single-item measure ("How do you feel right now?") using a 1 = *very bad* to 9 = *very good* scale.

Positive activation. Positive activation was assessed with Elliot et al.'s (2007) single-item short form ("How energetic did you feel while solving the creativity task?") of the General Activation subscale of Thayer's (1986) Activation–Deactivation Adjective Check List. This item is the highest loader on the General Activation subscale. Participants responded on a 1 = *not at all* to 5 = *very strongly* scale.

Results and Discussion

Preliminary analyses did not reveal sex effects on any dependent variable (Fs < 0.74, ps > .39), so sex was not included in the final analyses. Preliminary analyses indicated that age was a marginally significant or significant positive predictor of creativity ($F = 3.32$, $p < .10$) and number of responses ($F = 4.81$, $p < .05$); therefore, age was included as a covariate in the final analyses with these variables.

A unifactorial (color condition: green vs. blue vs. gray) between-subjects ANCOVA was conducted on creativity. The analysis revealed a significant effect of color condition on creativity, $F(2, 61) = 3.18$, $p < .05$, $\eta^2_p = .09$ (see Figure 4 for means by color condition). Planned comparisons were then conducted to determine the precise nature of the effect. The analyses revealed that participants in the green condition exhibited more creativity than did those in the blue condition, $t(61) = 2.46$, $p < .05$, $d = .63$, and tended to exhibit more creativity than did those in the gray condition, $t(61) = 1.77$, $p = .08$, $d = .45$. Participants in the blue and gray conditions displayed comparable levels of creativity, $t = 0.78$; $p = .44$.

The same ANCOVA was then conducted on the number of responses generated. This analysis indicated that color condition did not have a significant effect on the overall number of responses ($F = 1.08$; $p = .35$). ANOVAs on mood and positive activation also failed to yield significant effects of color condition (Fs < 0.98, ps $> .38$).

A chi-square test of independence was calculated to determine whether participants' color reports corresponded to their color condition.

The analysis yielded a significant effect, $\chi^2(4, N = 52) = 20.58$, $p < .01$, indicating that participants were indeed cognizant of the color on the first page of the task. In the awareness probe, however, not a single participant correctly guessed the purpose of the experiment.

In sum, the results again supported our predictions. Participants who viewed the color green prior to engaging in a creativity task exhibited more creativity than did those who viewed blue or gray. Blue neither facilitated nor undermined creativity relative to gray. No differences were observed for participants' overall number of responses. Participants correctly reported the color they saw, but could not correctly guess the purpose of the experiment. Furthermore, null effects were observed on mood and positive activation, suggesting color had no influence on participants' conscious affective experience.

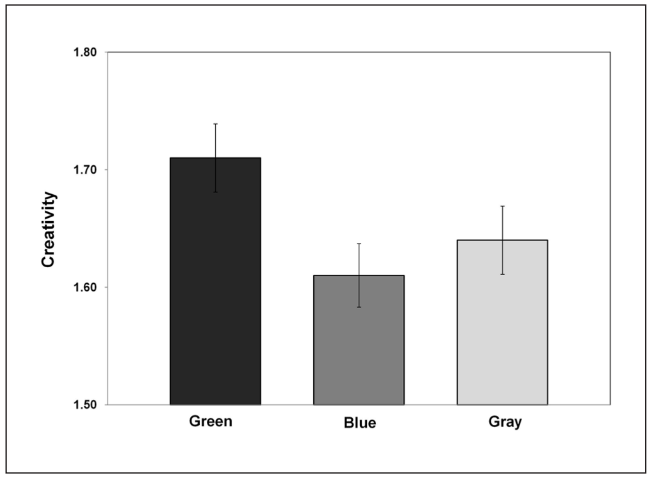

Figure 4. Creativity as a function of color in Experiment 4 (means are adjusted for age)
Note: Standard errors are indicated by vertical lines.

General Discussion

The results of the present research provide strong support for the hypothesized influence of green on creativity. In four experiments we demonstrated that a brief glimpse of green prior to engaging in a creativity task facilitates the creativity (but not overall amount) of response output. This green effect was observed using achromatic (white, gray) and chromatic (red, blue) contrast colors and using picture-based and word-based assessments of creativity. Critically, the effect was documented using hues matched at the spectral level on lightness and chroma. Participants were not aware of the purpose of the experiment, and null effects were obtained on measures of participants' conscious, self-reported, experiential states.

Our documentation of a green effect in this research nicely extends the extant empirical work on color and psychological functioning. Prior work has focused on the color red, showing links to analytical performance and attraction-relevant behavior (e.g., Elliot & Niesta, 2008; Maier et al., 2008). Here, we show that another color, green, has a systematic influence on another important outcome, creativity performance. Other recent work has reported that blue enhances creativity performance (Mehta & Zhu, 2009), but our research using carefully controlled color stimuli indicates that it is green, not blue, that facilitates creativity. Additional research is needed to further examine a possible link between blue and creativity, but at present, the data support green as the critical hue in this regard and hint that the prior findings attributed to blue may actually be due to lightness, chroma, or some sort of interaction among the three basic color properties (see Valdez & Mehrabian, 1994; Whitfield & Wiltshire, 1990).

Together, the emerging data on color and performance exhibit the following pattern: Green facilitates creativity performance, but has no influence on analytical performance, whereas red undermines analytical performance, but has no influence on creativity performance. This differentiated pattern suggests that broad and simple statements regarding color and performance are not warranted. Rather, it is necessary to consider factors such as the specific meaning/motivation associated with a particular color and the specific processing demands involved in performing a particular task in seeking to understand the link between color and performance outcomes. We do this in the following for green and red, respectively.

Regarding green, we do not view green as a general appetitive cue in performance contexts, but rather as a cue of growth-oriented mastery. In the achievement motivation literature, appetitive motivation is differentiated in terms of mastery-approach and performance-approach; mastery-approach motivation focuses on developing one's skills and improving one's performance, whereas performance-approach motivation focuses on demonstrating one's ability and outperforming others (Dweck, 1986; Elliot & Harackiewicz, 1996; Nicholls, 1984). Mastery-approach motivation is most similar to the growth-oriented appetitive state thought to be associated with green. Interestingly, mastery-approach motivation has been shown to facilitate deep processing, intrinsic interest, and creative performance, but has no clear relation to analytical performance (Elliot, McGregor, & Gable, 1999; Hirst et al., 2009; Hulleman, Schrager, Bodmann, & Harackiewicz, 2010; Janssen & Van Yperen, 2004; Shally, Gilson, & Blum, 2009). These findings are consistent with both the positive relation between green and creativity in the present research and the null relation between green and analytical performance in prior research. Thus, green appears to prompt a growth-oriented appetitive state akin to mastery-approach motivation that facilitates the type of pure, open processing required to do well on creativity tasks. Analytical tasks require a more constrained, outcome-based processing that is facilitated by performance-approach motivation (Elliot & McGregor, 2001; Moller & Elliot, 2006; Senko, Hulleman, & Harackiewicz, 2011), and we see no reason to believe that green would prompt this other form of appetitive motivation.

Regarding red, we view this color as a general aversive cue signaling danger and potential negative outcomes in performance contexts (Elliot & Maier, 2007; Moller et al., 2009). A substantial amount of research in the test anxiety and achievement motivation literatures has shown that aversive motivation prompts worry, distraction, perceptual-cognitive rigidity, and self-protective processes known to undermine performance on analytical tasks (Elliot & McGregor, 2001; Hembree, 1988; McCrea & Hirt, 2001; Urdan & Midgley, 2001). As such, it is not surprising that red has been linked to deleterious analytical performance in several experiments (e.g., Elliot, Payen, Brisswalter, Cury, & Thayer, 2011; Lichtenfeld, Maier, Elliot, & Pekrun, 2009; Maier et al., 2008). What is surprising is that red did not undermine creativity performance in Experiment 3. The traditional stance in the literature is that aversive states are antithetical to creativity (see Friedman & Förster, 2000, 2001), and we generated our Experiment 3 prediction for red accordingly. Why, then, did we obtain null results for red? One possibility is that an explicitly evaluative context is needed for red to serve as an aversive cue, and the nonthreatening, supportive environment that we established in our experiments to examine creative performance did not allow red to take on the meaning of danger and potential failure. Another possibility rests in recent research suggesting that aversive affective states can, in some instances, produce persistent effort that maintains or even facilitates creativity performance (De Dreu, Baas, & Giacomantonio, 2010; De Dreu et al., 2008; Roskes et al., 2011). It is possible that red in Experiment 3 prompted a combination of processes, some inimical for creativity and some beneficial for creativity, that together produced an overall null effect. Future research is needed to more thoroughly examine the link between red and creativity performance before a definitive statement on this relation is warranted.

The green effect observed in our research appears to be quite subtle in nature. In the experimental procedure in most of our experiments, green was presented briefly (for 2 s) as a mere background stimulus (on the first page of the task); no explicit attention was drawn to color at any time. In addition, participants showed no knowledge of the purpose of the experiment in a post-task awareness probe, and null effects were obtained across color condition on self-report measures of mood and positive activation. As such, green appears to serve as an implicit affective cue (Friedman & Förster, 2010) in influencing creativity performance.

As with other empirical work on implicit affective cues, including research on both creativity (Friedman & Förster, 2000, 2002) and color (Elliot et al., 2007; Elliot & Niesta, 2008), our focus in this initial examination of the green-creativity relation was on the presence or absence of a direct effect. Now that we have systematically documented that green facilitates creativity performance, subsequent research is needed to attend to the "second generation question" (Zanna & Fazio, 1982) of the mediational mechanism responsible for this direct effect. Such research is likely to be challenging, for two reasons. First, in general, testing mediation using implicit measures tends to be more difficult and precarious than testing mediation using explicit measures, as it requires the potentially disruptive assessment of an implicit process between the independent and dependent measures, rather than the mere addition of a few questionnaire items. Second, there is no implicit measure of mastery-approach motivation—our proposed mediational mechanism—available in the literature, meaning a preliminary step in testing mediation would be the development and validation of a new measure. Implicit measures of general appetitive motivation are available (see Bijleveld, Custers, & Aarts, 2009; Friedman & Förster, 2005; Robinson, Wilkowski, & Meier, 2008), but these undifferentiated assessments would not be sensitive enough to capture the more specific form of appetitive motivation posited to be involved in the green-creativity relation. Furthermore, the general appetitive mechanisms presumed to emerge from mastery-approach striving (e.g., open, flexible cognition) are downstream processes that proximally influence creativity; they may not be directly linked to green themselves. Despite these considerable challenges, we think that empirical examination of mediation is an important and necessary next step in this research program that promises to yield a more complete and precise understanding of the green effect documented herein.

Another issue worthy of exploration is the degree to which the meaning and influence of green are the same or different across cultures. Cross-cultural work may be particularly useful in determining whether the green-growth link (Elliot et al.,

2011) and the green effect observed in the present work are a product of social learning alone or have a biological basis. Definitive statements on such matters tend to be elusive, but acquiring data from different countries (e.g., East as well as West) and societies (e.g., remote tribes with little or no media contact) would be quite informative (see Davidoff, Fonteneau, & Goldstein, 2008; Elliot et al., 2010; Tracy & Robins, 2008). If the meaning and influence of green are indeed grounded in biology to some degree, relatively consistent data should be observed across these diverse groups.

In the present research, we showed that green facilitates creativity in a controlled experimental context, and an important question is whether this effect generalizes to real-world achievement settings in which creativity is highly valued. Thus, fieldwork could be conducted in which students or employees, for example, are regularly exposed to green (as well as other hues of equal lightness and chroma) in their work environment to see if this influences their creativity and innovation over time. On a related note, a number of theorists have posited that viewing nature or pictures of nature has beneficial implications for people's task engagement, emotional experience, and productivity (Kaplan & Kaplan, 1989; Orians & Heerwagen, 1992; Ulrich, 1993; Williams & Cary, 2002; Wilson, 1984), and research is starting to accumulate in support of this premise (Berman, Jonides, & Kaplan, 2008; Bringslimark, Hartig, & Patil, 2009; Hartmann & Apaolaza-Ibáñez, 2010; Ryan et al., 2010; Shibata & Suzuki, 2004; Ulrich, 1984). Interestingly, the nature manipulations used in these studies typically involve exposing subjects to live plants or to photos of natural settings replete with green trees and vegetation. In light of the results of the present experiments, it seems reasonable to raise the possibility that an (or even the) "active ingredient" in these nature manipulations is the color green. Green is also commonly used in other experimental paradigms as a cue to indicate "go," "potential gain," or "success," and as a potential distractor stimulus in Stroop-based procedures. The present results raise the possibility that these uses of green may be problematic, in that they may create confounds or, at minimum, produce extraneous variance.

In conclusion, careful, methodologically rigorous research on color and psychological functioning remains sparse and limited in scope. The present research extends this nascent literature by demonstrating that green, like red, can have a systematic influence on behavior. As such, green and red alike not only have aesthetic properties but also have functional properties, and clearly represent important perceptual stimuli in need of sustained empirical attention. We suspect that both green and red have a number of other influences on affect, cognition, and behavior beyond what has been documented in this and recent work. In other words, we believe that this is a fertile research area, destined for growth.

Declaration of Conflicting Interests

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Notes

1. We have emphasized the positive, appetitive meanings of green herein, because they are the most strong and prevalent, but green can also have negative, aversive connotations. For example, green can be linked to death and decay (Chamberlin, 1968), mold and poison (Mahnke, 1996), and youthful inexperience. Interestingly, each of these negative meanings may be seen as connected to the natural, cyclical progression of life, growth, death, and eventual renewal (Hutchings, 1997, 2004).
2. A correct guess was defined as stating something about color, something about creativity, and something about the direction of an effect.
3. Proper control of the nonhue properties of color requires measuring color stimuli at the spectral level using a spectrophotometer and equating the target hues on lightness and chroma. Soldat and Sinclair (2001) took no steps to equate their target hues on lightness and chroma. Mehta and Zhu (2009) sought to control nonhue color properties using a computer program to select comparable lightness and chroma values for their target hues. Unfortunately, color presentation is device dependent, and there is often considerable variation in color presentation across devices (Fairchild, 2005). As such, hue, lightness, and chroma were likely confounded in both instances, making clear interpretation of the results impossible (Elliot & Maier, 2007; Valdez & Mehrabian, 1994; Whitfield & Wiltshire, 1990) and, perhaps, explaining the divergent patterns obtained.

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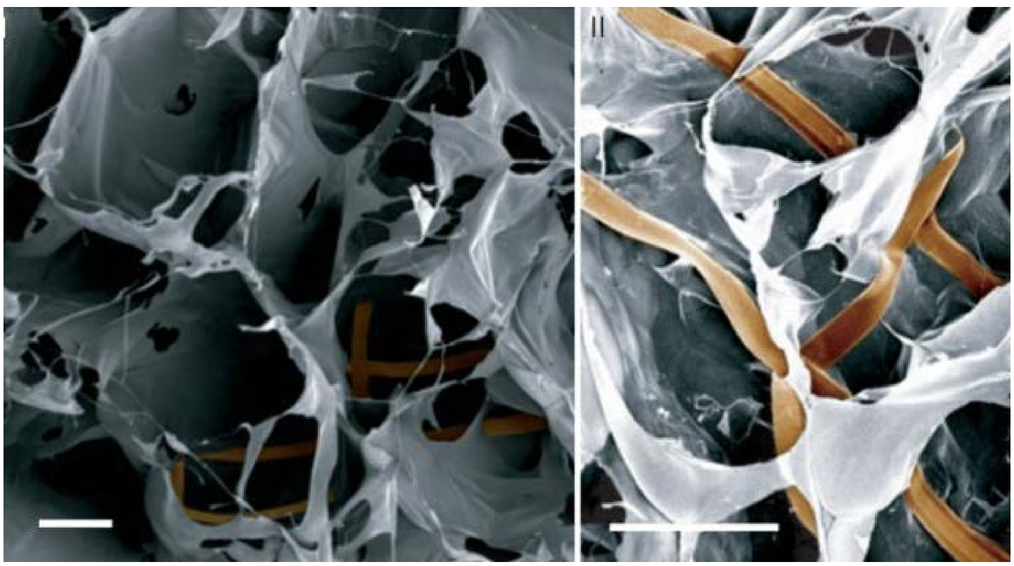
Harvard creates cyborg flesh that's half man, half machine

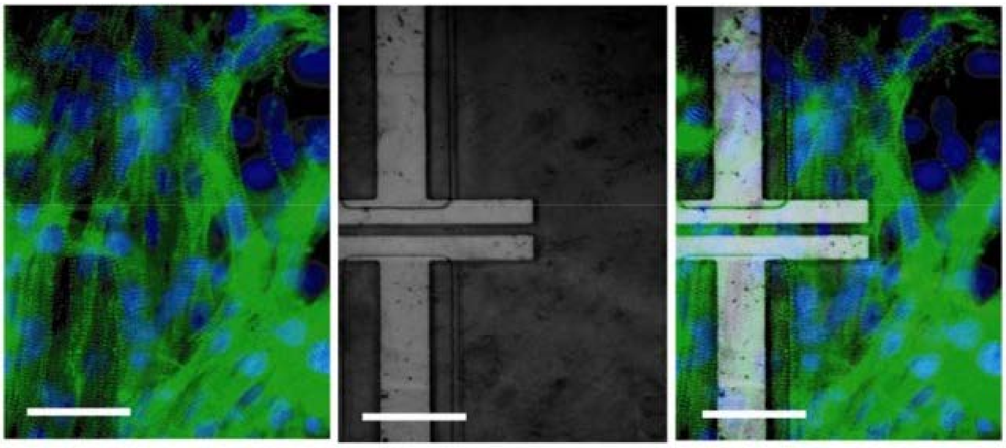
By Sebastian Anthony on August 29, 2012 at 6:54 am | 57 Comments



Bioengineers at Harvard University have created the first examples of cyborg tissue: Neurons, heart cells, muscle, and blood vessels that are interwoven by nanowires and transistors.

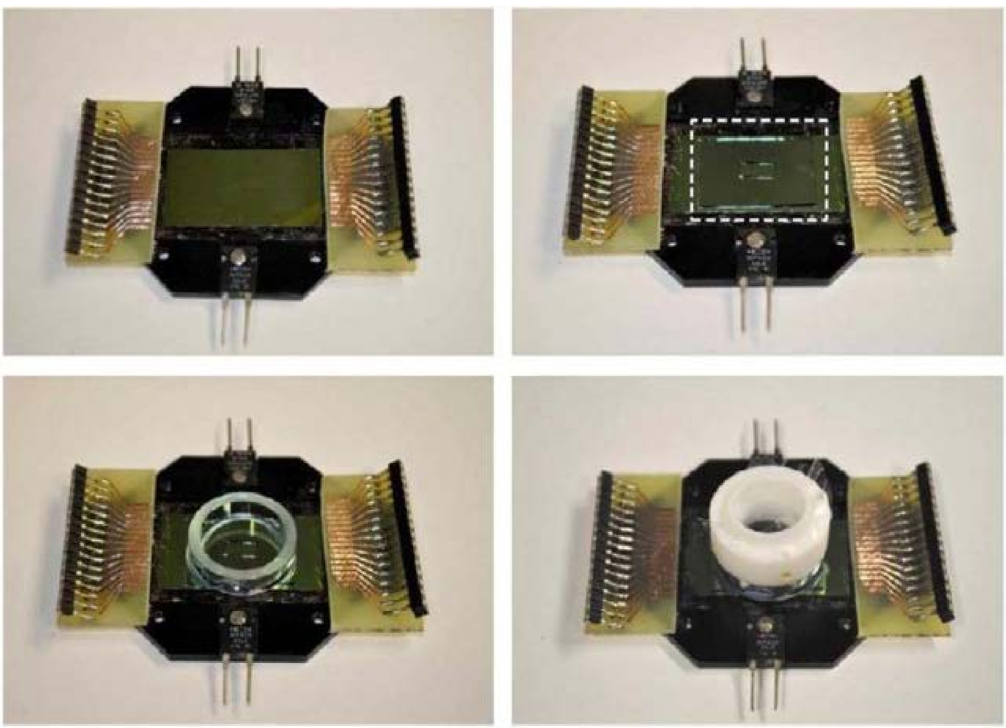
These cyborg tissues are half living cells, half electronics. As far as the cells are concerned, they're just normal cells that behave normally — but the electronic side actually acts as a sensor network, allowing a computer to interface directly with the cells. In the case of cyborg heart tissue, the researchers have already used the embedded nanowires to measure the contractions (heart rate) of the cells.

To create cyborg flesh, you start with a three-dimensional scaffold that encourages cells to grow around them. These scaffolds are generally made of collagen, which makes up the connective tissue in almost every animal. The Harvard engineers basically took normal collagen, and wove nanowires and transistors into the matrix to create nanoelectric scaffolds (nanoES). The neurons, heart cells, muscle, and blood vessels were then grown as normal, creating cyborg tissue with a built-in sensor network.



Cardiac cells, with a nanoelectroic electrode highlighted

So far the Havard team has mostly grown rat tissues, but they have also succeeded in growing a 1.5-centimeter (0.6in) cyborg human blood vessel. They’ve also only used the nanoelectric scaffolds to *read* data from the cells — but according to lead researcher Charles Lieber, the next step is to find a way of talking to the individual cells, to “wire up tissue and communicate with it in the same way a biological system does.”



A computer chip, containing a sample of nanoES tissue

Suffice it to say, if you can use a digital computer to read and write data to your body’s cells, there are some awesome applications. If you need a quick jolt of adrenaline, you would simply tap a button on your smartphone, which is directly connected to your sympathetic nervous system. You could augment your existing physiology with patches — a patch of nanoelectric heart cells, for example, that integrates with your heart and reports back if you experience any problems. When we eventually put nanobots into our bloodstream, small pulses of electricity emitted by the cells could be used as guidance to damaged areas. In the case of blood vessels and other organs, the nanoelectric sensor network could detect if there’s inflammation, blockage, or tumors.

Realistically, though, we’re a long way away from such applications. In the short term, though, these cyborg tissues could be used to create very accurate organs-on-a-chip —

lab-grown human organs that are encased within computer chips and then used to test drugs or substance toxicity, without harming a single bunny or bonobo.

Read: Nanotech: will it kill us all?, and Stanford's wireless, implantable "Innerspace" medical device

Research paper: doi:10.1038/nmat3404 (paywalled)

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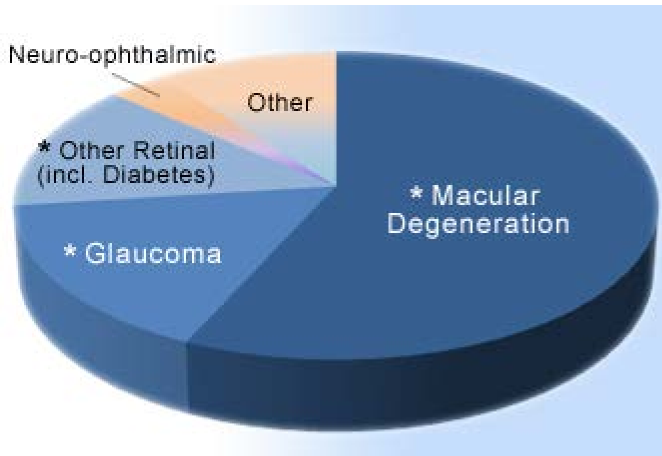
Who we can help

The MVG brain implant could bring sight to up to 85% of people who are clinically blind, including:

1. Patients affected by the three most common untreatable causes of blindness in Australia: Diabetic Retinopathy, Glaucoma and Macular Degeneration.
2. Patients with an intact visual cortex, who have previously had normal visual development.
3. Patients with acquired retinal, optic nerve or ocular disease.



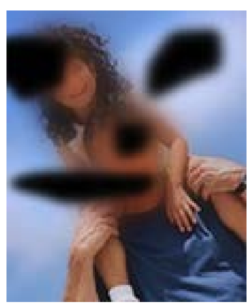
The Monash Vision direct to brain bionic eye could benefit patients in the blue* areas of this breakdown of causes of visual impairment in Australia

Diabetic Retinopathy, Glaucoma and Macular Degeneration tend to be progressive conditions that lead to gradual loss of sight restricted to some regions of the visual field. The images below provide an indication how these conditions can affect vision. This may vary, depending upon each individual and their history.


Unimpaired vision


Glaucoma


Macular Degeneration


Diabetic Retinopathy

MVG aims to deliver a commercially viable bionic eye system that is:

- Able to restore central vision without interfering with patients' residual vision
- Suitable for patients who have damaged optic nerves, where other bionic eye technologies are limited
- Implantable using standard neurosurgical techniques
- Externally adjustable after implantation for ongoing optimal performance.

The best of both worlds

The Monash bionic eye will supplement remaining areas of good natural vision.

Restoring sight

The Monash Vision direct to brain bionic eye will help people affected by, amongst others, the three main causes of untreatable blindness in Australia: Diabetic Retinopathy, Glaucoma and Macular Degeneration.

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RESEARCH

International Stem Cell Corporation Formalizes Stem Cell- Based Eye Care Programs Into Cyovis

Monday, August 23, 2010

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International Stem Cell Corporation (OTCBB:ISCO), announced that its stem cell therapeutic programs focused on protective, transparent corneas (CytoCor™) in the front of the eye and the light-sensitive retinal tissue (CytoRet™) in the back of the eye will be formalized into a new business unit, Cytovis™. Together these programs will leverage external and internal development, regulatory and commercial expertise in cellular ophthalmology to form a focused portfolio of complementary product candidates designed to address high unmet medical needs with apparent pharmacoeconomic and quality of life benefits.

CytoCor is the brand name for ISCO's corneal tissue that can be derived from the company's proprietary parthenogenetic stem cells or commonly used embryonic stem cells. Research and development with partners Absorption Systems in the US, Sankara Nethralaya in India and Automation Partnership in the UK continues for the purpose of optimizing the tissue for transplantation in the 10 million people worldwide suffering from corneal vision impairment and as an alternative to the use of live animals and animal eyes in the $500+M market for safety testing of drugs, chemicals and consumer products. ISCO's goal in the coming months is to establish funding and infrastructure in India for accelerated development of CytoCor for the therapeutic application and to advance and implement the chemical testing application with partners in the US and Europe.

CytoRet is the brand name for ISCO's stem cell-derived retinal tissue. ISCO is using its parthenogenetic stem cells to develop individual retinal pigmented epithelial ("RPE") cells and layered retinal structures internally and in collaboration with the laboratory of Dr. Hans Keirstead, Professor of Anatomy and Neurobiology at the University of California, Irvine. ISCO recently commenced a new research collaboration with UC Irvine to launch the next phase of its retinal studies with that institution, including preclinical trials. Potential therapeutic applications include retinitis pigmentosa, an untreatable inherited disease affecting about 100,000 Americans, and the dry form of age-related macular degeneration, a major cause of blindness in the elderly of the Western world. ISCO's goal is to establish functional proof of concept for RPE cellular therapy in models of human disease in the next twelve-eighteen months.

Jointly referred to as Cytovis ("cyto" for cellular, "vis" for vision), these two cellular ophthalmology programs share a number of features and benefits. First, with the aging of the population worldwide and the growing number of work-related eye injuries in India, China and other major countries, the market opportunity is growing steadily. Second, there are strong pharmacoeconomic and quality-of-life rationales for full or partial vision restoration or delay of vision impairment diseases. Third, delivery of cells and tissues to the confined anatomy of the eye inherently provides for better safety and efficacy than, for example, the systemic circulation or the central nervous system. This will likely result in lower regulatory barriers and shorter and less costly development paths compared to that of anatomically deeper and more widespread diseases. Fourth, a number of eye diseases cannot be treated with surgery or traditional small molecule or protein therapeutics, yet cell and tissue therapy is proven to work but currently limited by availability of safe and sufficient cells and tissue from human donors. Finally, eye care development programs like CytoCor and CytoRet share a number of regulatory, development and commercial aspects that make it feasible for a relatively small team to produce substantial clinical outcomes and achieve competitive presence in the marketplace alone or in collaboration with dedicated partners.

Brian Lundstrom, ISCO's President, says: "ISCO's proprietary parthenogenetic stem cell technology continues to form the foundation for the company's long term regenerative medicine therapy programs. In the nearer term, CytoCor and CytoRet's unique benefits in the field of cellular ophthalmology offer the potential for partnering and funding at a relatively early stage. Combined with the current and future revenue of Lifeline Cell Technology and the revenue potential of Lifeline

Skin Care, scheduled for launch in the 4th quarter, Cytovis adds significantly to ISCO's diversity and value creation potential for its investor base in a cost-efficient fashion."

Source:
International Stem Cell Corporation

Demonstration of an ultralow profile cloak for scattering suppression of a finite-length rod in free space

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Demonstration of an ultralow profile cloak for scattering suppression of a finite-length rod in free space

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Abstract. We present the first experimental realization and verification of a three-dimensional stand-alone *mantle cloak* designed to suppress the total scattering of a finite-length dielectric rod of moderate cross-section. Mantle cloaking has been proposed to realize ultralow-profile conformal covers that may achieve substantial camouflage, transparency and high-performance non-invasive near-field sensing. Here, we realize and verify a mantle cloak for radio-waves. We report an extensive campaign of far- and near-field free-space measurements demonstrating that conformal cloaks can indeed produce strong scattering suppression in all directions and over a relatively broad bandwidth of operation.

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Contents

1. Introduction

Over the last decade there have been exciting advances in the area of electromagnetic and acoustic cloaking. A variety of theoretical approaches have been proposed and demonstrated through the application of metamaterials, aimed at reducing the scattering of various objects, ranging in size and material composition, and spanning low-frequencies [1–4], microwave [5–14] and near-optical regimes [15–20] (for an overview of the most popular cloaking methods, see the surveys in [21–23]). Cloaking is arguably one of the most fascinating topics in modern physics, made possible through the unique characteristics of metamaterials. These artificial materials allow new avenues to redirect wavefronts around an object, as in transformation [13, 24–27] and waveguide-based cloaks [28–30], or to suppress the scattering at all angles [6, 11, 31–32]. In recent works, we have shown that an alternative approach to invisibility, which we have named *mantle cloaking*, may be achieved using ultrathin *metascreens* rather than bulk metamaterials. These conformal patterned surfaces may possess similar exotic scattering properties as metamaterial covers, but may be easier and more practical to realize and may offer an improved bandwidth [33–37].

In the general sense, the experimental validation of the *cloaking* concept has until recently been limited to two-dimensional (2D) configurations in waveguides, due to the difficulties in realizing three-dimensional (3D) robust metamaterial covers with the required material parameters. In particular, the realization of transformation-based cloaks typically requires metamaterials with strong inhomogeneities and anisotropy, and with inherently resonant features, which may make them very sensitive to manufacturing imperfections, Ohmic losses, wave polarization and incidence angle. Therefore, while the metamaterial approaches have been visionary and exciting from the theoretical point of view, their realizations have so far been far from ideal, often limited to specific excitation angles and arguably of limited practical interest. 2D configurations in closed environments also inherently parry the major difficulties encountered with finite-length objects, namely oblique angles of incidence and end effects. Recently, a few exciting 3D experiments were reported in the microwave range using different techniques, such as the *plasmonic* [11–12] and the *metal-plate* [14] approaches, which appear to be inherently more robust than those based on transformation optics. In [11], extensive near-field and far-field measurements were presented to demonstrate a reduction in the total scattering cross-section (SCS) of a finite-length dielectric rod using a plasmonic metamaterial cover. In [14] the scattering reduction of a finite-length metal-plate cloak was measured using bistatic far-field and forward scattering measurements in the microwave regime in order to estimate the scattering reduction at all viewing angles. It is not necessarily straightforward to apply the optical theorem to estimate the total SCS, as it requires very careful measurement conditions [38]. Another way to demonstrate reduction of the total SCS of an object is to measure its far-field bistatic cross-sections at various angles [11, 14], or map the fields in the near-field of the object [11].

Here we present the first experimental realization of *mantle cloaking* applied to a 3D finite-length cylinder. We achieve scattering cancellation with ultrathin conductive metasurfaces composed of subwavelength periodic elements. The patterned surface is tailored to realize an equivalent surface reactance that can scatter anti-phase fields to drastically suppress the scattering produced by a given stand-alone 3D object. Scattering cancellation is shown through measurements in the very near-field of the object, showing the restoration of the incident wavefront and realizing a moderately broadband cloaking phenomenon. One significant advantage of mantle cloaking is that the conformal patterned screen, or metasurface, can be easily implemented with printed technology, without requiring extreme values of bulk permittivity/permeability and/or anisotropies and inhomogeneities, as with other common metamaterial solutions to cloaking [5, 27]. The inherent conformability and low-profile of these surfaces may also allow the realistic possibility of cloaking arbitrarily shaped objects, extending the results in [39]. Recent works have also shown that the mantle cloaking method can be used to reduce antenna blockage and mutual coupling between co-sited antennas [34], opening novel practical avenues for the applications of cloaking. Additionally, exciting theoretical results have shown that mantle cloaking can be successfully extended to THz frequencies by leveraging the tunable conductivity of graphene monolayers of atomic thickness [23, 37].

The goal of this work is to experimentally verify the mantle cloaking approach envisioned in [33]. We demonstrate that this cloaking method is robust to practical limitations such as loss and design imperfections, and is effective for a large range of viewing angles. Our mantle cloak design is shown to significantly suppress the strongest scattering component at normal and near-normal incidence by over an order of magnitude and over a moderate bandwidth. For our experiment, as discussed in the following, we choose a dielectric rod of finite length and moderate cross-section, which poses some interesting challenges: (i) the field penetration inside the dielectric material can excite internal standing and surface waves along the dielectric rod, which manifest themselves as resonances at oblique incidence; (ii) the excitation of more than one significant scattering term may complicate the overall scattering signature of the object. Our experimental results open interesting venues by showing the practical applicability of mantle cloaking in a realistic configuration.

2. Mantle cloaking: theoretical background, design and simulations

2.1. Determination of the metasurface reactance at normal incidence for an infinite cylinder

Our goal is to achieve significant reduction of the *total* SCS of a 3D cylindrical object when covered by a properly designed passive metasurface, independent of the incidence angle of excitation. This goal is drastically different from low-observability or stealth techniques based on minimizing target backscatter, since they usually are not aimed at efficiently suppressing the *total* scattering of the object, and especially its shadow[5]. The total SCS of a finite cylinder includes contributions from all relevant transverse-magnetic (TM) and transverse-electric (TE) scattered waves, scattering in all directions. Here, TM or TE polarized wavefronts define whether the magnetic or electric field lies in the plane orthogonal to the cylinder axis, respectively. The total scattering width (SW) is an analytically more tractable expression for the scattering from a 2D (infinite) cylinder, which approximates well the total SCS for large length-to-diameter aspect ratios. The total SW is generally defined as [38]

$$\sigma_{2D} = \frac{4}{k_0} \sum_{n=-\infty}^{\infty} \left(\left| c_n^{TM} \right|^2 + \left| c_n^{TE} \right|^2 \right), \tag{1}$$

where k_0 is the wavenumber of the background medium. The Mie scattering coefficients c_n^{TM} and c_n^{TE} represent the multipolar contributions to the total SW. For dielectric cylinders of moderate cross-section illuminated by TM or TE polarized wavefronts, c_0^{TM} and c_1^{TE} dominate the total SW, respectively. At normal incidence, these scattering coefficients are uncoupled; however, as the angle of incidence changes from normal incidence to smaller angles, TM–TE cross coupling becomes more relevant, which may increase the scattering and the overall visibility of cylindrical targets [32, 40–41]. At oblique incidence we are also prone to excite scattering resonances caused by the field penetration inside the dielectric, which can excite standing waves along the cylinder length [32, 40, 41]. Since the scattering from cylinders with moderate cross-section is in general larger at normal incidence than at oblique angles, we focus our design on the case of normal incidence, without considering the more complex effects arising for oblique excitation. We then analyze the performance and robustness of our design when the incidence angle changes.

Consider the geometry of figures 1(a) and (b), formed by a magnetodielectric 2D cylinder with constitutive parameters (μ, ε) illuminated in free space by a monochromatic TM plane wave under the $e^{-i\omega t}$ time convention. An ultrathin conformal cylindrical metasurface of radius a_c covers the dielectric rod of radius a, such that $a_c/a \simeq 1$. Provided that the granularity of the mantle cover is much smaller than the wavelength of operation, we may model the metasurface using an average surface current density $\mathbf{J}$, associated with the discontinuity of the magnetic field across the thin cover. The surface impedance may then be related to this current density by Ohm's law: $\mathbf{E}_{tan} = \bar{\bar{\mathbf{Z}}}_s \cdot \mathbf{J}$, where $\bar{\bar{\mathbf{Z}}}_s$ is the surface impedance tensor and $\mathbf{E}_{tan}$ is the tangential component of the electric field, which is continuous across the metascreen cover. We assume in this section that the metascreen is lossless and, therefore, we may represent the equivalent surface impedance cover as purely reactive quantity $Z_s = -iX_s$.

For the geometry at hand, the incident and scattered fields are naturally represented by the Mie expansion in cylindrical harmonics [42]

$$\mathbf{E}_{tan} = \begin{cases} \hat{\mathbf{z}} E_0 \sum_{n=-\infty}^{\infty} i^n \left[a_n^{TM} J_n(k\rho) \right] e^{-in\varphi}, & \rho < a, \\ \hat{\mathbf{z}} E_0 \sum_{n=-\infty}^{\infty} i^n \left[b_n^{TM} J_n(k_c\rho) + d_n^{TM} Y_n(k_c\rho) \right] e^{-in\varphi}, & a < \rho < a_c, \\ \hat{\mathbf{z}} E_0 \sum_{n=-\infty}^{\infty} i^n \left[J_n(k_0\rho) + c_n^{TM} H_n^{(1)}(k_0\rho) \right] e^{-in\varphi}, & \rho > a_c. \end{cases} \tag{2}$$

[5] This implies that the object is less detectable only over a restricted range of observation angles. Typical in many scattering phenomena, the target backscatter is much reduced by sacrificing the forward scattering, or *shadow*, which may become quite large due to absorption.

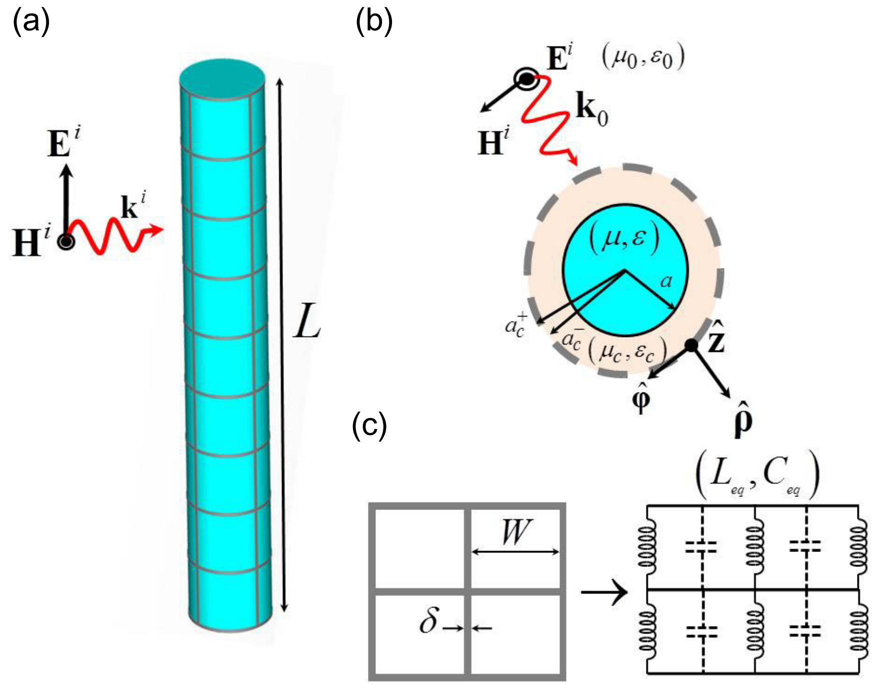

Figure 1. Magnetodielectric cylinder covered by a mantle metascreen and excited by a TM-polarized plane wave at normal incidence (a). Cross-section of the cylinder and of the conformal metascreen (b). Inductive surface reactance realized by a *fishnet* metascreen composed of subwavelength frequency-selective surface elements and its lumped equivalent circuit (c).

The corresponding incident and scattered magnetic fields may be found using the Maxwell–Faraday equation $\mathbf{H} = 1/\mathrm{i}\omega\mu\nabla\times\mathbf{E}$. In (2), $J_n(\cdot)$ and $H_n^{(1)}(\cdot)$ are the Bessel and Hankel functions of the first kind and order n representing standing and traveling cylindrical waves in each region, respectively [43]. For cylinders of moderate cross-section, the largest scattering contribution in figure 1(a) is due to TM polarization at normal incidence, for which the total electric field is purely along the cylinder axis and the impedance tensor $\bar{\bar{\mathbf{Z}}}_\mathrm{s}$ may be expressed as a scalar. Continuity of the total tangential electric and magnetic fields on the single-layered metasurface interface in figure 1(b) yields [33]

$$\mathbf{E}_{\tan}|_{r=a_c^\pm} = \mathrm{Z}_\mathrm{s}\left(\mathbf{H}_{\tan}|_{r=a_c^+} - \mathbf{H}_{\tan}|_{r=a_c^-}\right). \tag{3}$$

Thus, the total field relations for each of the regions in figure 1(b) allows to write the expression of the Mie scattering coefficients succinctly as [31]

$$c_n^{\mathrm{TM}} = -\frac{U_n^{\mathrm{TM}}}{U_n^{\mathrm{TM}} + \mathrm{i}V_n^{\mathrm{TM}}}, \tag{4}$$

where

$$U_n^{\mathrm{TM}} = \begin{vmatrix} J_n(ka) & J_n(k_\mathrm{c}a) & Y_n(k_\mathrm{c}a) & 0 \\ \frac{J_n'(ka)}{\eta} & \frac{J_n'(k_\mathrm{c}a)}{\eta_\mathrm{c}} & \frac{Y_n'(k_\mathrm{c}a)}{\eta_\mathrm{c}} & 0 \\ 0 & J_n(k_\mathrm{c}a_\mathrm{c}) & Y_n(k_\mathrm{c}a_\mathrm{c}) & J_n(k_0a_\mathrm{c}) \\ 0 & \frac{Z_\mathrm{s}}{\eta_\mathrm{c}}J_n'(k_\mathrm{c}a_\mathrm{c}) - \mathrm{i}J_n(k_\mathrm{c}a_\mathrm{c}) & \frac{Z_\mathrm{s}}{\eta_\mathrm{c}}Y_n'(k_\mathrm{c}a_\mathrm{c}) - \mathrm{i}Y_n(k_\mathrm{c}a_\mathrm{c}) & \frac{Z_\mathrm{s}}{\eta_0}J_n'(k_0a_\mathrm{c}) \end{vmatrix},$$

$$V_n^{\mathrm{TM}} = \begin{vmatrix} J_n(ka) & J_n(k_\mathrm{c}a) & Y_n(k_\mathrm{c}a) & 0 \\ \frac{J_n'(ka)}{\eta} & \frac{J_n'(k_\mathrm{c}a)}{\eta_\mathrm{c}} & \frac{Y_n'(k_\mathrm{c}a)}{\eta_\mathrm{c}} & 0 \\ 0 & J_n(k_\mathrm{c}a_\mathrm{c}) & Y_n(k_\mathrm{c}a_\mathrm{c}) & Y_n(k_0a_\mathrm{c}) \\ 0 & \frac{Z_\mathrm{s}}{\eta_\mathrm{c}}J_n'(k_\mathrm{c}a_\mathrm{c}) - \mathrm{i}J_n(k_\mathrm{c}a_\mathrm{c}) & \frac{Z_\mathrm{s}}{\eta_\mathrm{c}}Y_n'(k_\mathrm{c}a_\mathrm{c}) - \mathrm{i}Y_n(k_\mathrm{c}a_\mathrm{c}) & \frac{Z_\mathrm{s}}{\eta_0}Y_n'(k_0a_\mathrm{c}) \end{vmatrix}. \quad (5)$$

In the determinants of (5), k_l and η_l are the wave numbers and impedances in each region l and $Y_n(\cdot)$ is Neumann function of order n. Derivatives in (5) are with respect to the arguments of $J_n(\cdot)$ and $Y_n(\cdot)$. By electromagnetic duality, similar expressions may be derived for TE-polarized excitation at normal incidence.

The Mie scattering coefficients c_n^{TM}, written as the ratio of the determinants U_n^{TM} and V_n^{TM}, quantify the conditions for scattering suppression, viz., $U_n^{\mathrm{TM}} = 0 \Leftrightarrow |c_n^{\mathrm{TM}}| = 0$, or resonance, $V_n^{\mathrm{TM}} = 0 \Leftrightarrow |c_n^{\mathrm{TM}}| = 1$ [31]. Therefore, by properly designing a surface reactance to meet the condition $U_n^{\mathrm{TM}} = 0$, we may nullify any scattering contribution of order n at the frequency of interest. In general, the surface reactance required to cancel a particular scattering order, either TM or TE, will be different. Moreover, by nullifying a particular scattering order, we may risk to excite other scattering terms, since we may lie close to the condition $V_n = 0$ for other higher-order modes. Therefore, it is important to conduct a careful design of the cover to maximize bandwidth and overall scattering reduction [43].

Here we apply the concepts presented in [33, 35, 36] to create a patterned metasurface that may strongly reduce the total SCS of a finite-length dielectric cylinder with constitutive parameters $(3\varepsilon_0, \mu_0)$, as shown in figure 1. The length of the dielectric rod is $L = 18\,\mathrm{cm} \approx 2.2\lambda_0$ and the 2D cross-section (figure 1(b)) is $2a = 24.9\,\mathrm{mm} \simeq 0.31\lambda_0$, where the design frequency was chosen to be $f_0 = c/\lambda_0 = 3.73\,\mathrm{GHz}$ and λ_0 is the free space wavelength. We have chosen a conformal design ($a_\mathrm{c}/a \simeq 1$) because of its ultralow profile and bandwidth performance [33, 35]. Figure 2 shows the required surface reactance as a function of frequency to cancel the dominant scattering term c_0^{TM}, calculated using equation (4). At the central frequency f_0 an inductive reactance $X_\mathrm{s} = 195\Omega$ is needed.

Figure 3 shows the dispersion of the first four scattering coefficients for the bare (a), (c) and covered (b), (d) dielectric cylinders previously described, as calculated based on the above theory, assuming an ideal, homogeneous and infinitesimally thin surface impedance cover with the required reactance. As seen in the bare case, c_0^{TM} is by far the largest contribution due to an incident TM-polarized wavefront. However, there are also noticeable scattering contributions from TE harmonics (c). Our mantle cover is targeted to suppress the dominant scattering order, and indeed complete cancellation is observed at the design frequency (b). Interestingly, also the c_1^{TM} contribution is reduced at the design frequency f_0 and above. TE coefficients are also somewhat reduced by the cover (d) around the design frequency, but the cloak induces

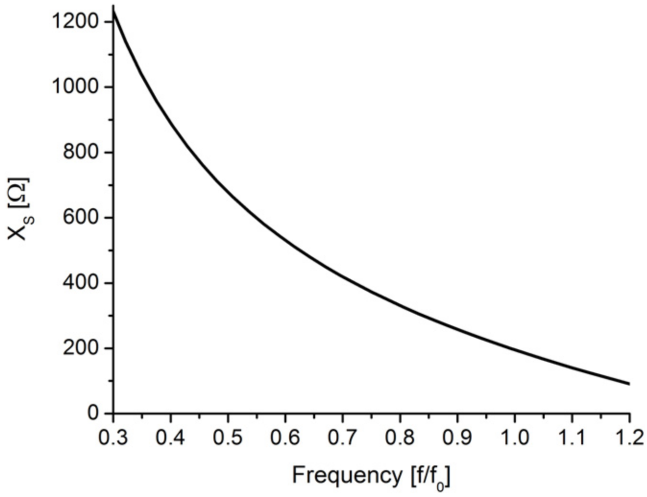

Figure 2. Required surface reactance to suppress the dominant scattering order for the geometry of figure 1 illuminated by a TM-polarized plane wave at normal incidence.

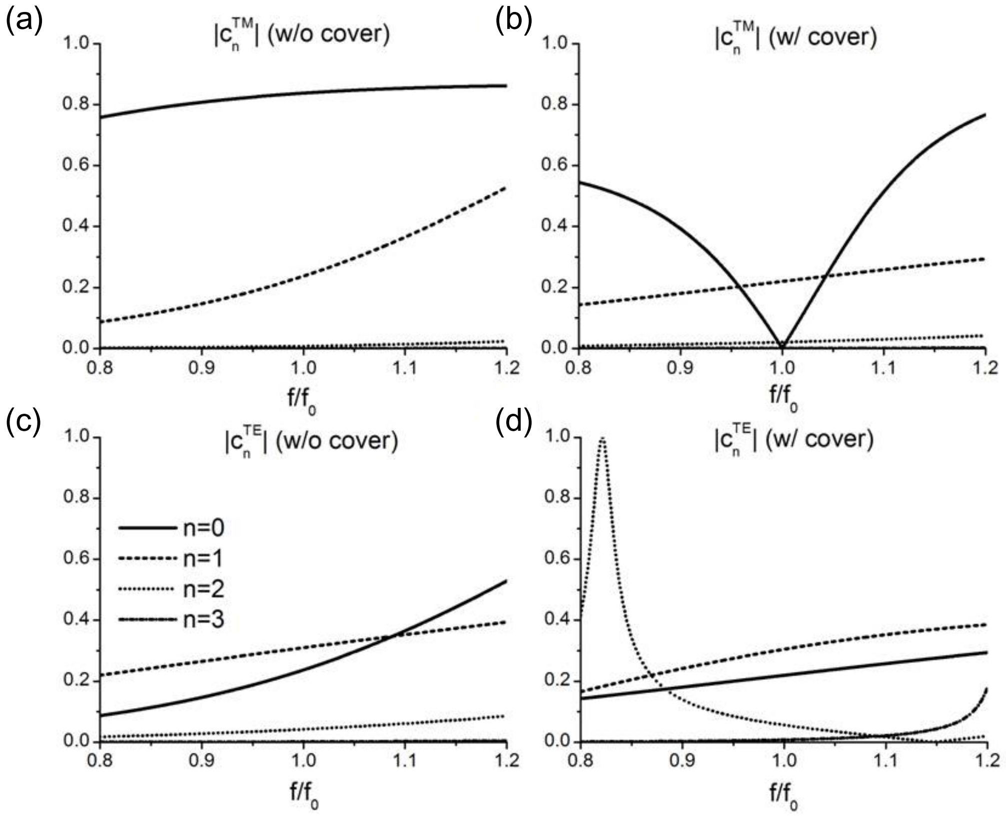

Figure 3. TM and electric scattering terms for the bare cylinder (a), (c) and the cylinder covered by an ideal $X_s = 195\,\Omega$ metascreen (b), (d).

a magnetic dipolar resonance ($V_1^{TE} = 0$) around $0.82 f_0$. While this effect will be reflected in scattering enhancement at lower frequencies, we expect strong total scattering reduction around the design frequency and for larger frequencies.

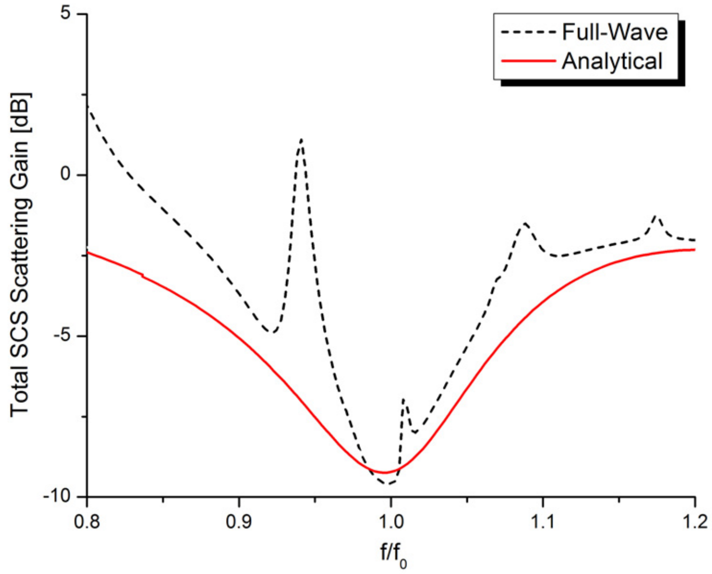

Figure 4. Analytical and full-wave simulations of the normalized total SCS.

2.2. *Full-wave numerical analysis*

We have used finite-integration simulations [44] to validate these analytical results for a realistic patterned surface tailored to synthesize the required shunt surface reactance in the case of a finite-length dielectric rod (figure 1). The optimized inductive metascreen consists of four longitudinal metallic traces running along the cylinder axis and ten circumferential traces (cf figure 1(c)), all with a line thickness $\delta = 1\,\mathrm{mm} \simeq 0.01\lambda_0$. There are a total of 36 square apertures with $W \simeq 1.8\,\mathrm{cm} \simeq 0.22\lambda_0$. We have verified that with good approximation we can neglect the metascreen losses here, due to the high conductivity of copper at microwave frequencies. The designed cover is tailored to realize the required surface reactance at the design frequency to suppress the dominant c_0^{TM} scattering term, as discussed in the previous section. The chosen fishnet configuration is well known to realize a compact, isotropic inductive response with a reduced parasitic capacitance between the conducting traces [45]. Our results in [36] have shown that analytical expressions to synthesize the required reactance in planar configurations may be safely used to design and tailor conformal metasurface designs with good accuracy, without the need of extensive optimization procedures.

Figure 4 compares analytical and simulated total SCS (integrated over all visible angles) for TM-polarized excitation at normal incidence. In the figure we simply show the *scattering gain*, defined as the scattering of the covered target normalized by that of the uncovered target at the same frequency, which allows an easy determination of the amount of overall scattering suppression. We can clearly see that strong scattering suppression is achieved over a moderately broad bandwidth, with largest scattering reduction around 9.6 dB at the design frequency. This is quite remarkable given the electrical cross-section of the target ($k_0 a \approx 1$) and its length, and the fact that this is obtained with a single conformal fishnet structure. The small disagreement between analytical and full-wave results, in particular the additional features visible in the full-wave spectrum, are due to the granularity of the realized metasurface. These non-idealities can be alleviated by using fewer circumferential traces; in the limit of

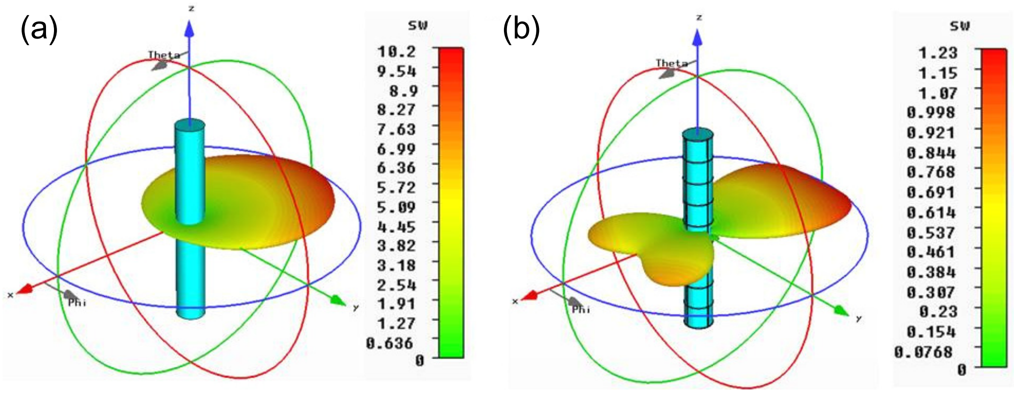

Figure 5. 3D far-field total scattering profiles for the uncloaked (a) and cloaked cases (b) at 3.73 GHz.

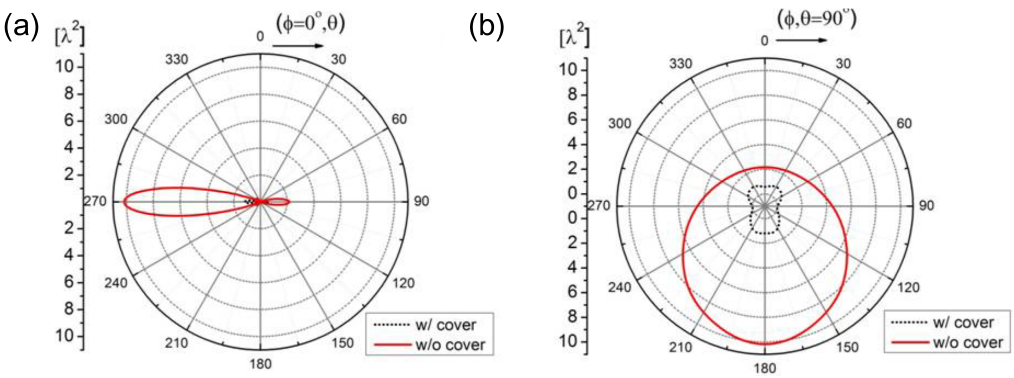

Figure 6. Principal plane elevation (a), and azimuthal (c) scattering profiles at 3.73 GHz.

thin cylindrical targets no circumferential strips are needed, since the scattering mechanism is dominated by the monopolar term, which for symmetry can be cancelled with longitudinal strips only. It is important to point out that it is difficult to simultaneously cancel several scattering multipoles at the same frequency with a single surface, due to the limited degrees of freedom. However, it may be possible to tailor the circumferential strips to cancel other relevant $c_n^{\mathrm{TE,TM}}$ scattering terms and further decrease the total SCS. We have not performed this optimization in the present work.

To better visualize the SCS reduction, figure 5 shows the calculated 3D far-field scattering profiles of the cloaked and uncloaked objects at the design frequency (notice the difference in scale), while figure 6 shows the SCS profiles along the principle plane cuts $\phi = 0^\circ$ plane (figure 5(a)) and $\theta = 90^\circ$ (figure 5(b)). Strong scattering reduction is observed over both principal planes, as expected. The figures confirm that the dominant monopolar scattering term is nearly cancelled and only residual higher-order scattering terms are left, producing residual and more directive scattering. This simple fishnet design is able to reduce the total scattering by over 85% at the design frequency.

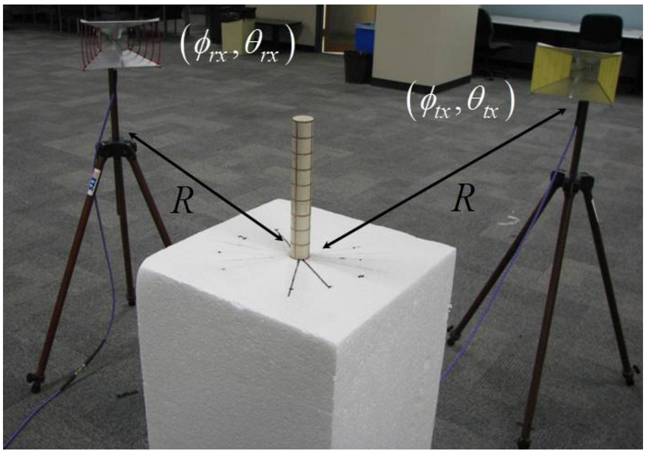

Figure 7. Far-field bistatic measurement setup. As shown in the schematic, the transmitter $(\phi_{\mathrm{tx}}, \theta_{\mathrm{tx}})$ and the receiver $(\phi_{\mathrm{rx}}, \theta_{\mathrm{rx}})$ are both at distance $R = 17.5\lambda_0$ from the region under test.

3. Measurement campaign

The optimized mantle cloak was fabricated using copper tape of thickness 66.0 μm, trimmed and attached to a polycarbonate flexible film of thickness 100.0 μm. Each of the conductive traces was cut to approximately 1 mm to realize the fishnet design in figure 1(c). To compare the measured results, all full-wave simulations considered losses with a non-ideal dielectric rod $\left(\delta = 0.002|_{f=3.7\mathrm{GHz}}\right)$ and copper tape $\left(\sigma = 5.8 \times 10^7\,\mathrm{S\,m^{-1}}\right)$.

3.1. Far-field measurements

Far-field bistatic measurements were performed to extract the radar cross-section (RCS) of the uncloaked and cloaked objects, and the extracted RCS was compared to full-wave simulations. Equal distances between the transmitter $(\phi_{\mathrm{tx}}, \theta_{\mathrm{tx}})$ and receiver $(\phi_{\mathrm{rx}}, \theta_{\mathrm{rx}})$ to the target were maintained at $R = 17.5\lambda_0$ while scanning over principal elevation and azimuthal planes as in figure 5, using calibrated ETS-Lindgren 3115 ultra-wideband horn antennas, shown in figure 7. Transmission data were acquired through an Agilent E5071C vector network analyzer, which measured the raw complex scattering response between the two antennas as the scattering parameter $\mathbf{S}_{21}$. In figure 7, as an example, we show the azimuthal bistatic measurement when the transmitter is located at $(\phi_{\mathrm{tx}} = 0^\circ, \theta_{\mathrm{tx}} = 90^\circ)$ and the receiving antenna is moved in the azimuth plane $(\phi_{\mathrm{rx}} = 90^\circ, \theta_{\mathrm{rx}} = 90^\circ)$.

Repositioning the antennas around the target at a constant target distance achieved the desired monostatic or bistatic measurements. Our non-anechoic laboratory environment necessitated vector background subtraction and software-based time gating steps in post-processing to remove background clutter. Background subtraction requires two measurements: one with the target in place, yielding $\mathbf{S}_{21,\mathbf{T}}$, and another with only the target removed, yielding $\mathbf{S}_{21,\mathbf{B}}$. The quantity $\mathbf{S}_{21,\mathbf{S}} = \mathbf{S}_{21,\mathbf{T}} - \mathbf{S}_{21,\mathbf{B}}$ closely corresponds to the response of the target with most environmental effects removed. Software-based time gating further reduces clutter. This

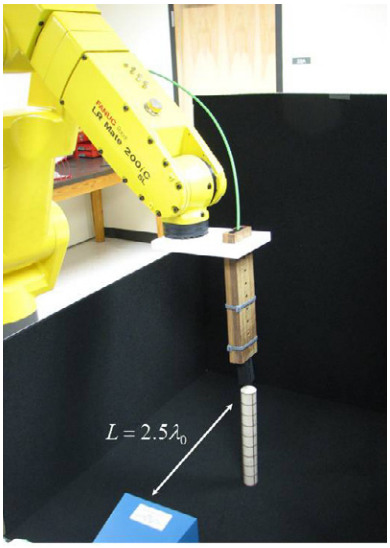

Figure 8. Picture of the near-field mapping system. A microwave horn excites each test scenario and a near-field probe samples the temporal and spatial TM-polarized electric field.

processing step is expressed as

$$\mathbf{S}'_{\mathbf{21,S}} = \mathrm{fft}[\mathbf{W} \cdot \mathrm{ifft}(\mathbf{S_{21,S}})], \tag{6}$$

where fft $(\cdot)$ and ifft $(\cdot)$ are the fast Fourier transform and its inverse, and $\mathbf{W}$ is a rectangular window function used to gate out returns due to the background clutter.

Post-processed S-parameter measurements were converted to RCS values using the radar range equation [46]

$$\left|\mathbf{S}'_{\mathbf{21,S}}\right|^2 = \frac{P_\mathrm{r}}{P_\mathrm{t}} = \frac{G_\mathrm{t} G_\mathrm{r} \lambda_0^2 \sigma}{(4\pi)^3 R_\mathrm{t}^2 R_\mathrm{r}^2}, \tag{7}$$

where P_r and (P_t) are the received and (transmitted) power, G_r and (G_t) are the receive and (transmit) gain, and R_r and (R_t) are the distances from the cloaked dielectric cylinder to the receive and (transmit) antennas. Substituting measured and known values (including antenna gain calibration values), one can solve for the RCS (σ).

To achieve high temporal resolution in the time gating step, measurements were performed over a wide frequency band of 1–5 GHz. The difference in $\mathbf{S}'_{\mathbf{21,S}}$ between the two measurements yields the metric scattering gain, which quantifies the scattering reduction by normalizing the cloaked RCS to the uncloaked RCS. To demonstrate and validate the time gating and background procedure, figure 9 overlays the raw RCS data with the post-processed time-gated data for a sample measurement in the forward direction. Panel (a) shows the raw measurements of the object along with the covered object, and (b) shows the scattering gain, both with and without time gating. It is clear that the forward scattering is significantly reduced, even beyond our measurement bandwidth, and the scattering gain shows more than 10 dB reduction over a moderate bandwidth. The optical theorem ensures that the total scattering is similarly reduced, in agreement with our full-wave simulations of figure 4. Additionally, it is seen that the time-gating matches the raw response extremely well. We note that some error is inevitably

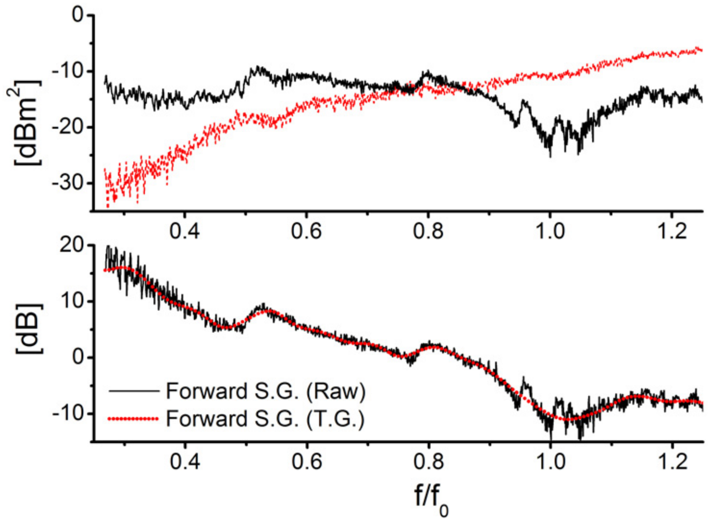

Figure 9. (a) Raw RCS data measured in the forward direction of the uncovered (dashed) and covered (solid) cylinder; (b) comparison of the computed scattering gain (S.G.) in the same direction obtained from raw RCS data and time-gated (T.G.) data.

introduced by filtering out the unintended returns in the time domain. The most significant errors are introduced near the edges of the data acquisition bandwidth, but these regions are far outside the designed bandwidth.

Figure 10 shows the measured and simulated scattering gains in the azimuthal plane, where the transmit antenna was held constant at ($\phi_{\rm tx} = 0°$, $\theta_{\rm tx} = 90°$), while the receive antenna was moved throughout the range ($30° \leqslant \phi_{\rm rx} \leqslant 180°$, $\theta_{\rm rx,tx} = 90°$). We can see that the strongest scattering contribution at normal incidence is significantly reduced by applying the cloak around the design frequency. The frequency of maximum scattering reduction is seen to move up in frequency from boresight to the forward scattering direction, consistent with our simulations. As will be shown in the near-field maps in the next section, this varying azimuthal scattering dip leads to an increased bandwidth of overall total SCS reduction, and is due to the complex interaction between the anisotropic effective surface impedance realized by our cover and the higher-order scattering terms, as shown in figure 3. Remarkably, we may observe a 13 dB reduction in forward scattering, which is typically the most difficult to suppress in cloaking experiments (figure 9).

The minor differences between measurements and simulations are attributed to the slight variation in the metascreen prototype. The realized traces were measured to have up to 5% error in width, corresponding to a maximum of 5% error in operating frequency, due to the nearly linear surface impedance dispersion around f_0 (see figure 2). It is also important to notice the difference in the strength of scattering gain dips between simulated and measured results. These differences are attributed to two main reasons: first, as shown in figure 9, the post-processing in the time gating step makes somewhat smooth the measured data depending on the length of the rectangular window. In removing the background clutter, we also necessarily remove some of the details of the scattering from the realistic anisotropic surface impedance. For instance, the anisotropic effects of the metascreen are more apparent in the simulations and raw data

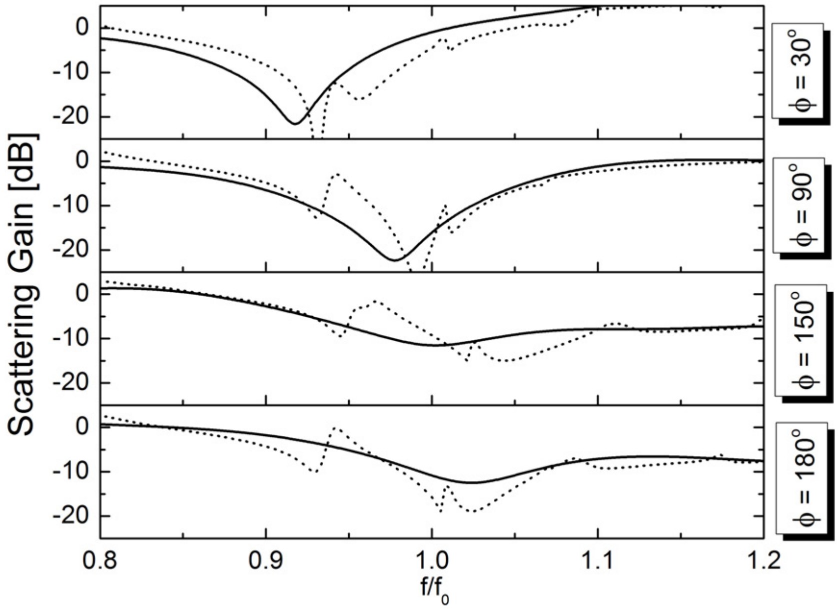

Figure 10. Bi-static scattering gain for normal incidence $30^\circ \leqslant \phi \leqslant 180^\circ$, $\theta_{\mathrm{rx,tx}} = 90^\circ$and various azimuthal receiver angles: measurements (solid) and simulations (dotted) are compared in each panel.

(see figure 9) than in the post-processed data in figure 10. To a lesser degree, while ideally small losses were considered in our simulations, differences due to manufacturing tolerances in the dielectric material, copper tape and polycarbonate sheet may have led to slightly more absorption in the cover and dielectric rod, thereby decreasing the sharpness of the cloaking dip in the realistic setup. Still, the agreement between simulations and measurements is good overall, and the trend of the cloaking dip as a function of angle is quite accurate.

Similarly, figure 11 shows a scan in the elevation plane for the case in which the transmitting antenna was held in the same location ($\phi_{\mathrm{tx}} = 0^\circ, \theta_{\mathrm{tx}} = 90^\circ$) while the receiving antenna was moved between ($\phi_{\mathrm{rx}} = 0^\circ, -60^\circ \leqslant \theta_{\mathrm{tx}} \leqslant 30^\circ$) in steps of 30°. The elevation measurements show more resonant features and relatively less agreement with the numerical simulations, but a consistent scattering reduction is observed around the frequency of interest, and the general trends are similar. As discussed above, time gating and realistic absorption may be responsible for some of the differences between the locations and depths of the resonances between the simulated and measured results in figure 11.

As derived in [36], the fishnet design is characterized by an impedance varying with angle of incidence as

$$X_{\mathrm{s}} = -\frac{f\eta_0 D}{c}\ln\left[\csc\left(\frac{\pi w}{2D}\right)\right]\left(1-\frac{\cos^2\theta_{\mathrm{s}}}{\varepsilon_{\mathrm{r}}+1}\right), \qquad (8)$$

where D is the period, w is the width of the traces, f is the frequency of interest, c is the speed of light, θ_{s} is the incidence angle measured from $\hat{z}$ (see figure 1(b)) and ε_{r} is the relative permittivity of the dielectric object. Therefore, as the elevation angle increases, the effective surface impedance is lowered. For instance, we predict from equation (8) a reduction of approximately 39 Ω between normal ($\theta = 90^\circ$) and ($\theta = 30^\circ$) incidence. As shown in figure 2, this lowering leads to an increase of the cloaking frequency, up to 8% at $\theta = 30^\circ$, which explains

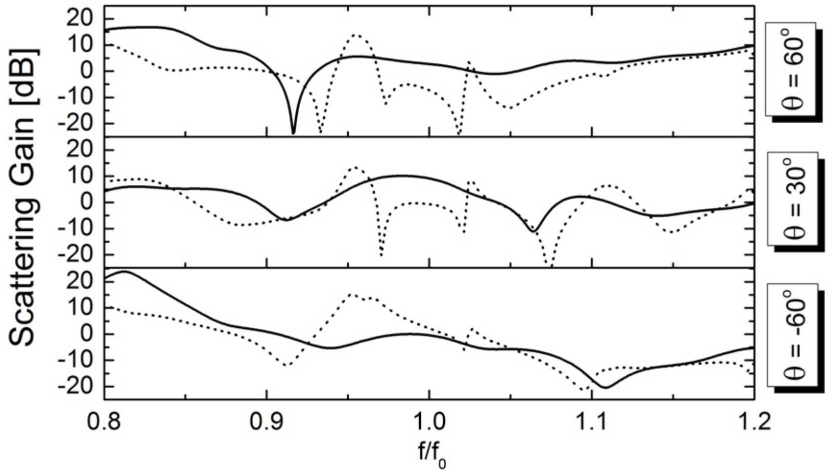

Figure 11. Bi-static scattering gain for $\phi_{\mathrm{tx,rx}} = 0^\circ$ and various elevation angles: measurements (solid) and simulations (dotted) are compared in each panel.

the trend in figure 11. The residual and more directive higher-order terms also add another layer of complexity to the measured spectra, especially for oblique incidence, consistent with the TE scattering term dispersion predicted in figure 3. Our design keeps suppressing the dominant term for larger incidence angles; however, the frequency of operation is varied.

It should be finally pointed out that, although at some angles the scattering gain is above 0 dB at the design frequency, in the elevation plane the overall scattering is significantly less than in the principal plane, especially for large incidence angles, consistent with figures 5 and 6. It is evident that suppressing the scattering at all angles with a single metasurface is not necessarily possible, but, by integrating over all the visible angles, as done in figure 4, significant total SCS suppression may be achieved. We predict that better results may be obtained by considering multiple stacked metasurfaces, or by tailoring a single surface to fit the required surface reactance curve over a broader frequency range, that may be able to suppress several scattering orders at the same frequency. It should be also stressed that figure 11 shows the scattering gain, i.e., the normalized scattering to the uncloaked scenario, and for oblique incidence the scattering may be significantly smaller than for normal incidence, weighing less on the total SCS of the object.

3.2. Near-field mapping

In addition to far-field measurements, we have conducted several near-field scans to visualize more strikingly the scattering reduction by the mantle cloak around the object. Our 3D near-field scanning system was programmed to map the temporal and spatial total electric field distribution around the device under test, similar to our setup in [11]. In this case, the illuminating microwave horn, polarized parallel to the cylinder's axis, was placed at $2.6\lambda_0$ from the target (cf figure 8). The scan area was $2.4\lambda_0 \times 2.4\lambda_0$with a fine sampling resolution $\Delta x = \Delta y = 0.08\lambda_0$. Three different scenarios are presented in figure 12: (i) uncloaked, (ii) cloaked and (iii) free-space. In each case, the near-field probe was held at a constant height of approximately 80% of the cylinder height L (see figure 1(a)) in the azimuthal plane, except for the case when the sampling plane intersected the region of the object. The black squares in figure 12 are the regions where

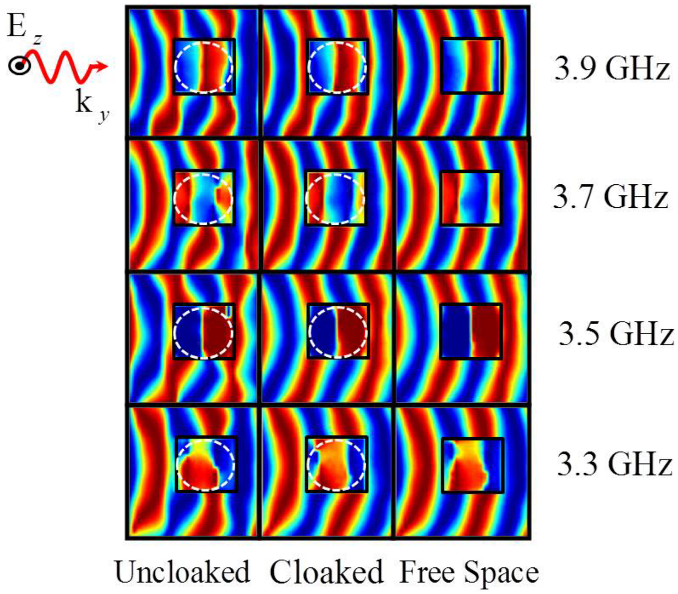

Figure 12. Snapshot in time of the normal electric field distribution for the azimuthal plane. A microwave horn illuminates each test scenario with a TM-polarized Gaussian wavefront at normal incidence.

the near-field probe was programmed to scan directly above the object (in a different plane) to avoid collision and the dashed white circle represents the location of the dielectric rod.

It is seen that the Gaussian wavefronts radiated by the horn are well restored by the cloak, and are nearly identical to the free-space case. Best cloaking performance is observed in the frequency band $3.3 - 3.9$ GHz, which demonstrates the moderately broad bandwidth of this cloaking technique. The experimental results show good agreement with our numerical modeling results in the previous section. In figure 12, the edges of the operation band are also shown (top and bottom rows), which, as expected, provide a somewhat weaker performance than in the design band 3.6–3.8 GHz. The third row shows the best scattering reduction performance at 3.7 GHz, consistent with the simulated total SCS results in figure 3. Here, the phase fronts around and on top of the cloaked object are nearly indistinguishable from the one measured in free-space, and it is impressive to notice the restored near-field field distribution, even just outside the thin cloaking layer, further illustrating the scattering cancellation induced by the metasurface. At 3.3 and 3.9 GHz, which are respectively the lower and upper bound of the cloaking operation, we can still find suppression of the near-field scattering, when compared to the uncloaked dielectric rod.

We have also tested the near-field distribution for oblique illumination. The results in the previous sections showed that the cloaking effect was maintained at oblique incidence, but the optimal cloaking dip was effectively *blue-shifted* with increasing incidence angles. This is confirmed and visually demonstrated in our measured near-field maps in figure 13, which considers the case of illumination at a 30° elevation angle. This is an extreme case, for which the target is nearly parallel to the azimuthal plane of measurement. Also in this case the field snapshots are taken in the azimuthal plane at a constant height, except for the positions for which the cloak or object (black outline) would hit the near-field probe. The white-dashed line

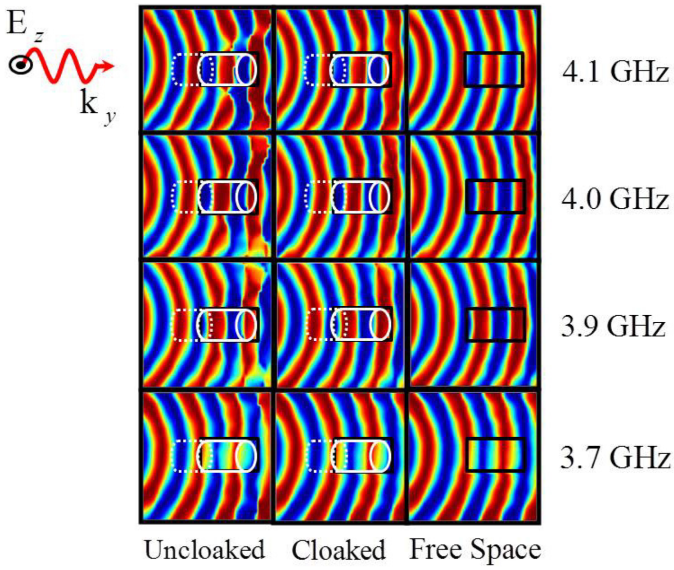

Figure 13. Snapshot in time of the electric near-field distribution for the azimuthal plane for 30° incidence.

in the figure corresponds to the points where the object under test is below the measurement plane and the probe plane did not need to be moved. The incident fields are shown to be only slightly disturbed by the presence of the covered dielectric rod for frequencies around the design frequency and higher. Here we should note that, due to the experimental setup, the end of the uncloaked and cloaked dielectric cylinders are fully exposed (not covered by the mantle cloak) to the incident field. However, the cross-sectional area at the end of the object is quite small, so it only adds a marginal amount to the total SCS. Overall, the cloaking effect due to the conformal metasurface shows strong suppression between 3.7 and 4.1 GHz for this excitation angle, consistent with our numerical results and far-field measurements.

4. Conclusions

We have reported here the first experimental verification of mantle cloaking for a 3D finite-length dielectric cylinder of moderate cross-section. We have shown good scattering suppression over a broad range of viewing angles and over a moderate frequency range using a simple ultrathin patterned metascreen tailored to suppress the dominant scattering order. Higher-order multipoles can contribute to the residual scattering and it is foreseen that the use of multiple mantle layers or an asymmetric tailoring of the cloak may be optimized to suppress more scattering orders, especially for larger objects. The observed scattering reduction was not limited to far-field observers, but it was also verified right around the cloaked object. As demonstrated in this work, cloaking in the very near-field by means of an equivalent surface reactance guarantees strong scattering suppression for arbitrary wavefronts, showing that the conformal metascreen cloak is resilient to complex and non-ideal phase patterns, as theoretically explored in [47]. Combined with the field penetration inside the cloak, these results pave the way to realizing not only 3D conformal camouflaging and invisibility, but also a practical scheme for non-invasive high-performance near-field sensors [48]. The ease of fabrication of our design is very appealing, especially at microwave frequencies, as opposed to other more complex cloaking strategies, and the realized prototype tested in this work also shows a strong invariance to manufacturing and measurement imperfections as well as realistic losses.

Acknowledgments

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iRobot And Cisco Build A Roving Telepresence Rig So Remote Workers Can Still Roam The Office

CHRIS VELAZCO

Monday, June 10th, 2013

19 Comments

It's no secret that iRobot's domestic cleaning machines can carry some interesting things while they putter around and wipe up your floors, and iRobot and Cisco have taken that notion to its next logical step. The two companies have just announced that they've taken this smart roving robotics platform and stuck this pricey enterprise video conferencing monitor on top, all to facilitate West Wing-style walk-and-talks with colleagues who couldn't be bothered to schlep into the office.

We've seen plenty of curious telepresence rigs before, but this is one of the few that makes it a point to break away from the confines of a desk. Once everything is put together, the Ava 500 stands at about 5'5″ and artfully dodges office debris the same way the more janitorial units do. Meanwhile, those remote users also get to control that roving robot by way of an iPad app, though the process isn't as hands-on as one might hope — the Ava 500 handles most of the control itself after the user selects a destination so it's perfect for remotely touring dangerous corners of the factory floor, but not so perfect for doing donuts outside of Conference Room B.

In case the notion of buying one of these to remotely dick around with friends has you reaching for your checkbook, you may want to look into a less ambitious way to go. iRobot looks at the Ava 500 as a strictly enterprise device and it has a price tag to match: according to the Boston Herald, the Ava will cost companies in the neighborhood of $70,000 when it launches next year, or about $2,000-$2,500 if you lease it monthly.

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The product of MIT, iRobot (IRBT) is the bellwether company for the emerging robot economy. It is the maker and home of the famous archetype military robot, the PackBot and of the world's first mass-produced consumer vacuum cleaner robot, the Roomba. Founded in 1990 by roboticists from the Massachusetts Institute of Technology, iRobot designs behavior-based, artificially intelligent robots. iRobot's products are designed to navigate through complex and dynamic real-world situations, from maneuvering around furniture to searching abandoned buildings. Their robots...

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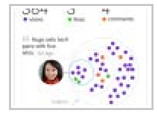

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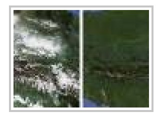

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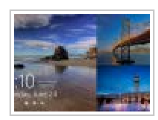

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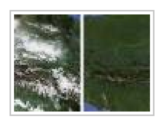

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Paras Sabharwal Jun 10, 2013

amazing Tech stuff, Future Telepresence in view now :)

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NadavBen-Haim Jun 10, 2013

or i can just use my google glass to do a hang out :)

Like Reply

NitterNatter Jun 10, 2013

If you have the capacity to invest in this, then why not? Sheldon would be very proud, and smug to say the least!

We're all about making work more flexible, although not that sure about the West Wing-style walk-and-talks!

Nadia

Nitter Natter

Like Reply

GianniMartire Jun 10, 2013

Incredibly useless. Did anyone think this through?

Like Reply

Gregory A. Levine Jun 10, 2013

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Hey, it's Michael Arrington

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Sheldon-bot : You think you have me stymied, don't you? Leonard: No, I think a doorknob has you stymied.

1 Like Reply

Molly Colliton Sheridan Jun 10, 2013

Sheldonbot!

Like Reply

michimoby Jun 10, 2013

So what you're saying is that we're finally catching up to the Back to the Future timeline? We're two years ahead of schedule! http://www.youtube.com/watch?v=vAEU-Lf60LA

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Jędrzej Kołtunowicz Jun 10, 2013

http://www.blogcdn.com/www.engadget.com/media/2010/10/shelbottexaiscreengraboct2010.jpg

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Sheldonbot!

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ok i will

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Sheldon did this before it was cool ;)

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First to break away from the desk? What about Double Robotics, reported even here at TC a number of times?

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I had to look at the calendar to see if it was April 1st

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DOI: 10.1088/1741-2560/6/3/035003

Abstract:

Visual impairing eye diseases are the major frontier facing ophthalmic research today in light of our rapidly aging population. The visual skills necessary for improving the quality of daily function and life are inextricably linked to these impairing diseases. Both research and reimbursement programs are emphasizing outcome-based results. Is improvement in visual acuity alone enough to improve the function and quality of life of visually impaired persons? This perspective summarizes the types of effectiveness endpoints for clinical investigations of visual prostheses that go beyond visual acuity. The clinical investigation of visual prostheses should include visual function, functional vision and quality of life measures. Specifically, they encompass contrast sensitivity, orientation and mobility, activities of daily living and quality of life assessments. The perspective focuses on the design of clinical trials for visual prostheses and the methods of determining effectiveness above and beyond visual acuity that will yield outcomes that are measured by improved function in the visual world and quality of life. The visually impaired population is the primary consideration in this presentation with particular emphases on retinitis pigmentosa and age-related macular degeneration. Clinical trials for visual prostheses cannot be isolated from the need for medical rehabilitation in order to obtain measurements of effectiveness that produce outcomes/evidence-based success. This approach will facilitate improvement in daily function and quality of life of patients with diseases that cause chronic vision impairment.

Citation:

Is acuity enough? Other considerations in clinical investigations of visual prostheses.
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Authors:
Lepri BP

Number of References:
10

Major Subjects:

- Artificial Intelligence
- Biomedical Engineering / * instrumentation
- Blindness / * rehabilitation
- Electric Stimulation Therapy / * instrumentation / trends
- Electrodes, Implanted
- Prostheses and Implants
- Visual Acuity / * physiology

Additional Subjects:

- Humans
- Prosthesis Design / methods

Laser Toys: Not Always Child's Play

Many a kid (and parent) who has seen Luke Skywalker battle Darth Vader with a lightsaber thinks lasers are cool.

What they may not know is this: When operated unsafely, or without certain controls, the highly-concentrated light from lasers—even those in toys—can be dangerous, causing serious eye injuries and even blindness. And not just to the person using a laser, but to anyone within range of the laser beam.

The Food and Drug Administration (FDA) is particularly concerned about this potential danger to children and those around them, and has issued a draft guidance document on the safety of toy laser products.

According to Dan Hewett, health promotion officer at FDA's Center for Devices and Radiological Health, "A beam shone directly into a person's eye can injure it in an instant, especially if the laser is a powerful one."

However, laser injuries usually don't hurt, and vision can deteriorate slowly over time. Eye injuries caused by laser light may go unnoticed, for days and even weeks, and could be permanent, he says.

Some examples of laser toys are:

- lasers mounted on toy guns that can be used for "aiming;"
- spinning tops that project laser beams while they spin;
- hand-held lasers used during play as "lightsabers;" and
- lasers intended for entertainment that create optical effects in an open room.

FDA Regulates Lasers

A laser creates a powerful, targeted beam of electromagnetic radiation that is used in many products, from music players and printers to eye-surgery tools. FDA regulates radiation-emitting electronic products, including lasers, and sets radiation-safety standards that manufacturers must meet. Hewett explains that this includes all laser products that are marketed as toys.

Toys with lasers are of particular interest to the FDA because it's often children who are injured by these products, says Hewett. He notes that because advertisers promote them as playthings, parents and kids alike may believe they're safe to use.

"For toys to be considered minimal risk, we recommend that the levels of radiation and light not exceed the limits of Class 1, which is the lowest level in regulated products," Hewett says. Lasers used for industrial and other purposes often require higher radiation levels, he explains. But in toys, those levels are unnecessary and potentially dangerous.

In recent years, Hewett says, lasers have increased markedly in power and have gone way down in price. And while adults may buy a laser pointer for use in work, kids often buy them for amusement.

"Low-cost, compact laser pointers used to be quite low in power," Hewett says; but, in the last 10 years, many laser pointers have increased in power 10-fold and more. The fact that lasers can be dangerous may not be evident, particularly to the children who use them as toys, or to the adults who supervise them.

Tips to Keep in Mind

- Never aim or shine a laser directly at anyone, including animals. The light energy from a laser aimed into the eye can be hazardous, perhaps even more than staring directly into the sun.
- Do not aim a laser at any reflective surface.
- Remember that the startling effect of a bright beam of light can cause serious accidents when aimed at a driver in a car or otherwise negatively affect someone who is engaged in other activity (such as playing sports).
- Look for a statement that it complies with 21 CFR (the Code of Federal Regulations) Subchapter J on the label.

"If you buy a laser toy or pointer and you don't see this information in the labeling, it's best not to make any assumptions about its safety," Hewett says.

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nature materials

NATURE MATERIALS | ARTICLE

Macroporous nanowire nanoelectronic scaffolds for synthetic tissues

Bozhi Tian, Jia Liu, Tal Dvir, Lihua Jin, Jonathan H. Tsui, Quan Qing, Zhigang Suo, Robert Langer, Daniel S. Kohane & Charles M. Lieber

Affiliations | Contributions | Corresponding authors

Nature Materials **11**, 986–994 (2012) | doi:10.1038/nmat3404

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Abstract

Abstract • References • Author information • Supplementary information

The development of three-dimensional (3D) synthetic biomaterials as structural and bioactive scaffolds is central to fields ranging from cellular biophysics to regenerative medicine. As of yet, these scaffolds cannot electrically probe the physicochemical and biological microenvironments throughout their 3D and macroporous interior, although this capability could have a marked impact in both electronics and biomaterials. Here, we address this challenge using macroporous, flexible and free-standing nanowire nanoelectronic scaffolds (nanoES), and their hybrids with synthetic or natural biomaterials. 3D macroporous nanoES mimic the structure of natural tissue scaffolds, and they were formed by self-organization of coplanar reticular networks with built-in strain and by manipulation of 2D mesh matrices. NanoES exhibited robust electronic properties and have been used alone or combined with other biomaterials as biocompatible extracellular scaffolds for 3D culture of neurons, cardiomyocytes and smooth muscle cells. Furthermore, we show the integrated sensory capability of the nanoES by real-time monitoring of the local electrical activity within 3D nanoES/cardiomyocyte constructs, the response of 3D-nanoES-based neural and cardiac tissue models to drugs, and distinct pH changes inside and outside tubular vascular smooth muscle constructs.

At a glance

Figures | Compounds | Genes and Proteins

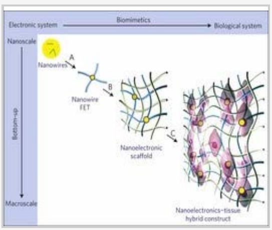

Figure 1

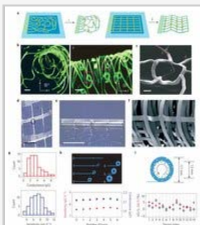

Figure 2

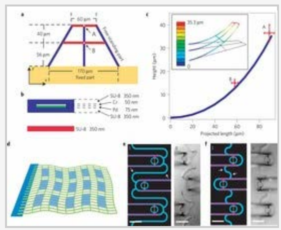

Figure 3

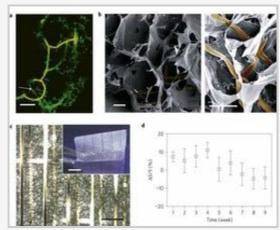

Figure 4

First | 1-4 of 6 | Last

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Contributions

B.T., J.L., T.D., D.S.K. and C.M.L. designed the experiments. B.T. and J.L. performed experiments. T.D., J.T. and Q.Q. assisted in the initial stage of the project. L.J. and Z.S. performed calculations and simulations. B.T., J.L., D.S.K. and C.M.L. wrote the paper. All authors discussed the results and commented on the manuscript.

Competing financial interests

The authors declare no competing financial interests.

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Supplementary information

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PDF files

1. Supplementary Information (1.96 MB)
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Nature Materials ISSN 1476-1122 EISSN 1476-4660

Microcomputer-based artificial vision support system for real-time image processing for camera-driven visual prostheses. - Fink W - *J Biomed Opt* - 01-JAN-2010; 15(1): 016013
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Abstract:

It is difficult to predict exactly what blind subjects with camera-driven visual prostheses (e.g., retinal implants) can perceive. Thus, it is prudent to offer them a wide variety of image processing filters and the capability to engage these filters repeatedly in any user-defined order to enhance their visual perception. To attain true portability, we employ a commercial off-the-shelf battery-powered general purpose Linux microprocessor platform to create the microcomputer-based artificial vision support system (microAVS(2)) for real-time image processing. Truly standalone, microAVS(2) is smaller than a deck of playing cards, lightweight, fast, and equipped with USB, RS-232 and Ethernet interfaces. Image processing filters on microAVS(2) operate in a user-defined linear sequential-loop fashion, resulting in vastly reduced memory and CPU requirements during execution. MiccroAVS(2) imports raw video frames from a USB or IP camera, performs image processing, and issues the processed data over an outbound Internet TCP/IP or RS-232 connection to the visual prosthesis system. Hence, microAVS(2) affords users of current and future visual prostheses independent mobility and the capability to customize the visual perception generated. Additionally, microAVS(2) can easily be reconfigured for other prosthetic systems. Testing of microAVS(2) with actual retinal implant carriers is envisioned in the near future.

Citation:

Microcomputer-based artificial vision support system for real-time image processing for camera-driven visual prostheses.
Fink W - *J Biomed Opt* - 01-JAN-2010; 15(1): 016013
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Authors:
Fink W; You CX; Tarbell MA

Major Subjects:

- Blindness / * therapy
- Image Processing, Computer-Assisted / * instrumentation / methods
- Microcomputers
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Paralyzed woman gets robotic arm she controls with her mind

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The BrainGate Collaboration

In a clinical trial, Cathy Hutchinson, who has been paralyzed for more than 14 years, used the BrainGate system to mentally control a robotic arm and reach for a drink.

The stroke that disconnected Cathy Hutchinson's brain from her body has kept her silent and unable to move for more than 14 years. But science is starting to change all that.

Researchers have connected the 58-year-old woman's brain to a computer that runs a robotic arm. As Hutchinson sits at a table staring at a bottled drink and imagining the robot grabbing the bottle and bringing it to her mouth, the robot arm begins to move.

The robot is running on signals detected by sensors implanted in the part of Hutchinson's brain that would normally control the movements of her right arm. The sensors pick up the sparking of nerve cells and send the signals to the computer which then translates them into commands for the robotic arm. Suddenly Hutchinson is able to do something she could only dream of before: As she thinks about getting herself a drink, the arm reaches over to the bottle and brings it to her lips, where she is able to sip the drink from a straw.

It's the first time Hutchinson's been able to do anything for herself since the stroke.

Hutchinson's experiences, along with those of another quadriplegic patient, were described in a groundbreaking paper published Wednesday in Nature. Both patients are part of an ongoing government funded trial that is testing the new brain translation technology, BrainGate, which one day may free "locked-in" patients like Hutchinson and give functional limbs to amputees.

It will be years before BrainGate could be available to the general public. But Hutchinson's happy to enjoy the future today. After realizing she could control the robot arm, she said she was "ecstatic." Though Hutchinson cannot speak, she can type her thoughts through a device that takes its cues from her eye movements.

She's optimistic about what the research might one day bring. "I would love to have robotic leg support," she says.

What's amazing is how researchers have "taught" their computer to essentially read Hutchinson's thoughts.

The baby-aspirin sized sensor implanted in Hutchinson's brain contains 96 hair-thin electrodes that record the sparking of neurons in the movement control center, the motor cortex.

The first step in the learning process is for the computer to "see" which neurons spark, and in what pattern, when a person picks up a bottle and brings it to her lips, explains the study's lead researcher, Dr. Leigh R. Hochberg, a professor of engineering at Brown University, a researcher at the Providence VA Medical Center, a critical care neurologist at the Massachusetts General Hospital/Brigham and Women's Hospital in Boston, and a visiting associate professor of neurology at the Harvard Medical School.

Fortuitously, it doesn't matter whether the person actually moves their limb or whether they're merely imagining themselves doing it. So, for several trials, Hochberg and his colleagues had the computer observe the sparking patterns of neurons in Hutchinson's brain as she watched the robot arm pick up the bottle and bring it to her lips.

Once the scientists had taught the computer which patterns would normally make Hutchinson's arm reach out for the bottle of coffee, they hardwired them as the command for the robot arm to do the same thing – but with the signal coming directly from Hutchinson's brain as she imagined herself grasping the cup and bringing it to her lips.

"Beyond this, our real dream for this research is for people with paralysis — from a brain stroke or spinal cord injury — to be able to one day reconnect the brain to the limbs," Hochberg says.

Those kinds of injuries often leave a healthy brain disconnected from a healthy set of nerves that would normally control the movement of the limbs. So, the hope is that someday doctors might be able to reconnect things, like an electrician replacing a bit of shorted out wire.

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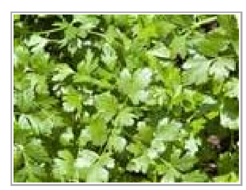
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To a very vocal online contingent, cilantro is the very worst. On "I Hate Cilantro" websites and Facebook pages they gripe that the herb tastes like soap, mold, or dirt. Cilantro haters not only despise its flavor, they also detest its smell.

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For her part, Hutchinson is hoping that the researchers come up with a permanent, wireless implant and a way to reconnect her brain to her body.

She imagines what it would be like to cook and garden again. “I know that someday this will happen again,” she says.

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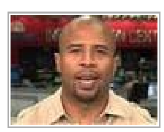

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Mind-controlled exoskeleton lets paralysed people walk

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Video: Thought-controlled exoskeleton

TWO years ago, Antonio Melillo was in a car crash that completely severed his spinal cord. He has not been able to move or feel his legs since. And yet here I am, in a lab at the Santa Lucia Foundation hospital in Rome, Italy, watching him walk.

Melillo is one of the first people with lower limb paralysis to try out MindWalker – the world's first exoskeleton that aims to enable paralysed and locked-in people to walk using only their mind.

Five people have been involved in the clinical trial of MindWalker over the past eight weeks. The trial culminates this week with a review by the European Commission, which funded the work; the project has been carried out by a consortium of several major universities and companies.

It's the end of a three-year development period for the project, which has three main elements. There is the exoskeleton itself, a contraption that holds a person's body weight and moves their legs when instructed. People learn how to use it in the second element: a virtual-reality environment. And

Step by step *(Image: Helen Thomson)*

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then there's the mind-reading component.

Over in the corner of the lab, Thomas Hoellinger of the Free University of Brussels (ULB) in Belgium is wearing an EEG cap, which measures electrical activity at various points across his scalp. There are several ways he can use it to control the exoskeleton through thought alone – at the moment, the most promising involves wearing a pair of glasses with flickering diodes attached to each lens.

Each set of diodes flashes at a different frequency in the wearer's peripheral vision. The light is processed by an area of the brain called the occipital cortex. Measurements from this part of the brain can detect whether Hoellinger is concentrating on the left diode or the right. He shows me how concentrating on the left starts the exoskeleton walking, while concentrating on the right stops it. All this happens in under a second.

Melillo isn't wearing the cap right now, because the team has hit a snag. When the exoskeleton moves, its motors induce electrical noise in the EEG signal, making the readings unreliable.

So instead of mind control, Melillo is walking by moving his upper body. As he leans left, a pressure sensor just above his buttock registers the movement and moves the opposite leg of the exoskeleton. He repeats the process on the other side to begin walking. "It's great, such an amazing sensation," he says. "Not just walking but even being able to stand upright."

Two days after my visit, the team identified flickering frequencies that are less affected by the mechanical noise and filmed a researcher controlling the exoskeleton with his mind alone.

The team plans to spend another five years refining MindWalker with an eye towards building a commercial product. "We're going to make it more lightweight and smooth out the movements," says Jeremi Gancet of Space Application Services in Zaventem, Belgium, a deputy coordinator on the project, "and possibly even incorporate it all into a pair of pants to make it a little less 'Robocop'."

They also want to ditch the glasses with the flashing diodes. A team led by Guy Chéron at ULB has identified the brain activity that corresponds with the intention of walking. This activity occurs about a second before you actually move and can be identified by EEG signals from the motor cortex. The team can even distinguish between the intention to walk quickly or slowly.

The creation of an algorithm that can recognise these signals reliably opens up the tantalising possibility that much more intuitive walking control could be given both to people who are paralysed and to those who are completely locked-in, unable to move even their eyes.

After some tentative first steps, Melillo is looking more confident. He won't be swapping his wheelchair for a MindWalker just yet, but hopefully one day. "It's great finally being able to look people in the eye," he says.

Clarification: *Since this article was first published on 4 June 2013, a reference to the MindWalker consortium has been added.*

This article appeared in print under the headline "Get your move on"

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16:10 21 June 2013

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Mischief managed: researchers produce an invisibility cloak in just 15 minutes

By **Melissa Grey** posted Sep 11th, 2013 at 4:51 AM

45

Grab your Marauder's Map and get ready to roll. Researchers at Zhejiang University in China have pioneered a new, time-efficient method of producing real world invisibility cloaks made out of Teflon. While it isn't the first time we've come across an invisibility cloak, it is the first to make use of an innovation called topology optimization. Thus far, physicists working on invisibility have largely relied on metamaterials -- synthetic materials that alter the behavior of light as it interacts with objects -- but the cost and difficulty of manufacturing them has made them an impractical option. The Zhejiang team has circumvented those obstacles by creating a so-called "eyelid" out of Teflon, the computer-altered topology of which minimizes the distortion of light as it moves past a cloaked object -- and it only took 15 minutes to produce. Since the Teflon eyelid is only invisible to microwaves, it won't enable you to roam the halls of Hogwarts unseen, but the technology could potentially open up new avenues in exploring invisibility on other wavelengths. To learn more, read the full paper at the source link below.

VIA: MIT Technology Review
SOURCE: arXiv (PDF)

TAGS: invisibility, InvisibilityCloak, research, teflon, topologyoptimization, ZhejiangUniversity

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sultonofsultons 18 hours ago

Once completed this will only be used for evil just like any other top secret over the edge cutting technology that's created. Looks like Solid Snake won't be the only guy running around unseen :(

Like Reply

bluecoatdataq 18 hours ago

Nice!

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Like Reply

Khobalt 22 hours ago

Seek to 47:00 in this video from 2011 if you'd like a more fun explanation of how it works:

http://video.pbs.org/video/1786635771/

1 Like Reply

Spaniard 19 hours ago

@Khobalt For non americans: https://www.youtube.com/watch?v=QUiUpUdK9_g

Like Reply

Yogtheterrible 1 day ago

Thank goodness...next time I find myself inside a human sized microwave I'll be safe...

Like Reply

espidus 1 day ago

I swear, if I read one more "invisibility cloak" article on engadget.......

Like Reply

MK2 1 day ago

All this "only invisible to microwaves" is seriously disappointing.

1 Like Reply

NicolaeTuns 1 day ago

@MK2 Disapointing? Not for the military ...

Like Reply

MK2 21 hours ago

@NicolaeTuns @MK2 Unfortunately, I don't represent the military, I represent a consumer who would really really like a practical invis cloak.

Like Reply

0xFADE 19 hours ago

@MK2 You wouldn't want to use it in a microwave. Stuff won't ever heat up.

1 Like Reply

SeanReno 1 day ago

For real though, I hate to admit this, but I will watch many women get naked once I own a cloak. I just know I will end up doing it and to be honest I can't wait to be dishonest.

Like Reply

nxp3 1 day ago

I can't wait for this tech to happen. I want to hide that mess of rat's nest cable behind my computer desk.

Seriously though I still don't get how this work even after reading the source article. What is this eyelid shape thing. I gotta see the setup. Can't you post some real research instead of these snippets

Like Reply

JDre 1 day ago

@nxp3 The MIT article links to the academic article, if that helps.

http://arxiv.org/abs/1308.6049

Like Reply

dcoke25 1 day ago

I knew it, another chinese kirf.

Like Reply

kannedfaru 1 day ago

I want pictures of invisible things!

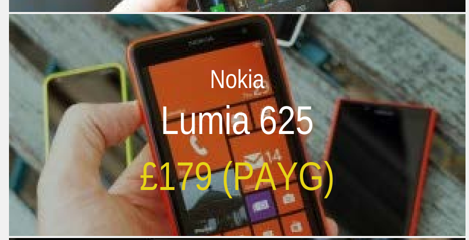
1 Like Reply

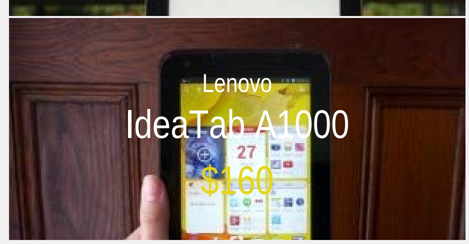
chordofdiscord 1 day ago

@kannedfaru

Here it is below:

RECENT REVIEWS





Did you see it?

3 Like Reply

kannedfaru 1 day ago

@chordofdiscord Thank you. At least someone knows what the readers want.

Like Reply

JDre 1 day ago

Read yesterday on MIT Tech Review.

Like Reply

dcoke25 1 day ago

@JDre and you're point being?

Like Reply

chordofdiscord 1 day ago

@dcoke25 @JDre

You should applaud ;)

Like Reply

JDre 1 day ago

@dcoke25 @JDre My only minor point that I think publishing a paragraph preface adding little insight or detail, then linking to the original story is lazy pseudo-journalism. Engadget should investigate it themselves and write an original piece with substance, rather than generating revenue in a lazy manner. But hey - that's blogging culture.

And then anyone with an RSS aggregator ends up with the same story over and over, as each blogger gets paid to do what I do, with the addition of writing a paragraph essentially just saying "hey, look what I read."

Like Reply

JDre 1 day ago

@dcoke25 In fact, the more I look at

QUOTED

Really hope Touch ID supports multiple users. Otherwise, my wife and dog are going to be very unhappy.
@darrenmurph

Pretty shocked the iPhone 5 got the ax, but the 30-pin 4s lives on.
@wmsteele

And you were worried about companies getting to your email. Now we're gonna hand over our thumbprints without the fun of getting arrested!
@RealBenGilbert

it, and the sentences directly lifted from the MIT article (without proper citation or quotes), the more I think this article arguably qualifies as plagiarism.

Like Reply

abujaffer 1 day ago

@JDre Engadget is a technology news website. Not an online university course on technology. It's supposed to give the basics, anyone who actually wants to/can understand the science behind can *gasp* click on the link and read it. Everyone else doesn't have to trudge through science they don't really care about, and both sides get what they came for.

Also, do I hear you complaining about the fact that this article is a day late, then complain about the fact that they didn't write an "investigation" on the subject? How about we leave you to provide us with "original pieces with substance", while Engadget keeps "generating revenue in a lazy manner." Whatever that means.

Like Reply

JDre 1 day ago

@abujaffer @JDre My point is pretty clear. There is little in this article that wasn't rather directly lifted from the MIT Technology Review article which appeared online a day earlier (a piece which did result from a review of the original research).

Apart from a Harry Potter reference, there is no original work here by the Engadget writer.

The Engadget article here is not

investigative (they didn't write to the researchers, or see the tech), not original (the very leap that this research could be extended to make an "invisibility cloak in 15 minutes" is copied from the MIT-TR article), and not journalism. It's a copy-paste of someone else's work, with the insufficient citation of "click here to see where I copied this from."

That is lazy. And Engadget makes ad revenue from it.

Like Reply

giuliop 1 day ago

@dcoke25 @JDre ù

I don't think he's point being.

2 Like Reply

yournot 1 day ago

This could protect you from the old "pain ray".

Like Reply

chordofdiscord 1 day ago

How is it an invisibility cloak when it does not affect the VISIBLE spectrum?

Like Reply

JDre 1 day ago

@chordofdiscord Look for the original story on MIT Technology review.

Like Reply

chordofdiscord 1 day ago

@JDre

It was a rhetorical question, I am very familiar with that field of research and I've been following it for a few years.

Like Reply

JDre 1 day ago

@chordofdiscord @JDre Sorry, I didn't catch that from what looked like a fair question.

The visible spectrum issue is alluded to in the second-to-last sentence of this article, and described briefly in the full MIT article. But I suppose you knew that they planned to extend it to the visible spectrum... and were just asking to highlight that the title is a ploy to grab our attention, citing development beyond the current state of the tech.

Like Reply

giuliop 1 day ago

Video or it didn't happen. And no, I don't want follow any link.

Like Reply

T__C 1 day ago

One step closer to the dream of the microwaveable ice-cream pie.

Like Reply

ratchetnclank 1 day ago

Kinda misleading headline.

1 Like Reply

JasonSherwood 1 day ago

This would be more for the next generation of stealth aircraft where detection is based on radar not sight. China developing this is such a comforting thought...

Like Reply

chordofdiscord 1 day ago

@JasonSherwood

Actually, radar stealth is quite old, the most "modern" development in that area is visual tracking and aiming. Radar can detect aircraft from much bigger distances, so visual tracking only kicks in at a proximity.

Like Reply

Oflife 1 day ago

@JasonSherwood If they do, and attack, I think a few nukes towards Bejing would lead to rapid extraction. Remember Cuba? #missiles #jfk

Like Reply

chordofdiscord 1 day ago

@Oflife @JasonSherwood

Nukes aren't what they used to be. Take a look at modern missile defenses - they can go orbital and engage multiple targets, and the number of missile defenses significantly exceeds the number of nuclear missiles. Last but not least, if nukes start flying to China, Russia's nukes will start flying to the US, and Russia has significantly more of them, which will spell game over for everyone. Blind patriot much?

Like Reply

Oflife 1 day ago

@chordofdiscord I thought both the US and Russia had steadily reduced their stockpiles, or has Vladimir been a naughty boy whilst the UN was looking the other way? BTW, as a child of the 80s I was terrified of nuclear war. We lived next to an American airbase here in the UK and every time cold war tensions ramped up, I could not sleep, fearing a Russian first strike. Unless it's a terrorist attack, and in view of the fear nuclear war strikes into everyone (look how much
harm Chernobyl and Fukushima did, without any intent to cause wanton harm), I think humanity has grown too smart to ever use it in 'planned' conflict, but will instead as we're doing now, use cyberwarfare and covert proxy wars to do battle - as is going on in Syria right now, where Russia, France, China and hesitantly the US are pulling strings. A switch to solar power will solve all this because then

we won't need to go on carbon resource wars.

Like Reply

chordofdiscord 1 day ago

@Oflife @chordofdiscord

Well, not really reducing, more like decommissioning the outdated ones. But Russia has very weak airforce and navy, at least compared to the US, so they keep more inventory for strategic balance.

Like Reply

abujaffer 1 day ago

@chordofdiscord We still have more nukes to wipe out Russia (and the world) multiple times over. We only need a pair or so to subdue any nation on Earth, and perhaps 25 or so to take down every major nation on Earth. We're good, for the time being.

Like Reply

Spedex 1 day ago

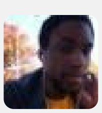
Who chopped the poor boys head off?

Like Reply

Str1der1 1 day ago

Cool.

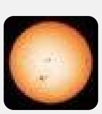
Like Reply



Radar11x 1 day ago

Neat

Like Reply



Oflife 1 day ago

"Professor Lu, where are you?"

Like Reply

efekt 1 day ago

@Oflife "I'm heel..." :)

Like Reply

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ZUCK: 'THE GOV'T BLEW IT'

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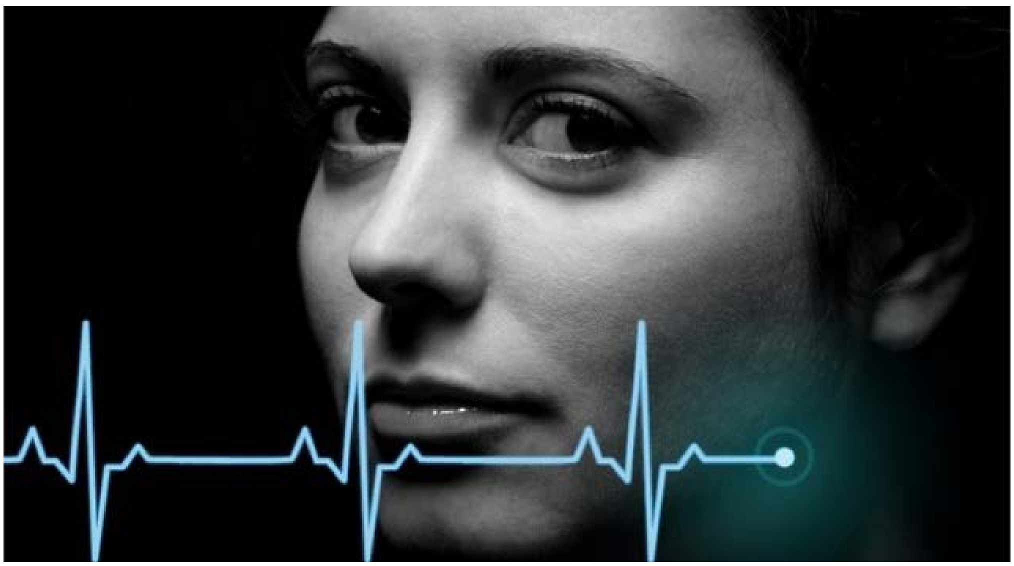
MIT researchers measure your pulse, detect heart abnormalities with smartphone camera

By John Hewitt on June 21, 2013 at 3:30 pm | 2 Comments



Last year, a group of researchers from MIT's Computer Science and Artificial Intelligence Lab (CSAIL) showed us just how easy it is to "see" a human heartbeat in ordinary video footage. With a little filtering, a little averaging, and a touch of turn-of-the-century (1900) mathematical analysis, the telltale color changes in the skin associated with the peak pressure pulse of the heart can be seen by anyone. The CSAIL researchers have now rejigged their algorithms to optimize instead for detection of the head motion artifact associated with each beat. Remote detection of the heartbeat is a tremendous convenience that could potentially spot heart abnormalities in those who would otherwise never look twice — if it is accurate enough.

The release from MIT on this work mentions that the heart rate variability (HRV) — the moment-to-moment deviations from constancy — can be used to diagnose potential heart issues. The researchers note that the true margin of error for their methods could be a few beats per minute. While that may seem pretty good as far as getting an overall pulse rate for everyday curiousity, it could be a problem if you want to try to extract interbeat variability. At issue is the fact that the noise that is introduced by those few questionable beats could easily swamp and confound the real HRV signal.

Without getting too boggled up, we will just mention here that there are many ways to derive and characterize HRV. We could measure each beat-to-beat delay for example, bin them up in a histogram, and report a standard deviation or RMS (Root-Mean-Square) value. Alternatively, a fancier *frequency domain analysis* can be done to generate a power spectrum. No matter what method is used, the potential problem is that errors as low as 2% in the ground-level data will result in significant bias in the HRV calculation. The researchers are working to improve their algorithms and suggest that accuracy may be gained by combining motion and colorimetric imaging.

While most of the finesse in these techniques is in the software, successful signal extractions of this kind are ultimately driven by the sensor hardware. If an ordinary smartphone camera can already do a decent job, we can imagine the level of detail that more dedicated remote sensors might be able gather. Finer-grained spatial detection, and thermal analysis, might reveal slight asymmetries in perfusion of the face to paint a clearer picture of vascular health.
Spectrographic detection of components in sweat might provide significant advances over the traditional galvanic skin resistance measurements. A quick and harmless laser pulse to the skin would evaporate hundreds of unique molecules readily available to be vacuumed up and analyzed. “Taking” such readings more-or-less covertly need not always be seen as suspicious. They may come to be normal conversational facilitators that amplify the feedbacks we already give, consciously or not, to indicate receptiveness.

On their own, things like pulse, blood oxygenation, pupil dilation, or skin resistance, are of limited use. If someone is exhausted, scared or startled, these metrics should be very predictable, and change in synchrony. The greater insights may come when these measures are analyzed differentially. In other words, if you note that someones heart speeds up, but their blood oxygenation has been sitting comfortably at 99%, you might suspect something more cerebral, rather than autonomic, is going on. If your data feeds note that a seemingly consistent right-side bias in the latency of your boss’s pupil dilation suddenly flip-flops, or the symmetry of the smile increases, that might be the moment to

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hit them up for a raise. While most of these things will be of little practicality to us, to our avatar and machine creations searching to understand human emotional virtuosity, they will likely be immensely interesting.

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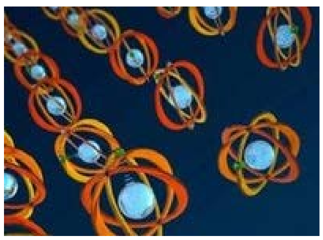

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04.05.11 Neurotech's NT-501 Implant Slows Vision Loss in Patients with Geographic Atrophy associated with Dry AMD as Reported in PNAS

Neurotech is a biotechnology company dedicated to the development of sight-saving therapeutics for chronic retinal diseases.

The Company's portfolio of product candidates includes NT-501, currently in late-stage clinical development for geographic atrophy (GA) associated with atrophic (dry) age-related macular degeneration (AMD) and retinitis pigmentosa (RP), and NT-503, currently in pre-clinical development for wet AMD.

In 2009, Neurotech completed three Phase 2 clinical studies of NT-501 for the treatment GA and RP. In the GA study the Company announced positive results, including the achievement of human proof of concept. In two RP studies, the Company announced consistent and positive biological effects on photoreceptors. All of Neurotech's development programs are based on the Company's proprietary Encapsulated Cell Technology (ECT). ECT uniquely enables the controlled, continuous delivery of biologics directly to the back of the eye, thereby overcoming a major obstacle in the treatment of retinal disease.

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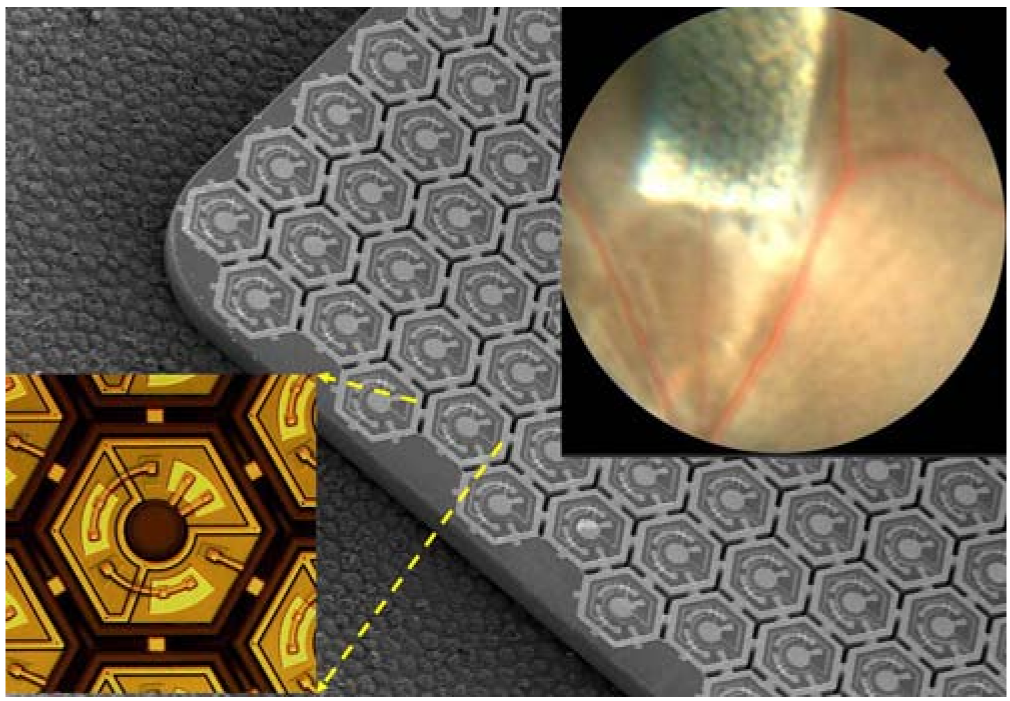
MAY 13, 2012

New type of retinal prosthesis could better restore sight to blind, study says

BY JONATHAN RABINOVITZ

Courtesy of the Daniel Palanker lab



This pinpoint-sized photovoltaic chip (upper right corner) is implanted under the retina in a blind rat to restore sight. The center image shows how the chip is comprised of an array of photodiodes, which can be activated by pulsed near-infrared light to stimulate neural signals in the eye that propagate then to the brain. A higher magnification view [lower left corner] shows a single pixel of the implant, which has three diodes around the perimeter and an electrode in the center. The diodes turn light into an electric current which flows from the chip into the inner layer of retinal cells

Using tiny solar-panel-like cells surgically placed underneath the retina, scientists at the Stanford University School of Medicine have devised a system that may someday restore sight to people who have lost vision because of certain types of degenerative eye diseases.

This device — a new type of retinal prosthesis — involves a specially designed pair of goggles, which are equipped with a miniature camera and a pocket PC that is designed to process the visual data stream. The resulting images would be displayed on a liquid crystal microdisplay embedded in the goggles, similar to what's used in video goggles for gaming. Unlike the regular video goggles, though, the images would be beamed from the LCD using laser pulses of near-infrared light to a photovoltaic silicon chip — one-third as thin as a strand of hair — implanted beneath the retina.

Electric currents from the photodiodes on the chip would then trigger signals in the retina, which then flow to the brain, enabling a patient to regain vision.

A study, published online May 13 in *Nature Photonics*, shows how scientists used rat retinas to assess the photodiode arrays in vitro, and how the diodes produced electric responses that are widely accepted indicators of visual activity. The scientists are now testing the system in live rats, taking both physiological and behavioral measurements, and are hoping to find a sponsor to support tests in humans.

"It works like the solar panels on your roof, converting light into electric current," said Daniel Palanker, PhD, associate professor of ophthalmology and the paper's senior author. "But instead of the current flowing to your refrigerator, it flows into your retina." Palanker is also a member of the Hansen Experimental Physics Laboratory at Stanford and of the interdisciplinary Stanford research program, Bio-X. The study's co-first authors are Keith Mathieson, PhD, a visiting scholar in Palanker's lab, and James Loudin, PhD, a postdoctoral scholar. Palanker and Loudin jointly conceived and designed the prosthesis system and the photovoltaic arrays.

RELATED NEWS

» **Laser system developed at Stanford shows promise for cataract surgery**

» **Stanford researchers develop the next generation of retinal implants**

There are several other retinal prostheses being developed, and at least two of them are in clinical trials. A device made by the Los Angeles-based company Second Sight was approved in April for use in Europe, and another prosthesis-maker, a German company called Retina Implant AG, announced earlier this month results from its clinical testing in Europe.

Unlike these other devices — which require coils, cables or antennas inside the eye to deliver power and information to the retinal implant — the Stanford device uses near-infrared light to transmit images, thereby avoiding any need for wires and cables, and making the device thin and easily implantable.

"The current implants are very bulky, and the surgery to place the intraocular wiring for receiving, processing and power is difficult," Palanker said. The device developed by his team, he noted, has virtually all of the hardware incorporated externally into the goggles. "The surgeon needs only to create a small pocket beneath the retina and then slip the photovoltaic cells inside it." What's more, one can tile these photovoltaic cells in larger numbers inside the eye to provide a wider field of view than the other systems can offer, he added.

Stanford University holds patents on two technologies used in the system, and Palanker and colleagues would receive royalties from the licensing of these patents.


Daniel Palanker

The proposed prosthesis is intended to help people suffering from retinal degenerative diseases, such as age-related macular degeneration and retinitis pigmentosa. The former is the foremost cause of vision loss in North America, and the latter causes an estimated 1.5 million people worldwide to lose sight, according to the nonprofit group Foundation Fighting Blindness. In these diseases, the retina's photoreceptor cells slowly degenerate, ultimately leading to blindness. But the inner retinal neurons that normally transmit signals from the photoreceptors to the brain are largely unscathed. Retinal prostheses are based on the idea that there are other ways to stimulate those neurons.

The Stanford device uses near-infrared light, which has longer wavelength than normal visible light. It's necessary to use such an approach because people blinded by retinal degenerative diseases still have photoreceptor cells, which continue to be sensitive to visible light. "To make this work, we have to deliver a lot more light than normal vision would require," said Palanker. "And if we used visible light, it would be painfully bright." Near-infrared light isn't visible to the naked eye, though it is "visible" to the diodes that are implanted as part of this prosthetic system, he said.

Palanker explained what he's done by comparing the eye to camera, in which the retina is the film or the digital chip, and each photoreceptor is a pixel. "In our model we replace those photoreceptors with photosensitive diodes," he said. "Every pixel is like a little solar cell; you send light, then you get current and that current stimulates neurons in the inner nuclear layer of the retina." That, in turn, should have a cascade effect, activating the ganglion cells on the outer layer of the retina, which send the visual information to the brain that allows us to see.

For this study, Palanker and his team fabricated a chip about the size of a pencil point that contains hundreds of these light-sensitive diodes. To test how these chips responded, the researchers used retinas from both normal rats and blind rats that serve as models of retinal degenerative disease. The scientists placed an array of photodiodes beneath the retinas and placed a multi-electrode array above the layer of ganglion cells to gauge their activity. The scientists then sent pulses of light, both normal and near-infrared, to produce electric current in the photodiodes and measured the response in the outer layer of the retinas.

In the normal rats, the ganglions were stimulated, as expected, by the normal visible light, but they also presented a similar response to the near-infrared light: That's confirmation that the diodes were triggering neural activity.

In the degenerative rat retinas, the normal light elicited little response, but the near-infrared light prompted strong spikes in activity roughly similar to what occurred in the normal rat retinas. "They didn't respond to normal light, but they did to infrared," said Palanker. "This way the sight is restored with our system." He noted that the degenerated rat retinas required greater amounts of near-infrared light to achieve the same level of activity as the normal rat retinas.

While there was concern that exposure to such doses of near-infrared light could cause the tissue to heat up, the study found that the irradiation was still one-hundredth of the established ocular safety limit.

Since completing the study, Palanker and his colleagues have implanted the photodiodes in rats' eyes and been observing and measuring their effect for the last six months. He said preliminary data indicates that the visual signals are reaching the brain in normal and in blind rats, though the study is still under way.

While this and other devices could help people to regain some sight, the current technologies do not allow people to see color, and the resulting vision is far from normal, Palanker said.

Other members of Palanker's lab involved in the research are graduate students Georges Goetz, David Boinagrov and Lele Wang; senior research associate Philip Huie; research associates Ludwig Galambos and Susanne Pangratz-Fuehrer, PhD; and postdoctoral scholars Yossi Mandel, MD, PhD, and Daniel Lavinsky, MD, PhD. In addition, Theodore Kamins, PhD, a consulting professor in electrical engineering, and James Harris, PhD, professor in the School of Engineering, are co-authors. The team also collaborated with scientists at the Santa Cruz Institute for Particle Physics at UC-Santa Cruz.

Funding was provided by the National Institutes of Health, the Air Force Office of Scientific Research and Stanford's Bio-X program. Information about Stanford's Department of Ophthalmology, which also supported the research, is available at http://ophthalmology.stanford.edu/.

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Off-the-shelf AR glasses used to restore depth perception to the partially blind

By Grant Brunner on January 24, 2013 at 1:31 pm | 1 Comment

For people with misaligned or damaged eyes, depth perception is limited. Monocular depth clues like shadows, comparative size, and motion parallax do exist, but binocular vision allows for a more accurate perception of depth. Researchers at Japan's University of Yamanashi are working with off-the-shelf augmented reality glasses to offer improved depth perception for the binocularly challenged.

By utilizing a pair of Wrap 920AR augmented reality glasses made by Vuzix, the team was able to record the scene from the angle of both eyes. The visual data is processed by a quad-core Windows 7 machine, and the merged images are then displayed to the healthy eye. Instead of having your brain merge the two pictures into one 3D image, the computer is doing the heavy lifting.

This system works by blurring objects according to their depth. As you can see in the image on the right, the objects at a set depth to the cameras remain clear and sharp while the more distant imagery becomes increasingly defocused. In a small test with eight subjects, seven of them were able to effectively use the synthesized imagery to solve a depth-based puzzle faster than they could with the use of normal monocular vision.

Reliance on binocular depth clues is highly variable between different people. The book *The Mind's Eye* by Dr. Oliver Sacks highlights his own severe difficulty interpreting visual information after most of his vision in his right eye was lost to cancer. People who are born without binocular vision generally seem to function well, but with some notable limitations. An entire chapter of the book is dedicated to a woman dubbed "Stereo Sue." In detail, he explains how she reacted when ocular surgery corrected her vision after she grew up with misaligned eyes. It should suffice to say that her depth perception improved handily.

The technology is still in its infancy. The processed imagery has a fairly low resolution and frame rate, and it requires the glasses to be connected to a laptop. Newer tech will provide better resolution, faster frames per second, and a larger viewport. The research team expects these improvements to increase the effectiveness down the road. Mobile computing with smartphones and tablets is growing at a rapid rate, so the portability will become easier as well. This research has the potential to improve the lives of millions of people with vision problems. The line between computers and humans continues to blur as we march towards functional cybernetics. This is transhumanism at its best.

Research paper: *Mono-glass for Providing Distance Information for People Losing Sight in One Eye*

[Image credit: Vuzix]

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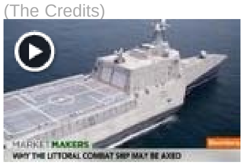

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Joel Detrow

Is it an odd coincidence that one of my dreams last night had a few augmented eyeballs, or just a normal coincidence?

That this system works by adjusting focus reminds me of Depth of Field in video games, where the spot you're pointed at stays in focus and the rest of the game world blurs out as appropriate. With a little tinkering, I think this is something that could be done by a powerful smartphone's hardware, if it were dedicated to it.

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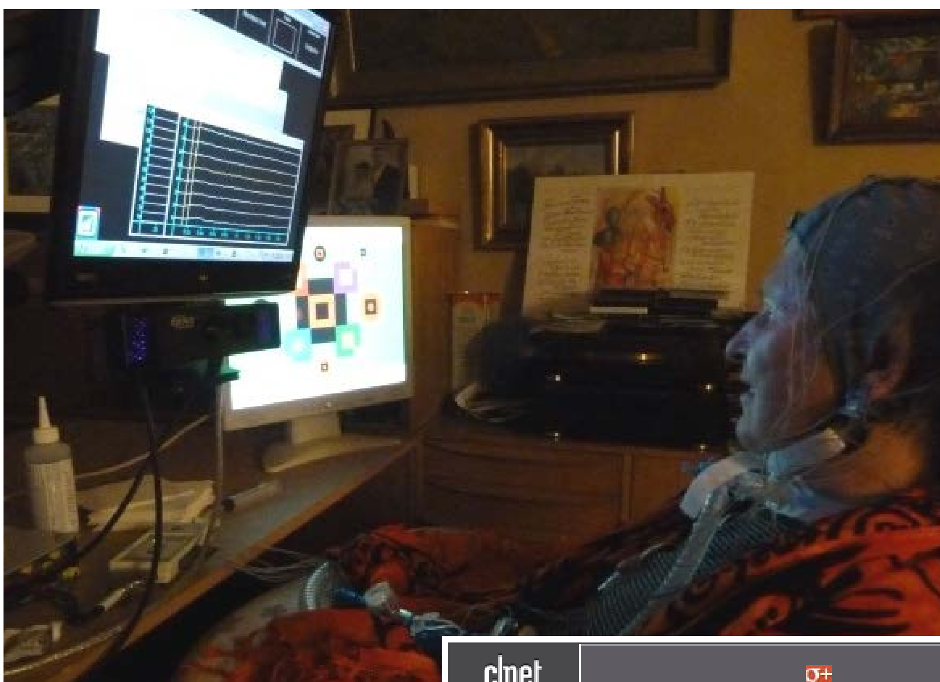
Paralyzed artist paints with mind alone

A woman with Lou Gehrig's disease paints using software that lets her control digital brushes with brainwaves. Now, thanks to a crowdfunding push, she's realizing her dream to exhibit her work.

by Leslie Katz | July 13, 2013 9:00 AM PDT



Heide Pfüetzner paints wearing an EEG cap that measures spikes in her brain activity.
(Credit: Startnext)

Heide Pfüetzner calls her 2007 diagnosis with Amyotrophic Lateral Sclerosis, or Lou Gehrig's disease, a "personal catastrophe." Six years later, she's celebrating a personal triumph as an exhibit of her paintings, all created by her mind controlling a computer, makes its debut.

The exhibit, titled "Brain on Fire," opened Friday on Easdale, a small island off the west coast of Scotland. Visitors to the Easdale Island Hall there will see vibrantly colored digital paintings created by the paralyzed artist using a computer program that lets her control digital brushes, shapes, and colors by concentrating on specific points on the screen.

"For the first time, this project gives me the opportunity to show the world that the ALS has not been the end of my life," Pfüetzner says on the Startnext crowdfunding page where she exceeded her $6,500 goal for mounting an exhibit in Easdale. Pfüetzner's daughter lives on the island; the longtime painter visited often before her illness and considers it one of her favorite destinations.

Heide Pfüetzner
(Credit: Startnext)

Pfüetzner, a former English teacher from Leipzig, Germany, "brain paints" using Intendix Painting software from biomedical engineering firm Gtec. Settled in her wheelchair in front of two monitors, she wears an electrode-laden electroencephalogram (EEG) cap.

One screen displays the program's matrix of tools, the other functions like a canvas, showing the picture as it evolves.

Images of the various tools flash at different times. As Pfüetzner focuses on the tool she wants to select, she counts the flashes, causing her brain activity to spike. The computer determines which option she's focusing on by comparing the timing of the brainwaves to the timing of the desired flashing tool.

Prior to becoming ill, "I had never been fond of technical equipment, and despised working with a computer," admits Pfüetzner, who can communicate only using her eyes and who breathes with the aid of a ventilation machine. But an EEG cap and brain computer interface have become her everyday companions.

Related stories

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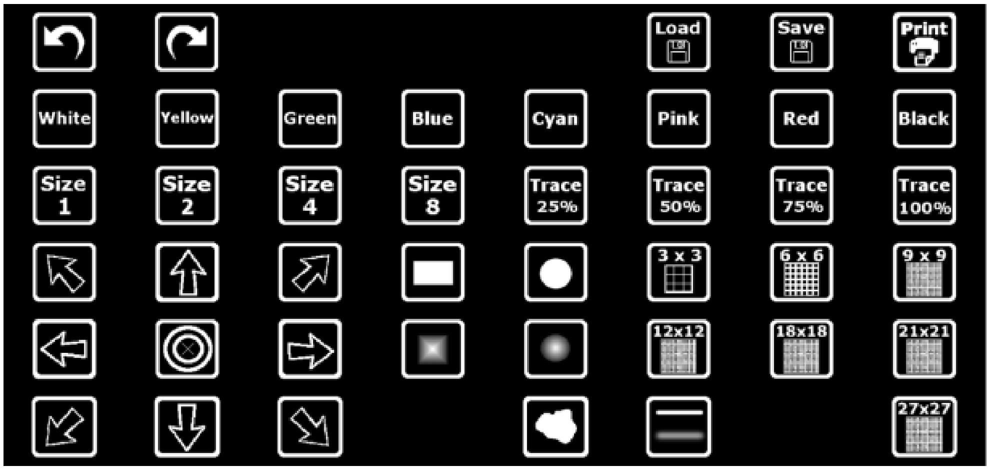
"BCI is a pioneer-making technology which allows me to create art and therefore, reconnect to my old life," she says.

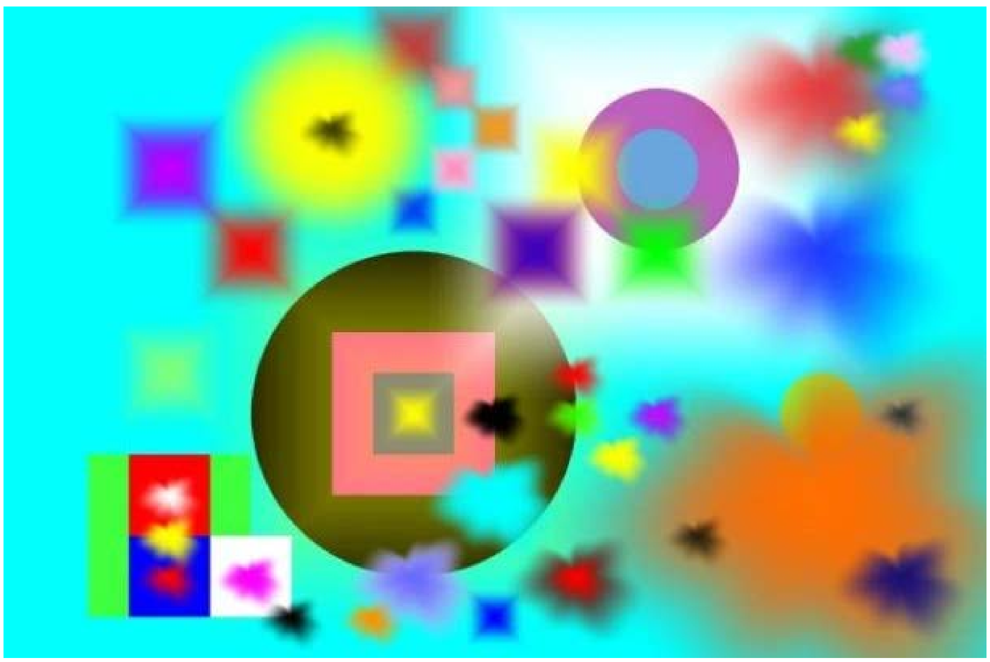
Similar computer systems have helped others with disabilities, allowing a man with locked-in syndrome to tweet through eye movements, for example, and a quadriplegic woman to control a robotic arm to manipulate objects. Pfüetzner has worked closely with a brain-computer interface team at the University of Wurzburg that's studied extensively the mechanics and significance of pushing BCI applications for the paralyzed beyond text input into the realm of visual art (read about their research in this Frontiers of Neuroprosthetics article).

ALS is a debilitating progressive neurodegenerative disease characterized by widespread muscle atrophy that affects mobility, speaking, swallowing, and breathing. Though the life expectancy of an ALS patient averages about two to five years from the time of diagnosis, according to the ALS Association, some ALS patients, including physicist and cosmologist Stephen Hawking, have far outlived that prognosis.

Money raised through Pfüetzner's Startnext campaign went toward printing and framing her work, as well as transporting her and her nursing team, as well as the medical equipment she needs, to Easdale, where the exhibit runs through July 25.



Intendix Painting users paint pictures using a matrix of tools for colors, shapes, borders, placement, and more.
(Credit: Gtec)



The artist's vibrant semi-abstract paintings will be on display in Scotland through July 25.
(Credit: Startnext)

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About Leslie Katz

Leslie Katz, senior editor of CNET's Crave, covers gadgets, games, and myriad other digital distractions. As a co-host of the now-retired CNET News Daily Podcast, she was sometimes known to channel Terry Gross and still uses her trained "podcast voice" to bully the speech recognition software on automated customer service lines. E-mail Leslie.

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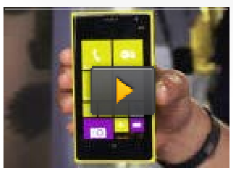

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Photoreceptor precursors derived from three-dimensional embryonic stem cell cultures integrate and mature within adult degenerate retina

Anai Gonzalez-Cordero, Emma L West, Rachael A Pearson, Yanai Duran, Livia S Carvalho, Colin J Chu, Arifa Naeem, Samuel J I Blackford, Anastasios Georgiadis, Jorn Lakowski, Mike Hubank, Alexander J Smith, James W B Bainbridge, Jane C Sowden & Robin R Ali

Affiliations | Contributions | Corresponding authors

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Irreversible blindness caused by loss of photoreceptors may be amenable to cell therapy. We previously demonstrated retinal repair[1] and restoration of vision through transplantation of photoreceptor precursors obtained from postnatal retinas into visually impaired adult mice[2, 3]. Considerable progress has been made in differentiating embryonic stem cells (ESCs) *in vitro* toward photoreceptor lineages[4, 5, 6]. However, the capability of ESC-derived photoreceptors to integrate after transplantation has not been demonstrated unequivocally. Here, to isolate photoreceptor precursors fit for transplantation, we adapted a recently reported three-dimensional (3D) differentiation protocol that generates neuroretina from mouse ESCs[6]. We show that rod precursors derived by this protocol and selected via a GFP reporter under the control of a *Rhodopsin* promoter integrate within degenerate retinas of adult mice and mature into outer segment–bearing photoreceptors. Notably, ESC-derived precursors at a developmental stage similar to postnatal days 4–8 integrate more efficiently compared with cells at other stages. This study shows conclusively that ESCs can provide a source of photoreceptors for retinal cell transplantation.

At a glance

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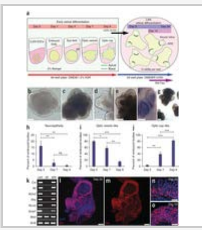
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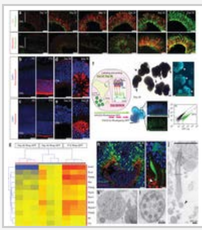
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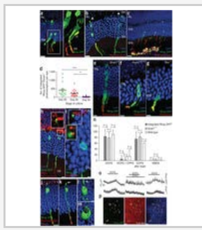
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Contributions

A.G.-C. and E.L.W. contributed equally to the concept, design, execution and analysis of all experiments and manuscript writing. R.A.P. performed subretinal transplantation and calcium imaging, and contributed to the concept and design of the experiments, funding and manuscript writing. Y.D. performed subretinal transplantations and histological processing. L.S.C., A.G. and J.L. contributed to experimental execution. C.J.C. performed IMARIS reconstruction. A.N. and S.J.I.B. provided technical assistance. M.H. performed microarray data analysis. J.W.B.B., A.J.S., J.C.S. and R.R.A. contributed to the concept and design of the experiments, funding and to manuscript writing.

Competing financial interests

The authors declare no competing financial interests.

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Video

1. Video 1: Cellular morphology and alignment of an integrated ESC-derived rod photoreceptor (6,951 KB, Download)
   Following transplantation of day 29 ESC-derived Rhop.GFP+ photoreceptors into Gnat1−/− mice, retinal flatmounts were stained for the ribbon synaptic marker, Ribeye (magenta) and rod a-Transducin (red). 3D reconstruction of a representative confocal image showing the correct position of the integrated cell in the ONL (DAPI, blue), the presence of inner and outer segments expressing rod a-Transducin, as well as an inner process ending in a spherule synaptic button correctly positioned in the OPL, where synapses were located. The 3D confocal image was reconstructed to illustrate these morphologies. The whole synaptic layer is shown first, before highlighting the synapse contacting the spherule. The surface of the entire cell was then rendered to demonstrate correct spatial alignment and morphology between the ribbon synapse in relation to the rod spherule. ONL, outer nuclear layer; OPL, outer plexiform layer.

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1. Supplementary Text and Figures (2.67 MB)
   Supplementary Figures 1–11 and Supplementary Tables 1–2

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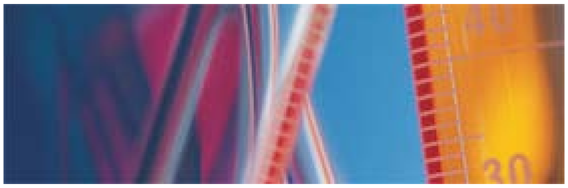

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Language:
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Major Subjects:

- Blindness / * surgery

- Prostheses and Implants
- Retina / * surgery

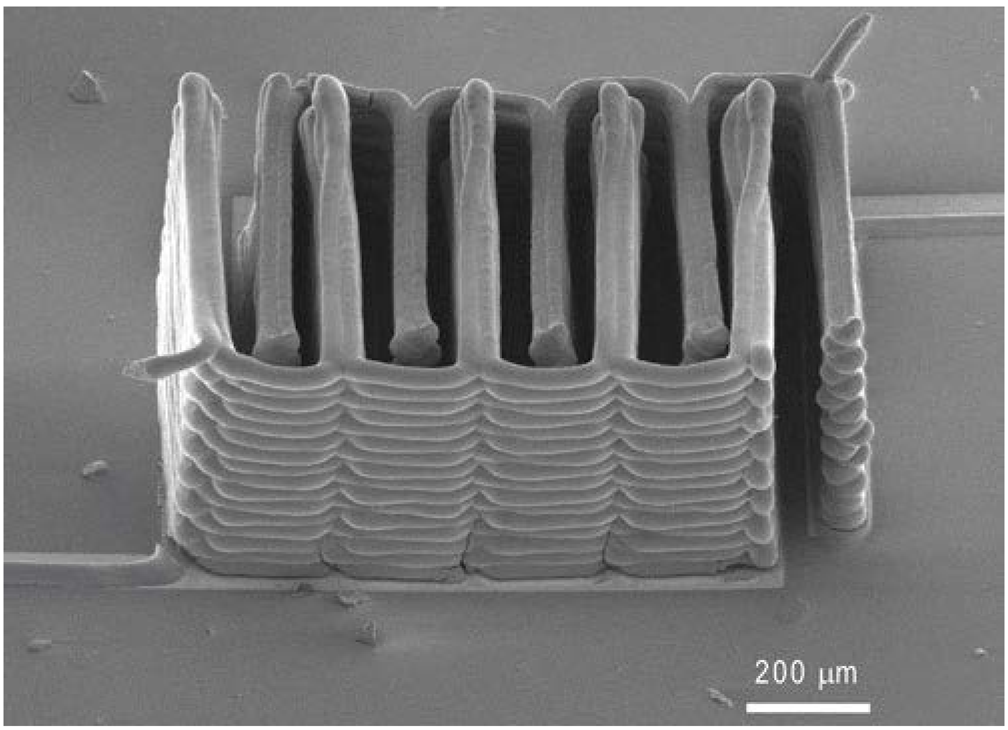
Additional Subjects:

- Adult
- Aged
- Feasibility Studies
- Female
- Humans
- Locomotion / physiology
- Male
- Middle Aged
- Orientation / physiology
- Retinitis Pigmentosa / surgery

Printing tiny batteries

By Dan Ferber, Wyss Institute
June 18, 2013

Novel application of 3D printing could enable the development of miniaturized medical implants, compact electronics, tiny robots, and more



A research team from Harvard University and the University of Illinois at Urbana-Champaign has demonstrated the ability to 3D print a battery. This image shows the interlaced stack of electrodes that were printed layer by layer to create the working anode and cathode of a microbattery. (SEM image courtesy of Jennifer A. Lewis.)

Cambridge, Mass. – June 18, 2013 – 3D printing can now be used to print lithium-ion microbatteries the size of a grain of sand. The printed microbatteries could supply electricity to tiny devices in fields from medicine to communications, including many that have lingered on lab benches for lack of a battery small enough to fit the device, yet provide enough stored energy to power them.

To make the microbatteries, a team based at Harvard University and the University of Illinois at Urbana-Champaign printed precisely interlaced stacks of tiny battery electrodes, each less than the width of a human hair.

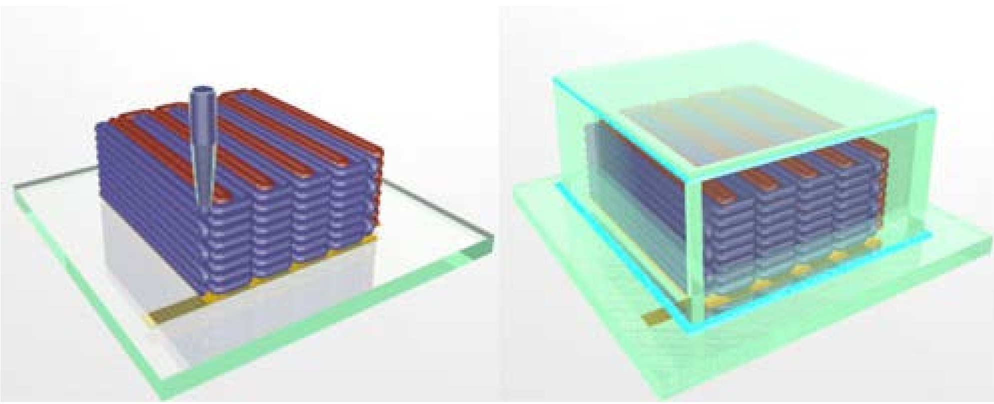
“Not only did we demonstrate for the first time that we can 3D-print a battery; we demonstrated it in the most rigorous way,” said Jennifer A. Lewis, senior author of the study, who is also the Hansjörg Wyss Professor of Biologically Inspired Engineering at the Harvard School of Engineering and Applied Sciences (SEAS), and a Core Faculty Member of the Wyss Institute for Biologically Inspired Engineering at Harvard University. Lewis led the project in her prior position at the University of Illinois at Urbana-Champaign, in collaboration with co-author Shen Dillon, an Assistant Professor of Materials Science and Engineering there.

The results have been published online in the journal *Advanced Materials*.

In recent years engineers have invented many miniaturized devices, including medical implants, flying insect-like robots, and tiny cameras and microphones that fit on a pair of glasses. But often the batteries that power them are as large or larger than the devices themselves, which defeats the purpose of building small.

To get around this problem, manufacturers have traditionally deposited thin films of solid materials to build the electrodes. However, due to their ultra-thin design, these solid-state micro-batteries do not pack sufficient energy to power tomorrow's miniaturized devices.

The scientists realized they could pack more energy if they could create stacks of tightly interlaced, ultrathin electrodes that were built out of plane. For this they turned to 3D printing. 3D printers follow instructions from three-dimensional computer drawings, depositing successive layers of material—inks—to build a physical object from the ground up, much like stacking a deck of cards one at a time. The technique is used in a range of fields, from producing crowns in dental labs to rapid prototyping of aerospace, automotive, and consumer goods. Lewis' group has greatly expanded the capabilities of 3D printing. They have designed a broad range of functional inks—inks with useful chemical and electrical properties. And they have used those inks with their custom-built 3D printers to create precise structures with the electronic, optical, mechanical, or biologically relevant properties they want.



To create the microbattery, a custom-built 3D printer extrudes special inks through a nozzle narrower than a human hair. Those inks solidify to create the battery's anode (red) and cathode (purple), layer by layer. A case (green) then encloses the electrodes and the electrolyte solution is added to create a working microbattery. (Illustration courtesy of Jennifer A. Lewis.)

To print 3D electrodes, Lewis' group first created and tested several specialized inks. Unlike the ink in an office inkjet printer, which comes out as droplets of liquid that wet the page, the inks developed for extrusion-based 3D printing must fulfill two difficult requirements. They must exit fine nozzles like toothpaste from a tube, and they must immediately harden into their final form.

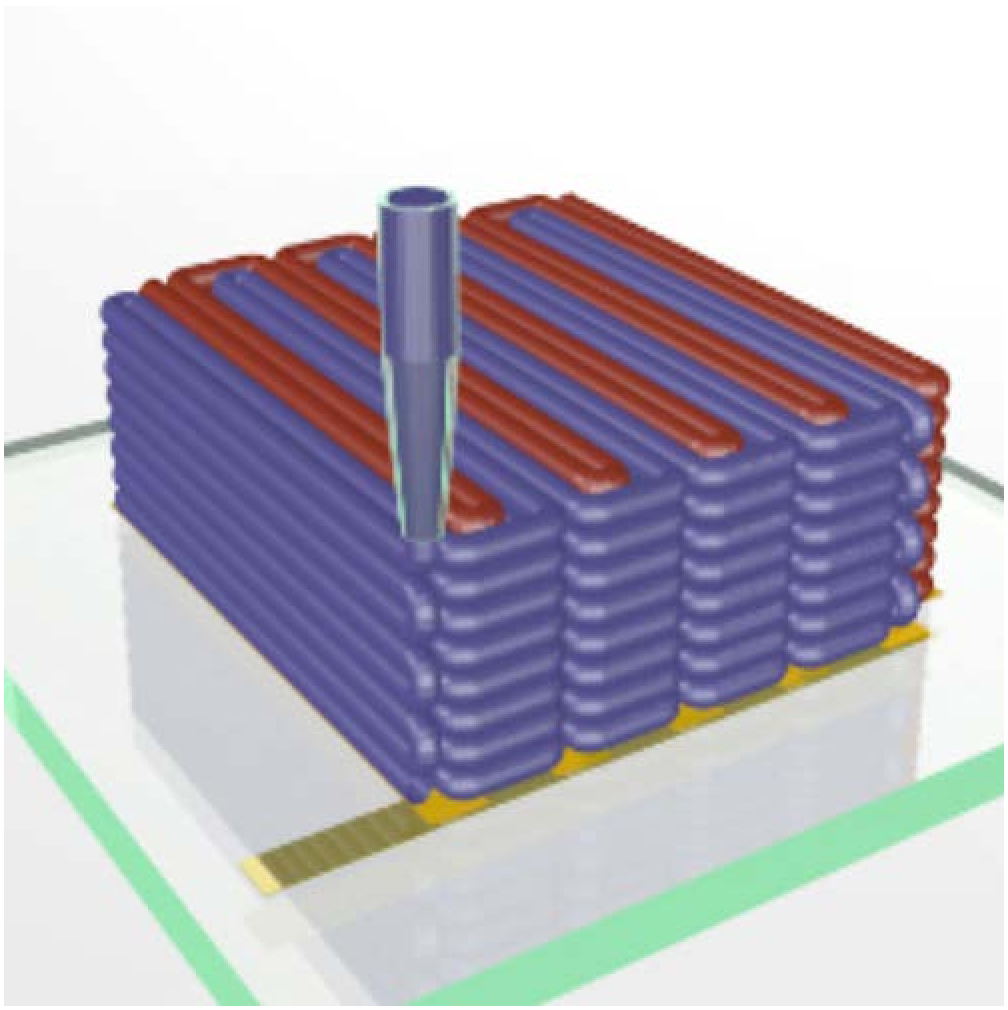
In this case, the inks also had to function as electrochemically active materials to create working anodes and cathodes, and they had to harden into layers that are as narrow as those produced by thin-film manufacturing methods. To accomplish these goals, the researchers created an ink for the anode with nanoparticles of one lithium metal oxide compound, and an ink for the cathode from nanoparticles of another. The printer deposited the inks onto the teeth of two gold combs, creating a tightly interlaced stack of anodes and cathodes. Then the researchers packaged the electrodes into a tiny container and filled it with an electrolyte solution to complete the battery.

Next, they measured how much energy could be packed into the tiny batteries, how much power they could deliver, and how long they held a charge. "The electrochemical performance is comparable to commercial batteries in terms of charge and discharge rate, cycle life and energy densities. We're just able to achieve this on a much smaller scale," Dillon said.

"Jennifer's innovative microbattery ink designs dramatically expand the practical uses of 3D printing, and simultaneously open up entirely new possibilities for miniaturization of all types of devices, both medical and non-medical. It's tremendously exciting," said Wyss Founding Director Donald Ingber, who is also a Professor of Bioengineering at Harvard SEAS.

The work was supported by the National Science Foundation and the DOE Energy Frontier Research Center on Light-Material Interactions in Energy Conversion. Lewis and Dillon collaborated with lead author Ke Sun, a graduate student in Materials Science and Engineering at the University of Illinois at Urbana-Champaign; Teng-Sing Wei, a graduate student at Harvard SEAS; Bok Yeop Ahn, a Senior Research Scientist at the Wyss Institute and SEAS; and Jung Yoon Seo, a visiting scientist in the Lewis group, from the Korea Advanced Institute of Science and Technology.

In this video, 3D printing is used to deposit a specially formulated "ink" through a fine nozzle to build a microbattery's anode layer by layer. Unlike an office inkjet printer that dispenses ink droplets onto paper, these inks are formulated to exit the nozzle like toothpaste from a tube and immediately harden into thin layers. The printed anode contains nanoparticles of a lithium metal oxide compound that provide the proper electrochemical properties.



3D printing can now be used to print lithium-ion microbatteries the size of a grain of sand. (Illustration courtesy of Jennifer A. Lewis.)

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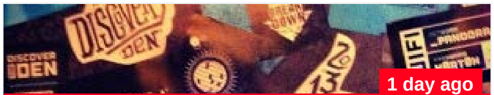

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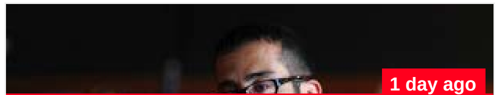

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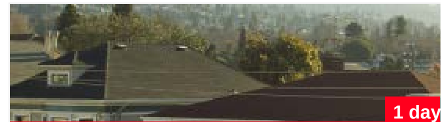

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Recon

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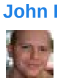


Google Glass is for walking around and getting directions to a cafe with perfect espresso. Recon Jet is for kicking your performance into the ultimate high gear and — yes — even saving lives.

The Vancouver, B.C.-based Recon Instruments, which created the first-ever heads-up display for sports in 2010, has launched the Recon Jet for preorders today. It's essentially a rugged take on Google Glass with perfect balance that does not require Wi-Fi or cellular connections, works in any weather conditions, and provides data-at-a-glance even under the worst viewing conditions.

"Recon Jet is an extremely activity-specific device," company CMO Tom Fowler — a former professional triathlete — told me today. "We do not aspire to be the general purpose device you wear when walking around in daily life but the device you need when you're engaged in a specific activity at a very high level."

In other words, Google Glass is consumer. Recon Jet is pro.

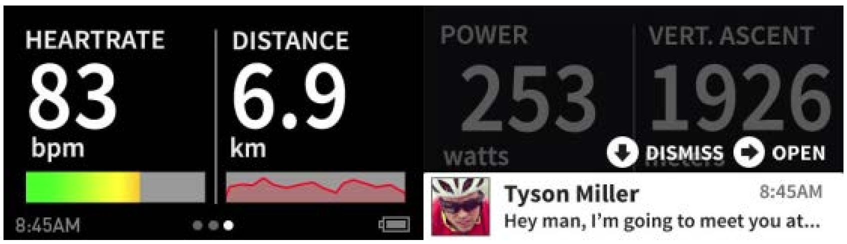
The device, which is embedded within a pair of sunglasses, weighs just 28 grams — less than an ounce — and is weighted perfectly with 14 grams to a side. Included in that ounce is a dual-core 1GHz processor, a graphics chip, Wi-Fi, built-in ANT+ for device communications, Bluetooth, GPS, a HD camera, and a raft of sensors: accelerometer, gyroscope, altimeter, magnetometer, and thermometer. And, of course, it has an HD display, infrared gaze detection, a mic, speakers, and a touchpad that Fowler says works even with gloves and even when it's snowing.

Cyclists like Fowler could use it to monitor performance. Runners and other athletes can access data from their fitness bands, shoe sensors, and body monitors without having to pull out a phone, open an app, and check a screen. And yes, you can get your texts and smartphone notifications as well as call display on Jet. But industry pros can use it as well: engineers, firefighters, builders, and doctors.

And in the hands of doctors, this kind of access to information can save lives.

“I showed this to a U.S. Army doctor who had done a couple of tours in Afghanistan,” Fowler told me. “He said that if he had had Recon Jet in Afghanistan delivering patient vital stats while operating … there are people who would have made it who, sadly, did not. That’s a pretty inspiring mission.”

But there are also some consumer-friendly social features, too.



When you take HD video or pictures with the built-in camera, Fowler says, you can elect to have it automatically upload to your [Facebook] or other social accounts. So a rider who just finished an inside mountain climb, or a weekend warrior who just completed a 3K run, could share their victories with their friends and community. Then, as people respond, those comments and congratulations will show up on your heads-up display.

What about Google as a competitor?

You’d think that Google would be a nightmare competitor to small company in the face-mounted wearable computing space. Not so. Fowler says he couldn’t be happier that Google launched Glass, because the search, software, and device giant is pumping up massive consumer interest in the market — interest that Recon intends to capitalize on.

But the Jet has a critical component that’s still coming: the open SDK. Recon wants the developer community to build anything and everything on this platform, and it’s already working with health and fitness companies to create apps for devices and data.

Product ordered today will be delivered in December of this year — probably around the same time Google Glass makes it to consumer release — and the SDK will be available “shortly.” Those who are interested should probably try to pick up a pair now — the price goes up to $599 when the product is actually in the market.

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NATURE COMMUNICATIONS | ARTICLE

Repopulation of decellularized mouse heart with human induced pluripotent stem cell-derived cardiovascular progenitor cells

Tung-Ying Lu, Bo Lin, Jong Kim, Mara Sullivan, Kimimasa Tobita, Guy Salama & Lei Yang

Affiliations | Contributions | Corresponding author

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Received 18 March 2013 | Accepted 15 July 2013 | Published 13 August 2013

Abstract

Abstract • References • Author information • Supplementary information

Heart disease is the leading cause of death in the world. Heart tissue engineering holds a great promise for future heart disease therapy by building personalized heart tissues. Here we create heart constructs by repopulating decellularized mouse hearts with human induced pluripotent stem cell-derived multipotential cardiovascular progenitor cells. We show that the seeded multipotential cardiovascular progenitor cells migrate, proliferate and differentiate *in situ* into cardiomyocytes, smooth muscle cells and endothelial cells to reconstruct the decellularized hearts. After 20 days of perfusion, the engineered heart tissues exhibit spontaneous contractions, generate mechanical force and are responsive to drugs. In addition, we observe that heart extracellular matrix promoted cardiomyocyte proliferation, differentiation and myofilament formation from the repopulated human multipotential cardiovascular progenitor cells. Our novel strategy to engineer personalized heart constructs could benefit the study of early heart formation or may find application in preclinical testing.

Subject terms: Biological sciences · Medical research

At a glance

Figures | Compounds | Genes and Proteins

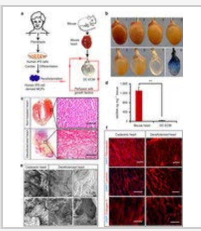


Figure 1

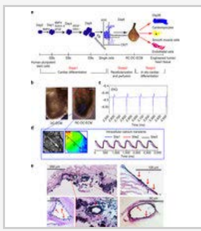


Figure 2

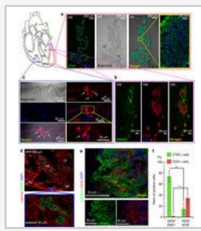
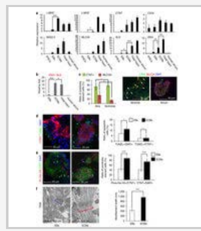


Figure 3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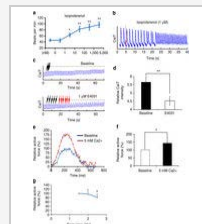
Figure 5

First | 1-5 of 5 | Last

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Contributions

L.Y. designed and oversaw all the studies. T.-Y.L. performed decellularization, ECM characterization, recellularization and assessments. B.L. performed cell culture, cardiovascular differentiation, PCR and IHC. M.S. conducted the electron microscopy. T.-Y.L., B.L. and L.Y. collected and analysed the data. J.K. and G.S. performed the optical mapping. G.S. and K.T.

revised the manuscript. K.T. performed the mechanical testing. T.-Y.L., B.L. and L.Y. prepared the manuscript.

Competing financial interests

The authors declare no competing financial interests.

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Supplementary information

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PDF files

1. Supplementary Figures and Table (3,438 KB)
   Supplementary Figures S1-S8 and Supplementary Table S1

Movies

1. Supplementary Movie 1 (743 KB)
   Human Y1 iPS cell-derived beating EBs.

2. Supplementary Movie 2 (321 KB)
   Day 20 contractile beating monolayers generated from the dissociated day 6 Y1 EBs cultured with VEGF (10 ng/ml) and DKK1 (150 ng/ml).

3. Supplementary Movie 3 (1,721 KB)
   A contractile heart construct engineered with human RUES2 ES cells.

4. Supplementary Movie 4 (1,008 KB)
   A contractile heart construct engineered with human Y1 iPS cells.

5. Supplementary Movie 5 (1,514 KB)
   An electrically synchronized area in the iPS cell recellularized heart construct.

6. Supplementary Movie 6 (3,970 KB)
   An electrically uncoupled area in the iPS cell recellularized heart construct. The uncoupled area can be synchronized with the electrical stimulation, which was loaded from the 5th to 10th second of the video.

7. Supplementary Movie 7 (2,062 KB)
   Mechanical force recording of a RC-DC-ECM in response to 5 mM [Ca2+]out.

8. Supplementary Movie 8 (331 KB)

The engineered heart construct increased the active contractile force in response to 1.5 Hz electrical pacing. The electrical stimulation was loaded from the 10th to 20th second of the video.

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Researchers create world's first 3D-printed bionic organ

By John Hewitt on May 2, 2013 at 2:01 pm | 4 Comments

Using 3D printers to create biological structures has become widespread. Printing electronics has made similar advances, particularly for low-cost, low-power disposable items. The first successful combination of these two technolgies has recently been reported by a group of researchers at Princeton. They described their methods in a recent issue of ACS NANO Letters. They claim that their new device can receive a wide range of frequencies using a coiled antenna printed with silver nanoparticles. Interfacing their device to actual nerve is the next obvious step, begging the question — can it actually hear?

The Princeton researchers previously developed a tattoo composed of a sensor and an antenna that could be fixed to the surface of a tooth. It was made from a combination of silk, gold, and graphene, and had the ability to detect small amounts of bacteria. Building on their knowledge, that team joined up with researchers at Johns Hopkins to build the electronic ear. Their 3D printer combined calf cells with a hydrogel matrix material to form the ear cartilage, and silver to form the embedded antenna coil.

In testing, they were able to pick up radiowaves in stereo using complimentary left and right side ears. Later on they hope to be able to detect acoustic energy directly using other built-in sensors. There are many ways this might be accomplished, the trick is to find a pressure-sensitive material that can be easily printed. Other researchers have used 3D printing of a material called carbomorph to create piezoresistive sensors that change resistance when bent or stressed. These researchers have also been able to print capacitive button sensors to measure changes in capacitance, and even connectors for hooking things together.

Printing biological structures that will be stable over time is a tricky business. The first stable 3D-printed ear was achieved not too long ago by researchers at Cornell using a very similar method. Since then, advances in bioprinting have progressed to ever smaller scales, culminating recently with a technique called 3D microdroplet printing. Using synthetic cell microdroplets, researchers could lay down geometrically precise tissues composed of human stem cells. These droplets could then undergo secondary developmental changes to their structure.

The bionic ear is a long way from something that might be used in humans, if that is even the intent of the authors. Successful printing of organs and tissues larger than just a cartilaginous ear will require supporting elements for bloodflow and nervous enervation. A test device for printed tissues and organs that might include these essential primitives will undoubtedly be needed soon. It may eventually come to resemble some kind of living proto-humanoid machine — and would probably be a little creepy-looking. However, asking lab animals to shoulder our test burden, may hopefully soon no longer be necessary.

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Research Paper: DOI: 10.1021/nl4007744 - “A 3D Printed Bionic Ear”

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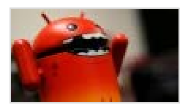

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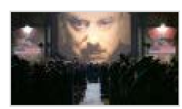

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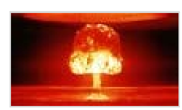

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Off-road wheelchair offers freedom for disabled poor

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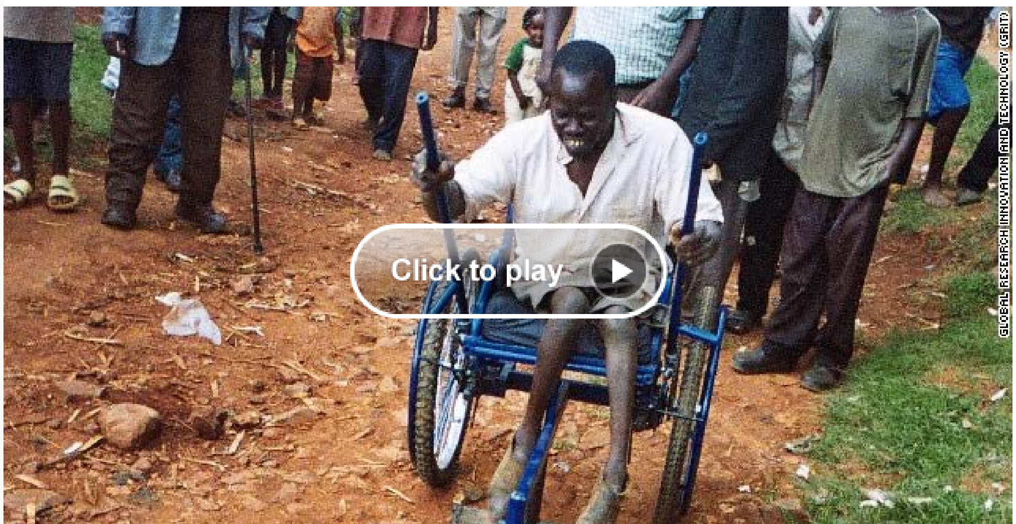

How 'Freedom Chair' could help millions

STORY HIGHLIGHTS

- An MIT professor has developed an affordable all-terrain wheelchair for developing countries.
- The device has given disabled persons in poor countries more freedom.
- Winter continues to pursue engineering-based solutions to worldwide social issues.

Boston, MA (CNN) -- Sometimes, implementing wide-reaching social change takes surprisingly few materials. With just a handful of bike gears, MIT professor Amos Winter is hoping to change the developing world forever.

Winter is the inventor of the Leveraged Freedom Chair (LFC). It is a low-cost wheelchair powered by two hand levers that function in a similar manner to gears on a bike. The higher you grab it, the more leverage you get when traversing over rough terrain like sand, mud, or unpaved road.

Grab down lower, and the machine can cruise along tarmac at five miles-an-hour. It is one of the most versatile wheelchairs on the market, and for the time being, it is aimed solely for disabled communities in the developing world.

"If you are a wheelchair user who lives in a rural area, there's not really a good mobility aid that allows you to travel a long distance on many types of terrains, but is also small and maneuverable to use indoors. That is kind of what set the stage for creating the LFC," says Winter.

A wheelchair for the developing world

It may seem like a simple premise, but the LFC has the potential to empower a community that, in poorer countries, can often feel disenfranchised.

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"As this technology has grown and become a product, it's been very fulfilling to see that not only can people ride off-road, but having that capability also lets them have a job, or go to school or fully participate in their community," says Winter.

What makes the LFC a truly invaluable tool in low income communities is its sheer value for money. Traditionally, wheelchairs with the capability to go off-road clock in somewhere between $4,500 and $6,500, making them prohibitive to the rural communities that need them the most. The LFC, by comparison, costs $200.

The low price point, explains Winter, makes it a sexier sell to the non-profit organizations responsible for delivering these units to emerging markets.

The chair not only had to be repairable, but we wanted it robust.

Amos Winter, LFC inventor

"It had to be cheap enough to fit within the current provision and donation structures that already distribute wheelchairs," he says. Furthermore, Winter recognized that to be of use to the developing world, it had to be built from parts that were easily accessible.

"The chair not only had to be repairable, but we wanted it robust," he says. "We wanted it to have minimal parts that could break in the field, but if the parts do need servicing, they're made from bike parts and they're easily available."

Winter's inspiration for the LFC came about in 2005, when he spent a summer in Tanzania assessing wheelchair technology for a group of wheelchair organizations. He later started developing the technology as a graduate student at MIT.

Read: Exoskeleton allows paraplegics to walk

"When we started the project, we were a team of gung-ho students who had this cool idea for the lever system. We made some prototypes and were excited about them and brought them abroad and people were like, 'these are terrible. What were you thinking? You have no frame of reference of what it's actually like to use a wheelchair everyday,'" he recalls. Over the next few years, he consulted continuously with wheelchair users, and went through several stages of trial and error before landing on the current model.

Winter is currently working with design consultancy firm Continuum on a version of the LFC for the first-world. In all likelihood, it will have more features than the original.

"In the developed world, because there is more disposable income, it's possible to add additional functionality, things that simply are nice to have but not essential to have," notes Gianfranco Zaccai, Continuum's president. The more advanced (and likely more expensive) model, though, "can help support the developing world wheelchair," he adds.

I love innovation and I love being

For Winter, however, the greatest implication of his invention is the platform it has given him to enact even more, farther-reaching change. In a few years, Winter has gone from MIT graduate to assistant professor of

able to work on problems that nobody else has solved before.

Amos Winter, LFC inventor

mechanical engineering, and director of the University's Global Engineering and Research (GEAR) Lab, an enterprise that couples engineering and product design to solve real-world problems.

In addition to the LFC, he has delved into how to deliver low-cost prosthetics to poor countries, eco-efficient irrigation systems that enable small-scale farmers to get a higher crop yield and projects related to water purification.

Video: Helping the disabled make music

"I am a total geek," admits Winter. "I love engineering, I love innovation, and I love being able to work on problems that nobody else has solved before."

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YEs. Practical intelligence with short term results and long term implications. The world needs more Amos Winters and less jerks wasting resources - see: robotic jellyfish. CNN please do not encourage the latter, as it is an insult to deserving articles such as these, and detracts significantly from it's value.

On that note, if you are reading this, please take a moment to consciously consider the significance of this chair, as well as the rare combination of intelligence, humility, and practicality behind it's creation. The man deserves an award.

Falconer375

An ingenious design, I recall seeing this on a TED talk that Winters did where he talked about trying to design a device that could be used over rough ground and be cheap and easy to repair (bike tools and parts) so it could be utilised I had really hoped the LFC took off as being a wheelchair user myself I know how tiring wheeling over rough ground can be.

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Devin Coldewey

Robotic fingertips are more sensitive than a human's

SynTouch

Two researchers from USC published a study Monday describing a new kind of robotic sensor, modeled on the human finger, that can feel, explore and identify more than a hundred common materials. They hope the technology will be integrated into prosthetic hands and other devices that could benefit from a tactile sense.

The research grew out of a simple desire to investigate whether a robot could be made to identify textures; now the duo is starting a company called SynTouch, outside the university, to further develop the synthetic fingertip they created, with funding from DARPA, the NIH, the NSF and others. Clearly the work touched a nerve, so to speak.

Machines exist that can smell and taste, and of course see and hear, but touch has remained somewhat difficult to even define. Touch involves many sensations: pressure, temperature, vibration, and is as much behavioral as it is mechanical. In order to identify an object, for instance, you might naturally press harder or lighter, or move your fingers in a different direction.

So Professor Gerald Loeb and doctoral student Jeremy Fishel (who has since graduated) had to not only create a device that could replicate those sensations, but to act in a logical manner regarding how the material in question was to be explored. This led to both the BioTac sensor and what they are calling "Bayesian Exploration," (named after pioneering 18th century mathematician Thomas Bayes), a set of algorithms and rules that lets the robot explore objects intelligently.

The BioTac system is more or less an electronic fingertip: the

USC

outside is a soft and flexible material with an actual fingerprint pattern that helps in recognizing vibrations. Inside there is a fluid to give the fingertip a pliable but firm structure, and within that fluid, the sensors that detect pressure, temperature and sound (that is, vibrations).

It was trained on 117 materials, from wool to metal to paper, and can identify them correctly 95 percent of the time. It even performed better than humans overall, especially in distinguishing some highly similar samples.

The BioTac and its associated systems are still in development, and it will be some time before someone with a prosthetic arm will be able to tell the difference between table and coaster with their eyes closed. But the device must certainly be considered highly successful.

Loeb and Fishel's research appeared Monday in Frontiers in Neurorobotics. You can watch a video of the inventors and their robot on Vimeo.

Devin Coldewey is a contributing writer for msnbc.com. His personal website is coldewey.cc.

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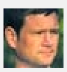
50 days  John Roach
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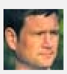
32 days  John Roach
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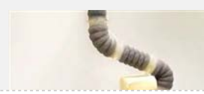
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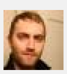
18 hrs.  Devin Coldewey
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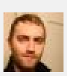
1 day  Devin Coldewey
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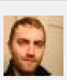
4 days  Devin Coldewey
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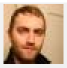

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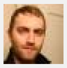

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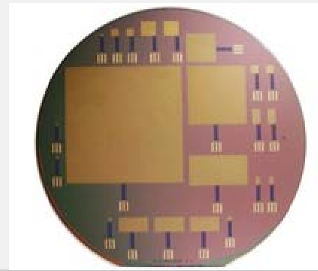

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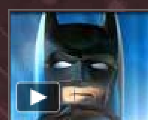

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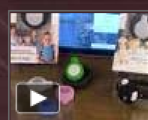

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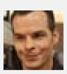

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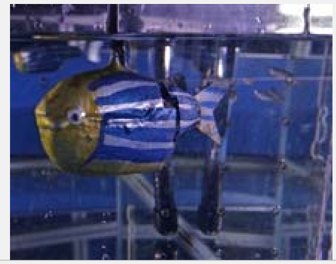

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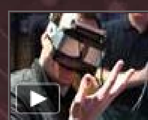

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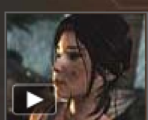

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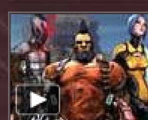

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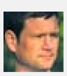

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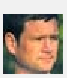

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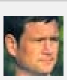

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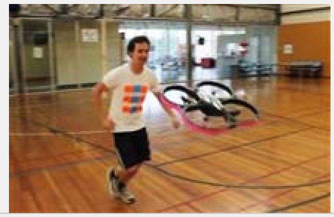

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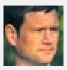

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ORIGINAL ARTICLE

Robotic Leg Control with EMG Decoding in an Amputee with Nerve Transfers

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N Engl J Med 2013; 369:1237-1242 | September 26, 2013 | DOI: 10.1056/NEJMoa1300126

The clinical application of robotic technology to powered prosthetic knees and ankles is limited by the lack of a robust control strategy. We found that the use of electromyographic (EMG) signals from natively innervated and surgically reinnervated residual thigh muscles in a patient who had undergone knee amputation improved control of a robotic leg prosthesis. EMG signals were decoded with a pattern-recognition algorithm and combined with data from sensors on the prosthesis to interpret the patient's intended movements. This provided robust and intuitive control of ambulation — with seamless transitions between walking on level ground, stairs, and ramps — and of the ability to reposition the leg while the patient was seated.

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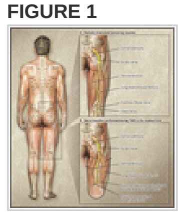
Control of Robotic Prosthesis.

FIGURE 1



Natively Innervated and Surgically Reinnervated Residual Thigh Muscles.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

This article was updated on September 26, 2013, at NEJM.org.

We thank the electronics team at the Center for Bionic Medicine, Rehabilitation Institute of Chicago, for technical support.

SOURCE INFORMATION

From the Center for Bionic Medicine, Rehabilitation Institute of Chicago (L.J.H., A.M.S., A.J.Y., R.D.L., S.B.F., T.A.K.), and the Department of Physical Medicine and Rehabilitation, Northwestern University (L.J.H., A.M.S., R.D.L., T.A.K.), Chicago, and the Department of Biomedical Engineering, Northwestern University, Evanston (A.J.Y., T.A.K.) — all in Illinois; and the Department of Orthopaedic Surgery, University of Washington, Seattle (D.G.S.).

Address reprint requests to Dr. Hargrove at the Center for Bionic Medicine, Rehabilitation Institute of Chicago, 345 E. Superior St., Rm. 1309, Chicago, IL 60611, or at l-hargrove@northwestern.edu.

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Electric Eye: Retina Implant Research Expands in Europe, Seeks FDA Approval in U.S.

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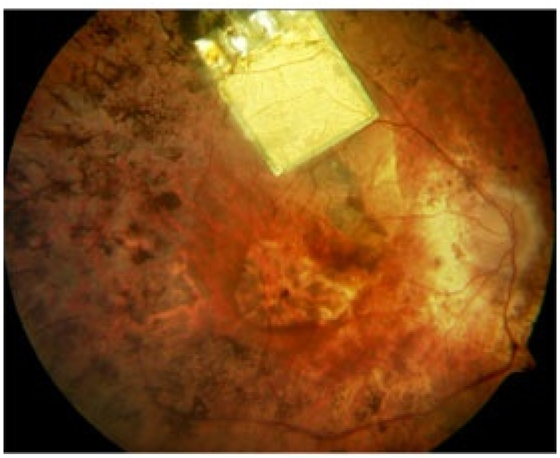
By Larry Greenemeier | Monday, December 12, 2011 | 2



CHIPPING AWAY AT BLINDNESS: There is no effective treatment for retinitis pigmentosa, but researchers such as those at Retina Implant, AG, are making great strides to remedy this through implants that stimulate still-active nerves in the retina, the layer of tissue at the back of the inner eye. Image: Courtesy of Retina Implant, AG

Promising treatments for those blinded by an often-hereditary, retina-damaging disease are expanding throughout Europe and making their way across the pond, offering a ray of hope for the hundreds of thousands of people in the U.S. left in the dark by retinitis pigmentosa. The disease—which affects about one in 4,000 people in the U.S. and about 1.5 million people worldwide—kills the retina's photoreceptors, the rod and cone cells that convert light into electrical signals, which are transmitted via the optic nerve to the brain's visual cortex for processing.

There is no effective treatment for the condition, but researchers are making great strides to remedy this through implants that stimulate still-active nerves in the retina, the layer of tissue at the back of the inner eye. In mid-November Retina Implant, AG, got approval to extend the yearlong phase II human clinical trial of its retinal implant outside its native Tübingen, Germany, to five new sites—Oxford, London and Budapest, along with two additional locations in Germany.

The company's implant is a three- by three-millimeter microelectronic chip (0.1-millimeter thick), containing about 1,500 light-sensitive photodiodes, amplifiers and electrodes surgically inserted beneath the fovea (which contains the cone cells) in the retina's macula region. The fovea enables the clarity of vision that people rely on to read, watch TV and drive. The chip helps generate at least partial vision by stimulating intact nerve cells in the retina. The nervous impulses from these cells are then led via the optic nerve to the visual cortex where they finally lead to impressions of sight.

Thus far, some patients report having a narrow field of vision partially restored, providing them with enough acuity to locate light sources such as windows and lamps as well as detect lighted objects against dark backgrounds. The chip's power source is positioned under the skin behind the ear and connected via a thin cable.

Window on the world

For those suffering with retinitis pigmentosa, Retina Implant's technology creates a small black-and-white window on the world, says Eberhart Zrenner, the company's co-founder and director and chairman of the University of Tübingen's Institute for Ophthalmic Research in Germany.

Retina Implant has successfully placed chips beneath the retina of nine patients since May 2010. A 10th patient experienced a problem when their optic nerve did not forward the information on the chip to the brain.

Looking ahead, Zrenner hopes to widen patients' field of vision further. "Because our chip has independent miniature photodiodes, we could arrange three of them in a row beneath the retina," he says. The ability to produce accurate colors via retinal implants, however, is very complicated and may not be possible for years, he adds. Retina Implant has also developed an outpatient treatment for early-stage retinitis pigmentosa called Okuvision, which uses electric stimulation to help preserve retinal cells.

Sights set on the U.S.
The phase II extension expands Retina Implant's trial to an additional 25 patients beginning early next year and follows a partnership the company struck in March with the Wills Eye Institute in Philadelphia. Wills is looking to become the lead U.S. clinical trial investigator site for Retina Implant's technology and to help the company through the U.S. Food and Drug Administration's (FDA) review process.

Cutting-edge technologies such as sub-retinal implants are typically at a disadvantage when seeking FDA approval due to the lack of a track record, but Retina Implant's work in Europe provides a precedent for the FDA to consider, says Julia Haller, Wills's ophthalmologist in chief. "There's information available to U.S. regulators about how patients have responded so far," she adds.

Commercial implant
Whereas Retina Implant's technology is just getting started in the U.S., another retinal implant–maker is already in FDA human clinical trials, which are expected to conclude in July 2014. Second Sight Medical Products sells its Argus II Retinal Prosthesis System in Europe—the first commercial implantation of their device took place October 29 in Pisa, Italy (pdf).

Second Sight's technology is fundamentally different, converting video images captured by a miniature camera—housed in a special pair of glasses worn by the patient—into a series of small electrical pulses transmitted wirelessly to an array of electrodes implanted on the retina's surface, rather than under it. These pulses are intended to stimulate the retina's remaining cells and create the perception of patterns of light in the brain. Epiretinal devices (overlying the retina) such as the Argus II preprocess an image before sending it to the retina. Because the camera does not create an exact simulation of normal retinal outputs, patients need time to learn how to process the information that their brain receives.

Although both Retina Implant and Second Sight's technologies are still relatively unproved, their potential is great. "As somebody who has to tell families that their child is going to lose all vision and not be able to do any of the things they had dreamed he or she would be able to do, I know that every little step you make, from absolute blindness to being able to see shapes to being able to count fingers and read words makes an incredible impact on a person's life," says Haller, who, in addition to being familiar with Retina Implant, has experience implanting Second Sight's retinal prosthetic devices.

Alternative implants
Retina Implant and Second Sight's technologies may be the furthest along in terms of testing but they are not the only ones working on ways to treat, and even prevent, retinitis pigmentosa.

A sub-retinal implant under development by Optobionics in Glen Ellyn, Ill., most closely resembles the work of Retina Associates. Optobionics's Artificial Silicon Retina (ASR) microchip is designed as a stand-alone implant placed behind the retina to directly stimulate the remaining viable cells of the retina. Instead of an external power supply, the Optobionics chip has an array of micro-photodiodes that convert light energy to electrical signals, which stimulate retinal cells. Haller implanted several Optobionics sub-retinal chips as part of a study conducted at the Wilmer Eye Institute at Johns Hopkins in Baltimore throughout 2004 and 2005 while she was a surgeon there (pdf). The company's funding subsequently ran out, however. Only recently were Optobionics' co-founders able to acquire the rights to the ASR implant technology. They plan to reorganize a new company under the Optobionics name.

Neurotech Pharmaceuticals, Inc. in Lincoln, R.I., is developing a different type of implant. Their intraocular implant consists of human cells genetically modified to secrete a nerve growth factor they say is capable of rescuing and protecting dying photoreceptors. The implant does not replace retinal tissue but rather is a way to resuscitate damaged retinal cells.

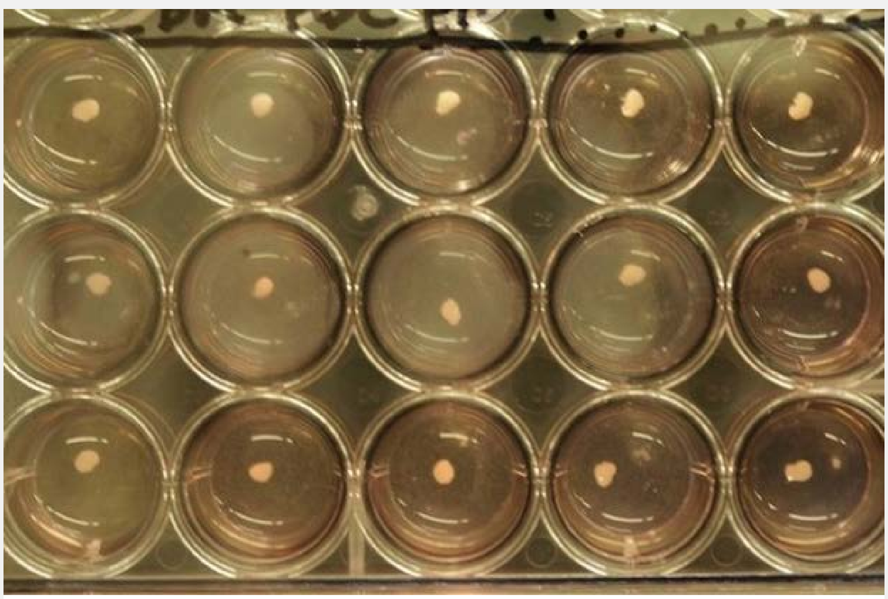
At Weill Cornell Medical College of Cornell University in New York City, neuroscientist Sheila Nirenberg is leading a project to develop an artificial retina with the capacity to reproduce normal vision. Rather than increasing the number of electrodes placed in an eye to capture more information and send signals to the brain, Nirenberg's work focuses on the quality of the artificial signals themselves so as to improve their ability to carry impulses to the brain.

It will take some time to see which approach works best, Haller says, adding, "All of the treatments for retinitis pigmentosa are experimental right now, so there's no real comparison yet between what works and what doesn't."

MENU

Scientists grow human liver from stem cells, hope to relieve transplant woes (video)

By **Nicole Lee** posted Jul 4th, 2013 at 5:09 AM 0



Stem cell research has resulted in several important breakthroughs in medicine, such as rebuilding the larynx and regenerating spinal cord connectors. Now the liver, one of the most highly sought after organs on the donor transplant list, could get some serious stem cell assistance as well. A team of scientists led by Takanori Takebe of Yokohama City University has successfully created a miniature version of the human liver with the help of induced pluripotent stem cells (iPSC), which are derived from adult somatic cells. They developed the iPSC into generalized liver cells called hepatocytes, at which point the researchers mixed in endothelial cells and mesenchymal stem cells, left the petri dishes alone for a couple days, and voila -- an extremely tiny version of a human liver, said to be the first-ever functional human organ grown from stem cells, was born.

The liver "buds," as they're known, measure five millimeters long and are the sort you would find in human embryos shortly after fertilization. When implanted in mice, the baby livers managed to perform all the functions of their adult equivalents. The researchers' next step would be to generate liver buds that are a touch closer to normal liver tissue -- like the addition of bile ducts -- and to see if they can mass produce them by the tens of thousands. Don't go wasting your liver just yet though, as it'll likely be years before the likes of you and me will be able to have a lab-grown liver in our bodies. In the meantime, check out the time-lapse video after the break to see a young liver bud take shape in a petri dish.

VIA: Smithsonian
SOURCE: Nature

TAGS: humanliver, ipsc, liver, stemcells, takanoritakebe, yokohamacityuniversity

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Second Sight

Second Sight announces First Commercial Implant of Retinal Prosthesis

Argus® II becomes the first ever commercial artificial retina.

Lausanne, November 2nd – Second Sight Medical Products, Inc., the world's leading developer of retinal prostheses for the blind, announced that the first ever commercial implantation of such a prosthesis was successfully completed on Saturday, October 29th in Pisa, Italy. The company's **Argus® II Retinal Prosthesis System ('Argus II')** was surgically implanted by Dr. Stanislao Rizzo, Director of the University Hospital Ophthalmic Department of Pisa, in a patient suffering from advanced Retinitis Pigmentosa (RP). Argus II, which received marketing clearance in Europe earlier this year, becomes the world's first ever commercial implant intended to restore some vision to a previously blind patient.

"I am very pleased to offer in Italy for the first time ever this approved treatment for blindness due to RP. I hope that it will encourage patients suffering from this impactful condition to seek medical advice in centers of excellence around Europe, like the one we have here in Pisa," said Dr. Rizzo. "It is wonderful that medicine can now do something for the blind."

Argus II is Second Sight's less invasive second generation implantable device intended to treat blind people suffering from degenerative diseases of the outer retina such as RP. The system works by converting video images captured by a miniature camera, housed in the patient's glasses, into a series of small electrical pulses that are transmitted wirelessly to an array of electrodes on the surface of the retina (epi-retinal). These pulses are intended to stimulate the retina's remaining cells resulting in the corresponding perception of patterns of light in the brain. Patients can learn to interpret these visual patterns thereby gaining some functional vision. The system was tested in a multi-center international clinical trial that began in 2007.

Dr. Rizzo indicated that the surgery proceeded without incident, and that the patient is recovering very well. Within a week of surgery, testing of the implanted device will begin and the **Argus II** will be electronically customized for the patient, who could be using the system at home before the end of the month. Typically, patients require a short period of training and low vision rehabilitation to obtain the best results.

Gregoire Cosendai, PhD, head of Second Sight's European subsidiary added, "This is truly a historic event that has been decades in the making. This milestone is significant for the company and the field of vision restoration, but most importantly, for these patients who now have a treatment option." Cosendai further indicated that the **Argus II** system is currently available in Germany, France, the UK, and Switzerland, and that Second Sight is actively adding more centers throughout the EEA.

For more information please contact

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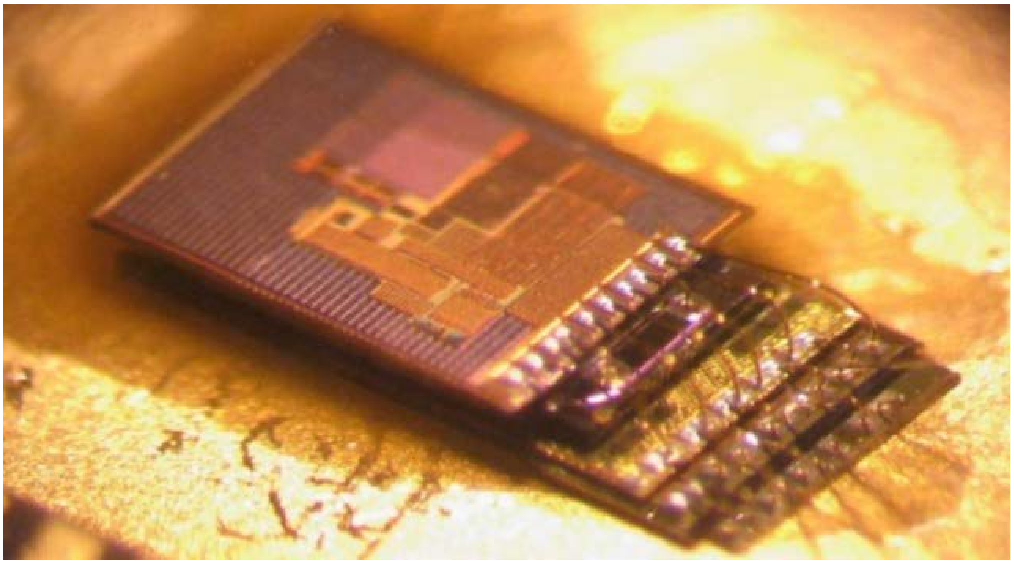
patients@2-sight.com

publicrelations@2-sight.com

Second Sight Medical Products, Inc., located in Los Angeles, California, was founded in 1998 to create a retinal prosthesis to provide sight to patients blinded from outer retinal degenerations, such as Retinitis Pigmentosa. Through dedication and innovation, Second Sight's mission is to develop, manufacture and market implantable visual prosthetics to enable blind individuals to achieve greater independence. European Headquarters are in Lausanne, Switzerland. Second Sight and Argus are registered trademarks and the Second Sight logo is a trademark of Second Sight Medical Products, Inc. Argus II is not approved for commercial use in the United States; it is being used in clinical trials under an FDA-approved Investigational Device Exemption (IDE).

Smart dust: A complete computer that's smaller than a grain of sand

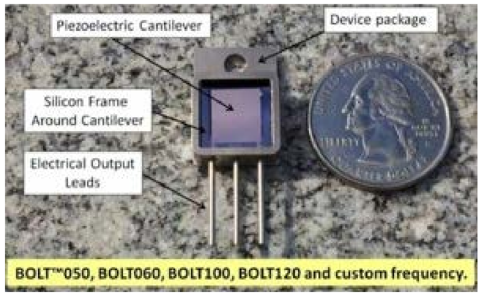
By Graham Templeton on May 15, 2013 at 11:58 am | 2 Comments



Most breakthroughs in miniaturization are important but boring; this substance can be stretched thinner than before, that manufacturing process is now 8% cheaper. This has always been in pursuit of a day when enough fundamental nano-breakthroughs have come together from materials and manufacturing that we can start inventing whole machines on that scale. Nobody's ever written a *Star Trek* episode about the world's smallest microchip, only about the world's smallest computer. Now, a team from the University of Michigan has built not just a very small microchip, but a whole functioning computer, and it's less than a cubic millimeter in size. Called the Michigan Micro Mote, or M^3, this tiny computer features processing, data storage, and wireless communication. Researcher Pabral Dutta thinks it will be the "next revolution in computing."

These M^3 units are, of course, very limited. They are about as simple as they can be, and for now they're being designed for very simple sensory tasks; load one up with a detector, say for the fluid pressure in a person's skull, and it might be able to monitor that value until it reaches some threshold, then alert its closest neighbor. (This is all hypothetical, as the concept has only just started animal testing.) The technology works with a very low-powered and low-range wireless standard to broadcast its latest state every few minutes. Presumably, if the signal is more than the usual “all clear,” it gets ferried on by its nearest brothers until finally reaching a base station with real computing power.

This implies that the chips are designed to necessarily work as a swarm, and indeed the term “smart dust” seems to have been a rallying cry for the researchers. Yet, few of their proposed uses seem to fit well with the technology itself; will we have a *swarm* of M^3 computers in our eye, or just one? Even if we have hundreds of the little monitors in various parts of the body, these millimeter-scale computers might struggle to communicate.



This passive power generator has already been scaled down quite effectively.

Additionally, as is always the case with extreme miniaturization, power generation and storage has been a big problem. Wireless power is an obvious choice, but that technology is having efficiency problems even on the human scale, let alone the dust one. To power the M^3, researchers fitted it with a tiny solar cell — but how much sunlight will be available while monitoring intracranial conditions? Passive power generation techniques, like MicroGen’s ambient vibration harvester, have already been scaled down quite nicely, and their meager energy output is well-suited to the equally tiny energy requirements of the new smart dust. And, since these are mostly being put forward for medical or at least bio-technological uses, body heat is another obvious potential source of energy.

Most possible applications require some faith that the micro-motes will improve over time. The researchers present their swarmputers as the next stage in overall processor evolution, from desktop to laptop to cell phone to bloodstream. And yet, these computers are limited by both processing power and communication, relaying information to one another only over very small windows, like deep space satellites. This does not seem to lend itself well to distributed computing. Samsung’s proposed graphene micro-antennae might offer some hope here, but even these function only on the centimeter scale. This would work for a tightly clustered network of chips, but how many applications will actually see these things bound closely together?

By far the most plausible short-term application is in diagnosis. If we can inject a patient with a small swarm of computers (made to break down slowly in the blood, so we don’t clog any arteries) we could send them on all kinds of missions. They could flush down larger blood vessels to detect a blockage or circulate freely until they bind to some programmed target. Autonomous endobots are one of the holy grails of diagnostic medicine.

There are also possible non-medical uses, though for those we must get quite speculative indeed. Being so small, they could easily get airborne with even tiny little wings; imagine the sensor ball idea from *Twister,* but on the millimeter scale. Now the solar panel begins to make more sense, and the possible applications much easier to imagine. What if you could paint a laser security system onto a door frame, a transparent medium laced with thousands of tiny computers that randomly fire bursts of light and wait for them to bounce back off a body moving through the door?

One other possible use for these computers is to make their size a temporary measure and have them reassemble into a larger whole. This would be a good way to get complex

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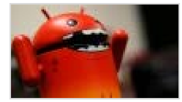

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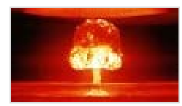

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computers through tight bottlenecks, medical or otherwise. Civil engineers might find it useful to flood a city's sewer system with little surveyor computers which periodically meet up to connect and to pool their power to send a signal back to home base.

All these possible applications hinge on detection or monitoring, though, never on taking modern processing power and breaking it up. This does not seem to be a further step in the miniaturization of computer power, but rather a new and independent path that could have benefits all its own.

Now read: Real life "Constructicon" quadcopter robots being developed

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Ch

Pascal Ribreau made his own standing chair with the help of a friend.

Photo by Simon Willms/SimonWillms.com

This is the story of three chefs and how an auto accident, a fallen tree and a carjacking forced them to figure out how their love of food meshed with spinal cord injury. If we told you they clawed their way back into the kitchen and white hat to the delight and praise of eaters everywhere, that would be a nice fairy tale, but it wouldn't quite be true. What is true is that none of them gave up the devotion to the culinary arts that was

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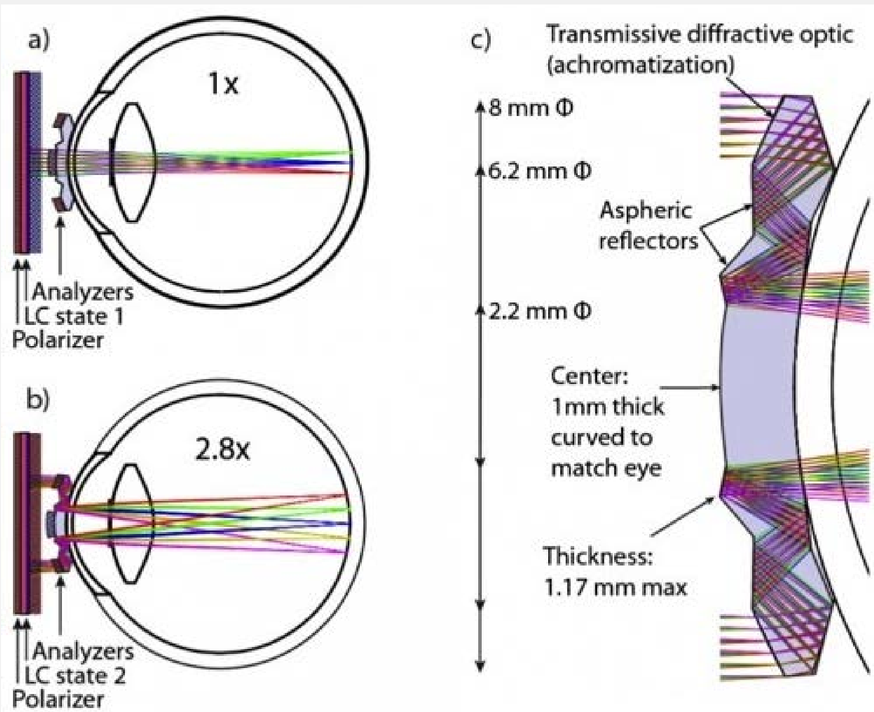
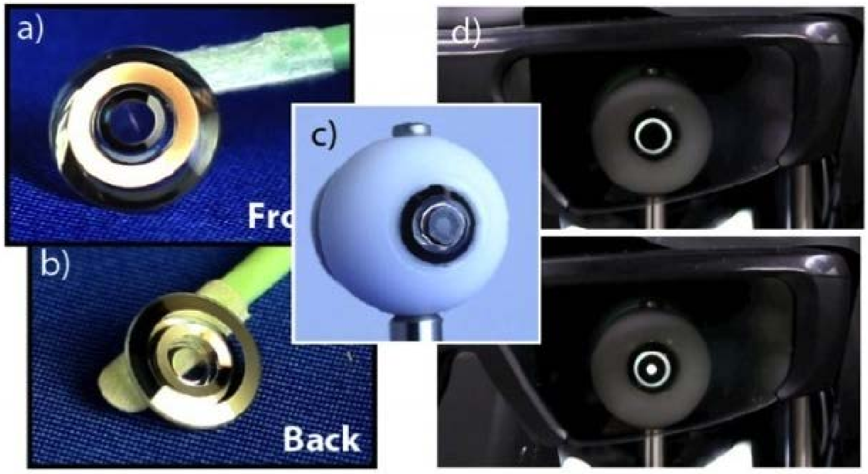
Telescopic contact lenses magnify sight 2.8 times, turn wearer into cyborg

By **Melissa Grey** posted Jul 2nd, 2013 at 12:39 AM 42



Interested in upgrading your eyeballs? Well, a team of DARPA-funded researchers led by Joseph Ford of UC San Diego recently published a proposal for a new type of telescopic contact lens in *Optics Express*. Designed for people with age-related macular degeneration, the lenses are only 1.17mm thick and can magnify images up to 2.8 times. Their layered construction admits light near the outer edge of the lens, bouncing it across a series of tiny aluminum mirrors before transmitting it to the back of the retina, kind of like the origami-optics lens. Telescopic sight can be toggled on and off by using a pair of 3D glasses to switch the polarization of the central part of the lens. It sounds promising, but the lenses -- pictured after the break -- currently have some obstacles, like gas-impermeable materials unsuitable for long-term wear and sub-par image quality. Want to read more? Pop on your glasses and check out the full paper at the source link below.



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VIA: Extreme Tech
SOURCE: Optics Express (PDF)

TAGS: healthcare, JosephFord, MedicalTechnology, OpticsExpress, telescopiccontacts, TelescopicLens, UcSanDiego, ucsd, UniversityOfCaliforniaSanDiego

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RyanStonn1 6 days ago

News from 2016: Men finally able to find the fabled clitoris :D

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mradelet 7 days ago

I have no issues with PMMA contact lenses. Used em for 14 + hours a day when I first got contacts, for years. My eye doc kept saying I was wearing them too long but when he checked my eyes they were healthy. After they were discontinued I tried 3 different brands to find something comfortable and actually ended up getting corneal edema in 1 eye.

Now I wear glasses :(

Like Reply

Tim15 8 days ago

News from 2016: Contacts go on sale.

News from 2017: Automobile crashes go up 800%....

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drewcrosby 8 days ago

When I did an image search for "burning eyes," this little gem popped up. I had to share.

http://cabeijo.com/static/images/eyes-burning-and-itching.jpg

Like Reply

MyoCarDiA 8 days ago

I'd still find a way to put them in backwards.

Like Reply

houndzm 8 days ago

Wonder if there are any concerns about staring in to the sun?

Like Reply

JonStern 8 days ago

DARPA has wanted this for soldiers (and pilots I presume) for a long time. They're not thinking about macular degeneration though.

Like Reply

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jsmmr5 9 days ago

The mention of 3D glasses is only because of the active shutter switching between 2D "Non-polarized" and 3D "Polarized" due to them being electronic. I am guessing they use them since a simple switch can be pressed to toggle between normal view and telescopic view. The same telescopic effect could be accomplished by putting on any pair of polarized sunglasses, i.e. $10 cheapies from your local drugstore or your fancy cool oakleys you got for christmas.

The bigger issue with these is the fact they aren't gas permeable, which would dry one's eyes out rather quickly, being the reason they can only be worn for short periods of time. Material alternatives will come though, and this is definitely a cool development for the disabled.

Like Reply

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simpleas 9 days ago

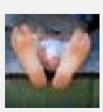
and you'll throw up after a min lol

Like Reply

search_ATARI2600SSD_on_ebay 9 days ago

if one activates this by accident while driving, one dies

Like Reply



DraftingDave 9 days ago

@search_ATARI2600SSD_on_ebay You mean by putting on/taking off your glasses (how it's activated/deactivated)? Because that's sooo different than it is now for someone with bad eye sight (using glasses).

1 Like Reply

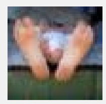
---

mradelet 7 days ago

@DraftingDave @search_ATARI2600SSD_on_ebay "By switching the polarizing state of the spectacles (a pair of active, liquid crystal Samsung 3D specs in this case), the user can choose between normal and magnified vision."

There you go. They could be activated by a slight bump while driving. That's if you've actually used the Sammy glasses before.

Like Reply



DraftingDave 7 days ago

@mradelet I have not used the Sammy glasses before, if indeed the polarization can be glitched that easily by a bump, I doubt they'd use them in practice. In reality, Liquid Crystal glasses are not needed for this product, they're using polarization, which is stagnant. The only use the Liquid Crystal glasses have, is that you do not have to change glasses to change the polarization (and in effect the magnification).

If you are in a situation where it would be dangerous to switch the magnification, you could just use a stagnant ($5 pair) or polarized glasses. Which is no different than any other driver relying on glasses for sight.

Like Reply

metro72 9 days ago

I really wanted these to wear to football games, etc. Then I read that to activate them, you have to put on 3D glasses. I can find lenses that can help me see much farther than 2.8x that don't make me look like I just got out of a bad movie.

And yes...that looks like the most painful "lens" to put in your eye ever.

Like Reply

JoeO'Neill 9 days ago

"Telescopic sight can be toggled on and off by using a pair of 3D glasses..." Sooo you can "activate" magnified vision by putting on a...pair...of...glasses...? W.T.F.

1 Like Reply

lightbulbit 9 days ago

Wait! Now I have to wear contact lenses AND glasses? I can do that now! It's called "binoculars" and they magnify alot more than 3x!

1 Like Reply

areaman714 9 days ago

A man barely alive. . . .

1 Like Reply

octosock 9 days ago

incredible

Like Reply

DuckOfDeath 9 days ago

Pros: Makes you see things with great clarity.

Cons: Will tear off your eyelids.

2 Like Reply

Oflife 9 days ago

I see what you did there, bigger.

Like Reply

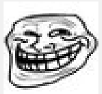
dark-star 9 days ago

wake me up when it has...x-ray vision! :)

1 Like Reply

Bub 9 days ago

Those look like extremely uncomfortable contact lenses.



Like Reply

JasonSherwood 9 days ago

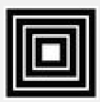
Geordi LaForge tested and approved.

Like Reply

darknessangel 9 days ago

@JasonSherwood Pssssh... the Borg approve of this!

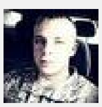
Like Reply



GenIus 9 days ago

looks tron-ish

1 Like Reply



Jonathan88 9 days ago

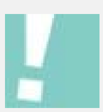
Free mail in sample or its fake! lol jk. Hopefully it wouldn't make a persons vision worse..Combine this tech with the wearable contact lense computer, and you got yourself some awesome cyborg human hacks

Like Reply

ChrisTippet 9 days ago

Reading the post, you'd have to wear 3d glasses.... Rendering them pointless.....!?

1 Like Reply



C38S 9 days ago

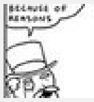
@ChrisTippet I did wonder about that and I can't really work it out. Having contacts + glasses? Perhaps it works out for people who break their glases often?? The polarised glasses are cheaper to change than magnified ones??

Like Reply

lslencrypted 9 days ago

@C38S @ChrisTippet I think the polarized glasses act as a filter. I don't think you can use these lenses without one.

Like Reply



Sean J 9 days ago

Hopefully keratoconus sufferers will get some trickle down tech from this.

Like Reply

TPRIDE 9 days ago

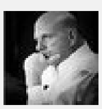
@Sean J Unfortunately, they are very different conditions and this technology wouldn't help at all. However, there are new techniques like collagen cross linking that DO help keratoconus.

Like Reply

LivinVidaLoca 9 days ago

This is what I always dreamt of ... now all we want is image capturing technique built into these lenses ...yank bank will be a reality soon

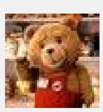
Like Reply



Ballmer 9 days ago

My goal is to work at Microsoft, although working at DARPA would be amazing. Just imagine how many things they research but don't get released.

2 Like Reply



xconan 9 days ago

@Ballmer Why? Doesn't Ballmer already work at Microsoft making questionable decisions?

1 Like Reply

lightbulbit 9 days ago

@xconan @Ballmer Questionable, no. BAD, yes.

1 Like Reply

Duke456 9 days ago

Alls I can hear now is the sound effect for Steve Austin,

Do do do do do do do do do do do do do do do

Like Reply

JoeRandomPerson 9 days ago

@Duke456 What is a Steve Austin?

Like Reply

TylerHunt 9 days ago

@JoeRandomPerson @Duke456 Whaaaaaat? Six Million Dollar Man? 'We can rebuild him. We have the technology.'

1 Like Reply

Krighton_ 9 days ago

@TylerHunt @JoeRandomPerson @Duke456 Young people.. pfftt I'm 35 and that show was before my time, however I educated myself.

Growing up, not knowing about the movie Goonies..should be punishable by death.

Like Reply

Duke456 9 days ago

@JoeRandomPerson @Duke456

http://www.youtube.com/watch?v=HoLs0V8T5AA

Like Reply

lightbulbit 9 days ago

@Duke456 Aaaannnddd... here is the clip with the "sound" he was talking about:

http://www.youtube.com/watch?v=__RypL2hsTY

Note: Only a couple tenths faster and 1 arm for another million dollars? Well, I have seen less results from a million dollars in tech :-D

Like Reply

lendzion.allen 9 days ago

@Duke456 that's Stone Cold. hahaha

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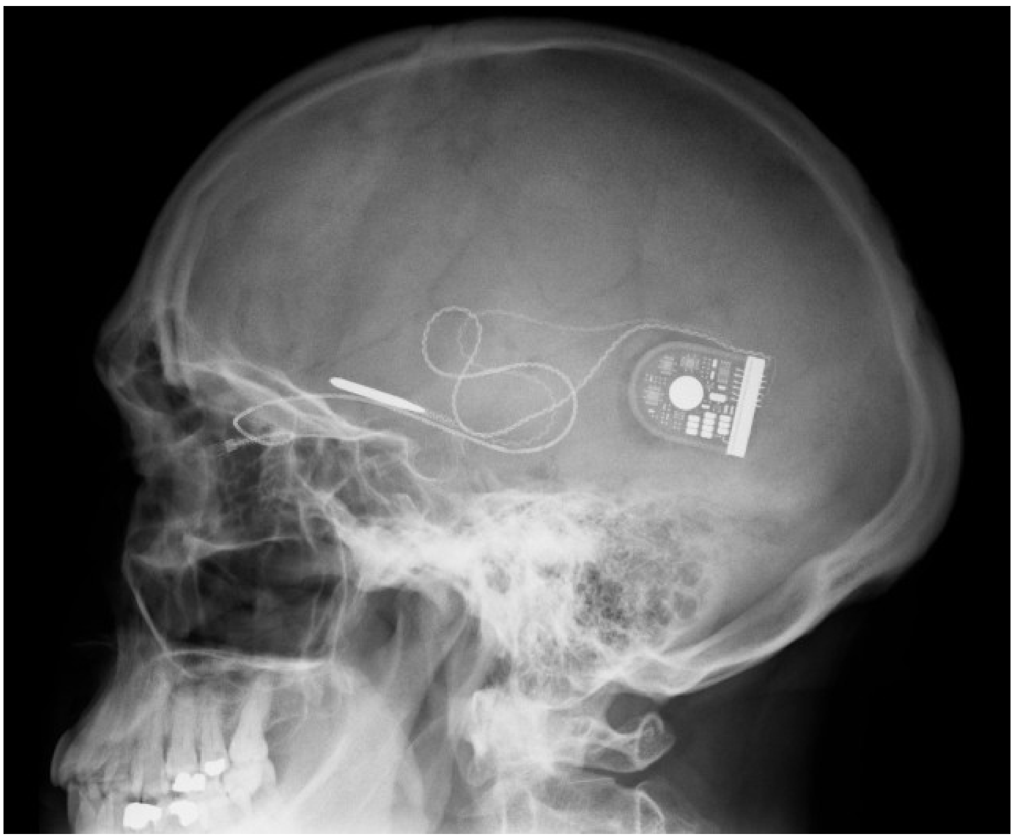
The first real, high-resolution, user-configurable bionic eye

By Sebastian Anthony on February 22, 2013 at 11:29 am | 10 Comments



Researchers in Germany have unveiled the Alpha IMS retinal prosthesis; a device that completely redefines the state of the art of implanted, bionic devices. The first round of clinical trials were a huge success, with eight out of nine patients reporting that they can now detect mouth shapes (smiles, frowns), small objects such as telephones and cutlery, signs on doors, and — most importantly — whether a glass of wine is red or white.

The Alpha IMS, developed by the University of Tübingen in Germany, is exciting for two reasons. First, it is connected to your brain via 1,500 electrodes, providing unparalleled visual acuity and resolution (the recently-approved-in-the-US Argus II retinal prosthesis has just 60 electrodes). Second, Alpha IMS is completely self-contained: Where the Argus II relies on an external camera to relay data to the implant embedded in your retina, the Alpha IMS prosthesis has a built-in sensor that directly gathers its imagery from the light that passes into your eye. This has the knock-on effect that the Argus II requires you to turn your head if you wish to look from side to side, while the Alpha IMS allows you to swivel your eyeballs normally. In essence, Alpha IMS is the first true, self-contained bionic eye.

At this point, you really should watch the two videos below. The first demonstrates where Alpha IMS is implanted, and how it works. The second video shows one of the first patients to receive the Alpha IMS prosthesis, and how it felt to see his wife's face for the first time. It isn't clear in the video, but the device is powered wirelessly from a battery in the patient's pocket.

The Alpha IMS and Argus II retinal prostheses work in fundamentally the same way. Basically, there are different kinds of blindness — cataracts, glaucoma, macular degeneration, disease, and so on. In a healthy eye, light is converted into electrical signals by the rods and cones in your retina, which are then transmitted down your optic nerve to your brain. In an eye that's been afflicted by macular generation or diabetic retinophathy,

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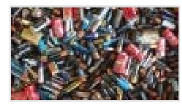
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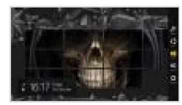
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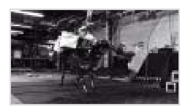
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these signals aren't generated. Alpha IMS and Argus II restore vision by, essentially, replacing the damaged piece of your retina with a computer chip that generates electrical signals that can be understood by your brain. (See: A bionic prosthetic eye that speaks the language of your brain.)

For the most part, these bionic eyes are still rather dumb and rely heavily on the brain's amazing ability to make sense of the alien signals being pumped into it. That isn't to say, though, that we don't have any control over the signals being produced, and thus the perceived image: In the image above, the large device above the patient's ear is a dial that can adjust the implant's brightness. Yes, we're now at the point where we can create bionic eyes with configurable settings. I wonder how long it'll be until there are bionic eyes that offer higher resolution and sharper visual acuity than our squishy, fleshy orbs.

Now read: The past, present, and future of bionic eyes

Research paper: doi: 10.1098/rspb.2013.0077 – "Artificial vision with wirelessly powered subretinal electronic implant alpha-IMS" [open access]

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Sly Cooper

It saddens me that humanity, especially the members residing in America, are happier to pour funding into military applications than for things like this.

Prosthesis, cancer, HIV etc all need more help. We're dipping in and out of a technological dark-age.

Aleina Mamun

First Real Bionic Eye â€“
Vsauce2 http://funnyandspicy.com/first...

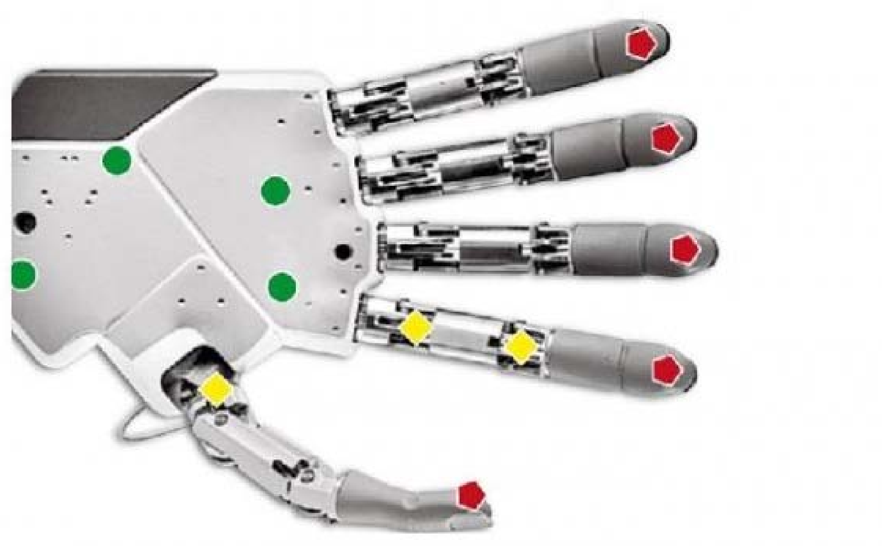
VirtualMark

I wonder when we'll have bionic eyes that can see outside of the light spectum. That'd be awesome, infra red or ultra violet vision.

JDRahman

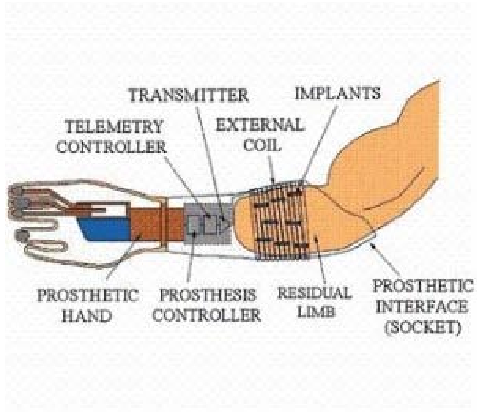
The mind-controlled bionic hand that also controls your mind

By Graham Templeton on February 19, 2013 at 1:53 pm | 5 Comments



From speech recognition to prosthetic legs, we've all but perfected the art of forcing computers to listen. Whether our input comes in the form of keystrokes or action potentials, by far our biggest concern in robotics has been finding ways to make machines better at understanding what we want from them. This week, a team of Swiss researchers announced that it will begin testing a new "sensing" bionic hand, one which looks to explore our ideas about the relationship between brain and machine. Now, it is the robots' turn to speak.

Most of us are familiar with the concept of training a computer, perhaps teaching a speech recognition program the nuances of our voice or accent. There is little conceptual distance between how you say the word "roof" and how you try to clench a fist; to a computer with the proper recording device, it's all just numbers in a matrix. When an unnamed Italian man gets his experimental new hand, however, it is the human who will have to learn an alien tongue. The system uses nanoscale wires fused to the ends of the median and ulnar nerves to allow communication both to and from the brain — but even properly attached, a robotic pressure sensor is an alien thing. The first step in becoming a cyborg? Figuring out which finger is which.



Each fingertip, along with the palm and wrist, will be able to transmit signals independently, for what lead researcher Silvestro Micera calls a truly realistic feeling hand. Details on just what this means are unfortunately quite slim; Micera spoke at the AGM for the American Association for the Advancement of Science, and since this is not a published paper it is woefully lacking in mechanical explanation. Micera has been publishing on thought-controlled prosthetics for years, but has not yet gone into too much detail on his research into prosthetic-controlled thoughts.

It's a bit unclear how the sensory signals are being generated, whether they are designed to mimic signals from the corresponding section of the other hand, or will simply rely on the patient to build associations between each type of stimulation and its sensory meaning (See: Researchers give animals the ability to feel infrared light; humans next). The latter seems more likely, given the newness of the technology, so the patient will have to go through the process of sensory substitution before the effect is complete.

The so-called *electrotactile system* that is to allow cyborg sensing is currently a bit ghoulish in appearance, with wires piercing the patient's forearm like something out of an '80s science fiction film — frontier science rarely has designers on hand until way down the line. An earlier version of this same technology was put into practice in 2009, and the patient reported being able to feel pinpricks in three different areas of the hand.

More casual use — the unconscious integration of mechanical and biological sensory information for pulling on a shirt or slapping an alarm clock — will require much higher fidelity in both number of sites and types of stimulation. Perhaps most importantly, levels of stimulation should greatly increase the usefulness of a grasper, so patients can literally *feel* how tightly they are gripping a glass and modulate the pressure accordingly. (See: Paraplegic woman uses mind-controlled robotic arm to feed herself a chocolate bar.)

Interestingly, this technology went through its zygotic stages in the form of *remote* sensing; in the age of ubiquitous WiFi, there's no reason your hand has to be physically attached to you. Once we're making steady progress toward feeling that which is right in front of us, the next next frontier could easily be feeling that which is far away.

Now read: A bionic prosthetic eye that speaks the language of your brain

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Harry_Wild

" â€œsensingâ€ bionic hand, one which looks to explore our ideas about the relationship between brain and machine. Now, it is the robotsâ€™ turn to speak."

From Wikipedia:

"Demon with a Glass Hand" is an episode of The Outer Limits television series, the second to be based on a script by Harlan Ellison, which Ellison wrote specifically with actor Robert Culp in mind for the lead role. It originally aired on 17 October 1964, and was the fifth episode of the second season.

"Through all the legends of ancient peoples â€" Assyrian, Babylonian, Sumerian, Semitic â€" runs the saga of the Eternal Man, the one who never dies, called by various names in various times, but historically known as Gilgamesh, the man who has never tasted death ... the hero who strides through the centuries ..."

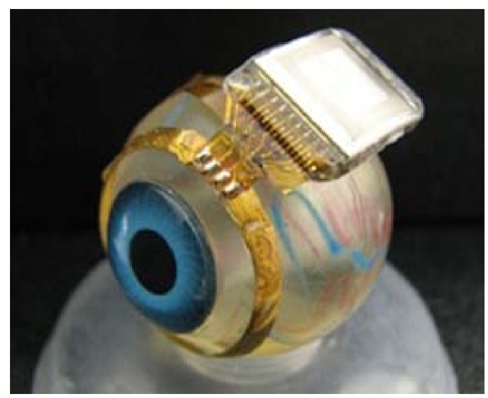
"Trent is a man with no memory of his life before the past ten days. His left hand has been replaced by an advanced computer shaped like his missing hand and protected by some transparent material. Three fingers are missing; the computer tells

The past, present, and future of bionic eyes

By John Hewitt on December 7, 2012 at 11:13 am

Next-generation bionic eyes are practically here today. Imagine a blind person's real-world conundrum trying to shop for one — they could schedule surgery for Nano Retina's implant today and see their daughter's wedding in 576-pixel clarity [1], but it would cost them their life's savings. The Nano Retina 5000-pixel device could be ready tomorrow, or in another six months… and would be much more affordable. When the procedure involves assimilation of an electrode pincushion into the ganglionic tentacles of your retina, hardware upgrades are not as simple as popping in more RAM. What kind of decision matrix could be offered under such critical circumstances?

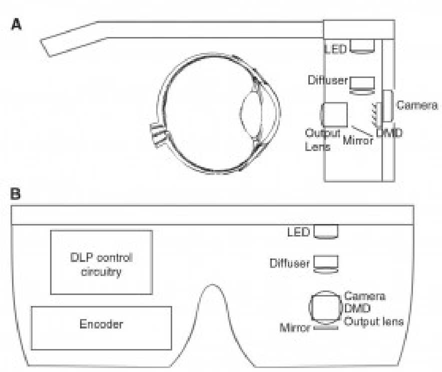
Cochlear implants, used to restore hearing, work phenomenally well when properly tuned and fitted. Most are refinements of the basic piece of hardware one might have sitting on their bookshelf — the graphic equalizer. The implant processes a single audio stream into bins of various sizes according to frequency, and then applies current to the corresponding frequency location in the cochlea, typically with a 16-spot linear electrode. The main function of these devices is to capture speech formants — the peaks in the frequency spectrum of the voice. The toughest challenge for the cochlear implant is to provide sound localization and source separation in noisy environments like a cocktail party.



[2]Vision implants are much more complex. As any practiced photographer knows, the eye is more than a camera. The optic nerve does not feed the brain pixels. If you imagine your camera responding to auto-selected targets several times a second, gathering the full spectrum of light through its entire range of settings at each pause, and compressing the data onto a bandwidth- and energy-limited channel ideally matched to its receiver, you have some idea of what the retina accomplishes routinely.

The reason cochlear implants work so well is that the brain is just that good at making sense out of virtually any kind of signal it is given. If presented only with noise, or with nothing at all, the brain will eventually begin to manufacture hallucinations. If the implant signal contains even some distorted fragment of the original signal, it can be made to work convincingly. This is also the reason why retina implants can work without incorporating any knowledge of what the retina actually does in the healthy state.

[3]These days researchers are trying to do a little better than the grainy images provided through our current implants [4]. Signal processing techniques were developed in the Cold War era to track and target incoming missiles by extracting signals from noisy radar data. These same techniques are now used to convert the activity of groups of neurons in the motor cortex into a set of commands for moving a cursor, prosthetic device, or de-enervated limb in brain machine interfaces [5] (BCIs). These methods and derivations of them can also be applied to incoming sensory data and can approximate what the retina actually does, without doing it in the same way.



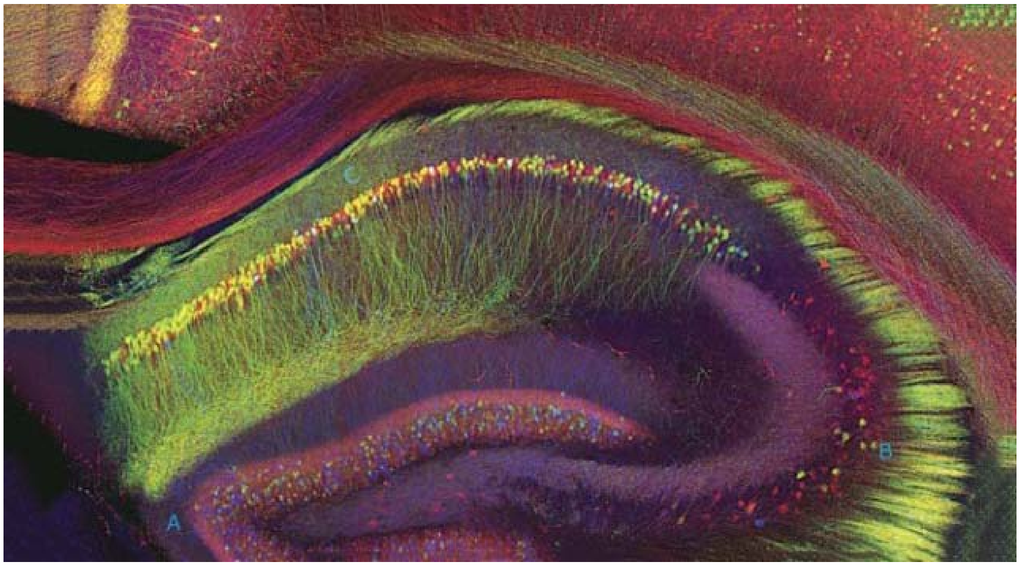
Unfortunately, videos and TED talks are not the places where this kind of knowledge is typically transmitted in much depth. For that, one needs to look back to the work of the founding father of cybernetics, Norbert Wiener, and his eminently practical inspiration, Vito Volterra. After suggesting that helium be used instead of hydrogen in airships, to great success, Volterra shifted gears and came up with some methods to characterize complex systems. Wiener simplified Volterra's equations and they are now widely used today in statistical techniques like linear regression analysis, and analysis of spike trains from neurons.

Next page: The future of high-res bionic eyes [6]

A single neuron in the brain of a blow fly can read input from its photoreceptors and command a wing muscle to change its flight path within about 30 milliseconds.

That's just time enough for a few spikes on a one-neuron chain, so the temporal structure of those spikes contains real information relevant both to the stimulus and motor imperative. It is therefore not just a coarse pulse frequency code. These Wiener equations, or more precisely, kernels, have been used to accurately represent the information in these spike trains and replace the neuron in simulated systems. To do so — even for a few spikes — requires intensive computation using reiterative numerical methods.

To attempt such a process for the million or more axons (the long connections between neurons) that constitute the output of the retina would be prohibitive. To get around this, researchers have further simplified the equations and can now do a decent job of reconstructing a stimulus, as long as the number of pixels or other kind of input chosen is limited. Rather than directly representing pixels, the processed responses of the ganglion cells in the retina can better be understood in terms of standard image-processing concepts like edge detection, and center-surround inhibition. These filters are built into the physical structure of the neuron's dendritic tree. A project to create a connectome [7] for the retina, known as Eyewire [8], is now looking to create a rough map of these details through a crowdsourced, online gaming effort.



[9]

Ultimately, this kind of analysis is a top-down approach and has its limitations. For the present time, it is the best we have. Neuromorphic chips [10] and artificial neural networks [11] could replace these methods in the interim time until actual biologic equivalents can be grown for replacement retinas. Research on stem cell replacements for the "hair" cells in the cochlea, which do the actual sound mechano-transduction into electrical nerve activity, is making astounding progress that will hopefully soon be transferred to visual and motor systems.

MIT Technology Review [12] has reported on a couple projects still in the early stages of development. At the Society of Neuroscience this meeting this November, Massoud Khraiche [13] proposed using silicon nanowires to replace damaged photoreceptors. These nanowires could allow for both light detection and neuron stimulation. Another group, at Carnegie Mellon [14], is also making inside-the-eye devices even smaller. Their device would provide detail comparable to that of the fovea, the part of the eye with the highest density of photoreceptors.

[15]Under some conditions, photoreceptors, like a dark-adapted rod cell, can detect a single photon. More impressively, that single rod cell can inform its owner of the event with some statistical reliability. In other words, the person can guess whether they saw the photon or not with significance better than chance. Considering that the same cell can also function on the reflective sands of a sunny beach, that gives us some appreciation for the dynamic range through which the retina can operate. Capturing this full complement of skill with a prosthetic bionic eye will certainly take time.

As far as choosing a go-to implant manufacturer, is hard to know what technologies and algorithms various developers may eventually employ. If your implant allows new vision apps to be installed over-the-air, that might be a good sign. Operating system/firmware upgrades should be provided for as well. Ultimately, if your implant permits actual hardware upgradeability by including a spare FPGA [16], that would be preferable. People with disabilities are learning today to temper their expectations when news reports announce medical breakthroughs. The day will come soon enough when lack of technology won't be the biggest problem, rather they might simply be too expensive for the mass market to acquire. Hopefully, equitable systems for the disbursement of these new products will be found, and they can be enjoyed in the spirit of the best for the most.

Now read: Scientists reverse engineer animal brains to create bionic prosthetic eyes [17]

Endnotes

1. in 576-pixel clarity: http://www.extremetech.com/extreme/132918-the-laser-powered-bionic-eye-that-gives-576-pixel-grayscale-vision-to-the-blind
2. : http://www.extremetech.com/wp-content/uploads/2012/12/eye.jpg
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4. current implants: http://www.extremetech.com/extreme/134498-scientists-reverse-engineer-animal-brains-to-create-bionic-prosthetic-eyes
5. brain machine interfaces: http://www.extremetech.com/extreme/126773-researchers-create-brain-computer-interface-that-bypasses-spinal-cord-injury-paralysis

6. The future of high-res bionic eyes: http://www.extremetech.com/extreme/142411-the-past-present-and-future-of-bionic-eyes/2
7. connectome: http://www.extremetech.com/extreme/139978-synaptic-tail-chasing-will-we-ever-have-a-human-connectome
8. Eyewire: https://eyewire.org
9. : http://www.extremetech.com/wp-content/uploads/2012/11/human-hippocampus.jpg
10. Neuromorphic chips: http://www.extremetech.com/computing/131230-cpus-of-the-future-amd-partners-with-arm-while-intel-designs-a-brain-on-a-chip
11. artificial neural networks: http://www.extremetech.com/extreme/141926-spaun-the-most-realistic-artificial-human-brain-yet
12. MIT Technology Review: http://www.technologyreview.com/news/508041/vision-restoring-implants-that-fit-inside-the-eye/#comments
13. Massoud Khraiche: http://neuralsens.com/neuralsens/Massoud_L_Khraiche.html
14. Carnegie Mellon: http://www.cmu.edu/news/stories/archives/2012/june/june8_retinalprosthesis.html
15. : http://www.extremetech.com/wp-content/uploads/2011/09/Prosthesis-Eye.jpg
16. FPGA: http://www.extremetech.com/tag/fpga
17. Scientists reverse engineer animal brains to create bionic prosthetic eyes: http://www.extremetech.com/extreme/134498-scientists-reverse-engineer-animal-brains-to-create-bionic-prosthetic-eyes

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Tiny terahertz chips can give smartphones X-ray vision, tricorder-like functionality

By James Plafke on July 9, 2013 at 7:45 am | 4 Comments

Back in the early days of comic books, before they were used to convey compelling, mature narratives, you could turn to the back page and order X-ray specs for a few bucks. They obviously didn't allow you to see through walls, but Caltech researchers have developed a tiny new terahertz chip that could give your smartphone that ability.

The terahertz frequency sits between 0.3 to 3 terahertz, tuckered into the electromagnetic spectrum between microwaves and far infrared. A large reason why terahertz waves can be considered special is because they can provide a similar function as X-rays, but whereas X-rays can be dangerous, terahertz radiation is comparatively harmless. Though the terahertz frequency has been utilized through a small device on a couple occasions, one reason why we haven't switched over to T-rays from X-rays is because terahertz frequency equipment is generally large and expensive. Now, though, a team of Caltech researchers has managed to eliminate both of those issues.

The chip is made of of silicon, smaller than a penny, and operates thanks to a group of small transistors that work together to act as a terahertz antenna. The chip is small enough that it could fit inside a device the size of a modern-day smartphone. Due to the types of objects terahertz waves can and cannot pass through, an app could theoretically be made that can read which objects the waves passed through and which objects bounced them back. With this information, the data could be visually recreated on a standard display, turning your phone into what is essentially a portable X-ray device (in the specs sense). The Caltech researchers feel that the buck doesn't have to stop at detecting a gun inside a purse, but the sensors could also scan for cancer without an invasive procedure, make motion control recognition more precise, and increase data transfer speeds — something we admittedly hear on a regular basis at this point.

This specific Caltech chip has been in development for a while, but as we seem to be petering on the edge of not really knowing where to go with our mobile device hardware lately, perhaps adding T-ray technology — a new kind of sensor, so to speak, to go along with our gyroscope and accelerometer and GPS — would be the next step in advancing the hardware. Perhaps doctors wouldn't immediately be diagnosing patients by waving a smartphone in front of them after minimizing *Angry Birds*, but it's certainly feasible that bouncers or sporting event security guards could add a smartphone T-ray scanner to their repertoire of security devices.

Of course, the biggest worry about this kind of widespread technology would be privacy concerns, as any old person with a T-ray-equipped smartphone could snap a photo of what's hiding underneath our clothes. That, however, is the kind of world in which we live nowadays, as Google's Glass continues to raise privacy concerns before the consumer market even tries the thing out. Like with Glass though, and even camera phones before it, the public will have to decide whether or not the benefits outweigh the potential privacy breach. There isn't any word on the chip's integration into consumer-level hardware, so maybe we'll have figured all this privacy stuff out with Glass by then.

Now read: Nano-scale terahertz antenna created, hand-held tricorders incoming

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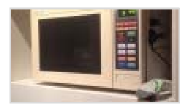

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Touch Bionics i-limb ultra revolution is controllable via a mobile app

Brian Sin, Apr 13th 2013 **Discuss [2]** +1 2 34

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Touch Bionics has just announced a new product in its inventory called the i-limb ultra revolution. It features a biosim mobile app that is usable through iOS devices. The i-limb ultra revolution features a powered rotating thumb, 24 Quick Grip options, and extra sensitive electrodes. Ian Stevens, the CEO of Touch Bionics, states that the i-limb ultra revolution will enable “wearers to more easily perform activities of daily living and thus increase their quality of life.”

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The ultra revolution allows the user not only the powered rotating thumb feature, but also the ability to articulate each individual finger, offering "unparalleled dexterity" and much more precise grip actions. There are also a variety of wrist options that allow more "natural positioning of hand when gripping or picking up objects". There are also various aesthetic products that can make the i-limb look more natural.

The i-limb ultra revolution is the first upper limb body part that is controllable via a mobile application. While using the biosim mobile app, users are able to access any of the preset 24 Quick Grips with a single touch. There is a Hand Health Check option that checks the make sure the i-limb is functioning correctly. There is also training modes that teaches the users how to fully utilize their prosthesis.

The Quick Grips offer a variety of useful options, including grips that allow the user to type, hold papers, or use a mouse. Users are also able to sort their favorite grips into a list so that they have quicker and easier access to them. Touch Bionics is very innovative in combining prosthesis with advanced technology. A couple of its previous products include a bionic finger and a prosthetic hand programmable via Bluetooth. An i-limb ultra revolution user, Bertolt Meyer, states,

> "Powered thumb rotation, combined with the mobile app and quick access to all these new grips, gives me natural hand function that I never imagined would be possible."

[via Touch Bionics]

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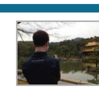

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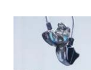

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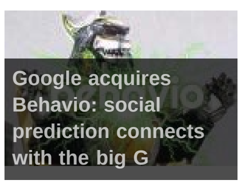
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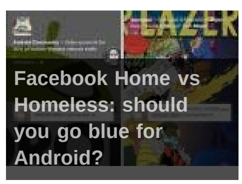
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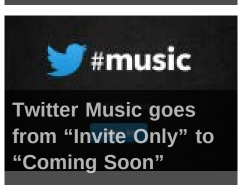

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3-D Printed Synthetic Bone Displays Future For Composite Materials

July 3rd, 2013 | by Txchnologist Staff

Scientists looking to nature for inspiration have long known that the whole of a structure is often greater than the parts. In bones, for instance, soft proteins and stiff but brittle minerals join in a complex matrix that distributes stresses to absorb impacts.

But it isn't very easy for those knocking off nature's best tricks to reproduce something like bone because the complex positioning of the different materials has been impossibly difficult to mimic. The hierarchical layering of soft collagen proteins with hard hydroxyapatite mineral is what gives the naturally occurring composite its great load-bearing qualities.

Now, though, an MIT team has revealed that they've gotten much closer.

They first investigated the molecular structure of natural bone to understand how the

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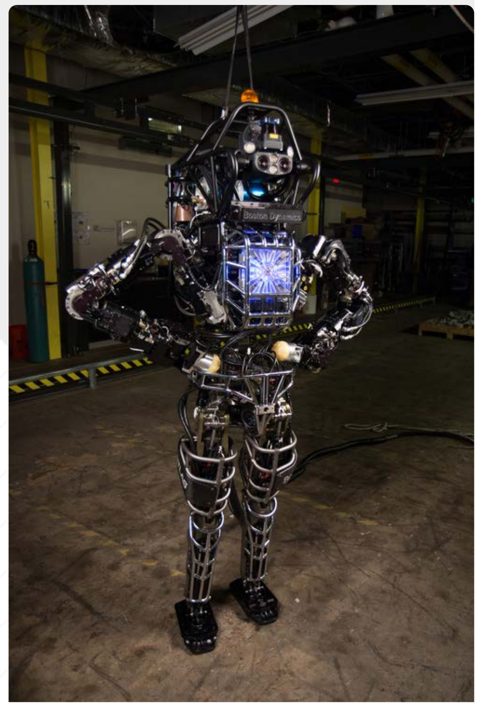

The Real RoboCop? Tech's Expanding Role In Public Safety

September 9th, 2013 | by Ysabel Yates

In anticipation of the 2014 release of the RoboCop remake, we started reflecting on the state of public safety and crime-fighting technologies.

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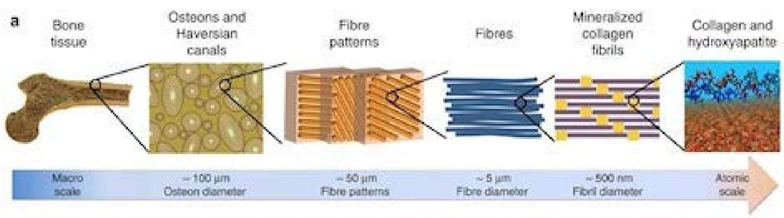
pieces fit together. Using that information, they developed a computer-optimized blueprint to lay out precise geometric patterns of soft and stiff polymers with properties similar to the biological material. Then they fed those instructions into a 3-D printer capable of extruding both polymers at once, which built the strong bonelike material layer by layer.

“The geometric patterns we used in the synthetic materials are based on those seen in natural materials like bone or nacre, but also include new designs that do not exist in nature,” said Markus Buehler, an associate engineering professor, in a university announcement. “As engineers we are no longer limited to the natural patterns. We can design our own, which may perform even better than the ones that already exist.”

Combining soft and hard

The advanced composite material they produced from this process is 22 times more fracture-resistant than its strongest constituent polymer part. They detailed their work in a recent edition of the journal Nature Communications.

"Our results suggest that the mineral crystals within this network bears up to four times the stress of the collagen fibrils, whereas the collagen is predominantly responsible for the material’s deformation response," the team wrote in the paper’s abstract. "These findings reveal the mechanism by which bone is able to achieve superior energy dissipation and fracture resistance characteristics beyond its individual constituents."



(Hierarchical structure of bone ranging from the macroscale skeleton to nanoscale soft collagen protein and hard but brittle hydroxyapatite mineral. Courtesy figures published by Nature Communications.)

Buehler says the production process could be scaled up to 3-d print multicomponent materials in precise patterns configured for specific functions in structures, with entire buildings manufactured with optimized materials that incorporate electrical circuits, plumbing and energy harvesting.

“The possibilities seem endless, as we are just beginning to push the limits of the kind of geometric features and material combinations we can print,” he said.

Top Image: This photo shows the brick-and-mortar pattern of simulated bone and nacre against the backdrop of real nacre found in the inner shell of many molluscs. Photo courtesy Graham Bratzel/MIT.

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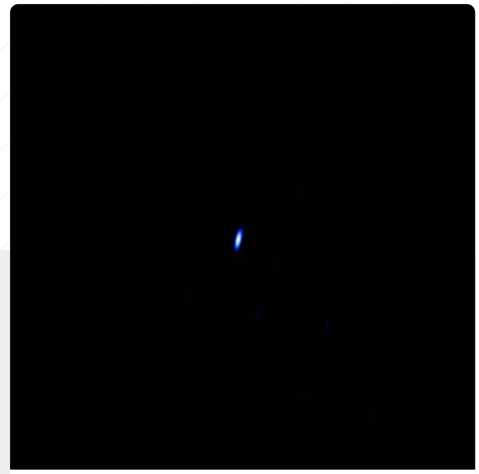

Did You Know We Can Still Spot Voyager 1?

September 9th, 2013 | by Michael Keller

NASA’s Voyager 1, which last week made headlines after scientists announced it had officially left our solar system, is now more than 11 billion miles from Earth. It has traveled farther than any other object humanity has ever produced.

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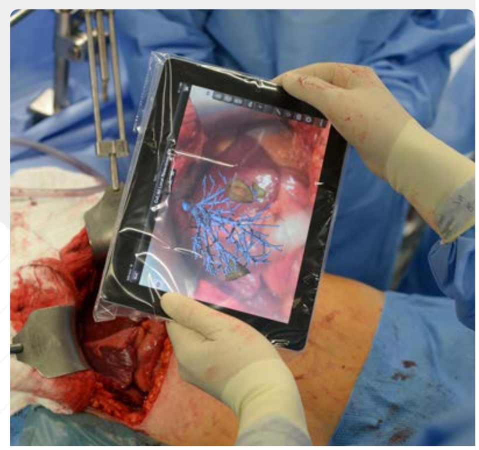

Augmented Interventions: The Next Wave Of Health Care

September 9th, 2013 | by Ysabel Yates

Augmented reality is no longer the stuff of science fiction. With a smartphone in every pocket to scan QR codes help navigate to a destination or spot hidden nearby restaurants, a real world mediated by the digital one is fast becoming part of our daily lives.

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August 16, 2011

Press Release, 11-47

United States Patent and Trademark Office Issues Patent Number 8,000,000

Patent Awarded to Second Sight Medical Products for a "Visual Prosthesis Apparatus" that Enhances Visual Perception for the Sight Impaired

WASHINGTON – The Department of Commerce's United States Patent and Trademark Office (USPTO) today issued patent number 8,000,000 to Second Sight Medical Products, Inc., for a visual prosthesis apparatus that enhances visual perception for people who have gone blind due to outer retinal degeneration. The invention uses electrical stimulation of the retina to produce the visual perception of patterns of light. The product, the Argus® II, is currently in U.S. clinical trials and has received marketing approval in Europe.

"This kind of innovation is a driver of our nation's economic growth and job creation," said Under Secretary of Commerce for Intellectual Property and Director of the USPTO David Kappos. "The USPTO plays a major role in serving America's innovators by granting the intellectual property rights they need to secure investment capital, build companies and bring their products and services to the global marketplace."

"Second Sight has 90 issued U.S. patents surrounding technology associated with sight restoration for the blind and treatment of a variety of other medical conditions," said Robert Greenberg, president and CEO of Second Sight. "This patent protection and significant federal support for innovation have already played key roles in creating nearly 100 U.S. jobs at our company. Once the Argus II has FDA approval in the United States, we expect to create hundreds of more jobs over the next several years, while delivering a breakthrough treatment for a previously untreatable medical condition."

It took 75 years to get to patent 1 million in August 1911, yet just under six years to get from patent number 7,000,000 to today's patent number 8,000,000. More information on these milestones is available online.

About Patent Number 8,000,000

In a healthy eye, the photoreceptors (rods and cones) on the retina convert light into tiny electrochemical impulses that are sent through the optic nerve and into the brain, where they are decoded into images. If the photoreceptors no longer function correctly, the first step in this process is disrupted and the visual system cannot transform light into images, causing blindness.

The system awarded patent number 8,000,000 is designed to bypass the damaged photoreceptors altogether. A miniature video camera housed in the patient's glasses sends information to a small computer worn by the patient where it is processed and transformed into instructions transmitted wirelessly to a receiver in an implanted stimulator. The signals are then sent to an electrode array, attached to the retina, which emits small pulses of electricity. These electrical pulses are intended to bypass the damaged photoreceptors and stimulate the retina's remaining cells to transmit the visual information along the optic nerve to the brain.

The signing and presentation of the 8 millionth patent by Director Kappos will take place at the Smithsonian American Art Museum on Sept. 8, 2011.

About Second Sight Medical Products

Second Sight Medical Products, Inc., located in Sylmar, Calif., is a privately held company founded in 1998 by Alfred Mann, Dr. Sam Williams and Gunnar Bjorg with the goal of creating a retinal prosthesis to provide sight to subjects blinded from outer retinal degenerations, such as retinitis pigmentosa.

For more information about Second Sight Medical Products, please visit www.2-sight.com or call 818-833-5026. Second Sight and Argus are registered trademarks of Second Sight Medical Products, Inc.

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UTD Nanotech Team Creates Yarn That Mimics Super-strong Muscle

EDUCATION *11/25/2012* | *by Christine Perez* | Share Post

Artificial muscles developed at UTD and made from nanotech yarns filled with paraffin wax could one day be used in robots and intelligent textiles, among numerous other uses. According to a UTD report, the yarns can lift more than 100,000 times their own weight and generate 85 times more mechanical power than natural muscle. The UTD team is working on the project with international colleagues in Australia, China, South Korea, Canada, and Brazil.

Dr. Ray Baughman, director of UTD's NanoTech Institute, said in the report that the yarn's potential uses include catheters for minimally invasive surgery. The article states that the artificial muscles are "constructed from carbon nanotubes, which are seamless, hollow cylinders made from the same type of graphite layers found in the core of ordinary pencils. Individual nanotubes can be 10,000 times smaller than the diameter of a human hair, yet pound-for-pound, can be 100 times stronger than steel."

Read the full story.

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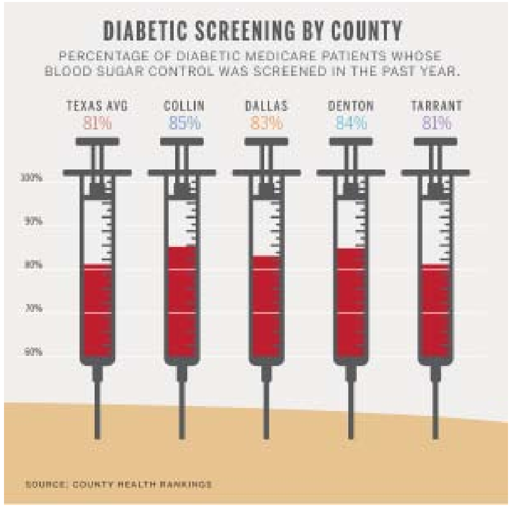

Diabetic Screening By County

DALLAS/FORT WORTH HEALTHCARE Daily

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Stem cell research has held the hope for future cures and treatments. Now, two blind patients have regained some of their sight thanks to implants of the cells, taken from embryos. ITN's Lawrence McGinty reports. (Nightly News)

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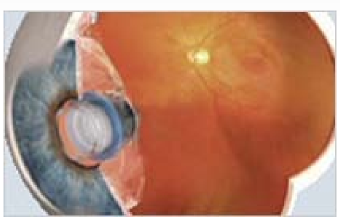

An Ophthalmic First

VisionCare has gained FDA approval for the first-ever, vision-improving implantable device for patients with End-Stage age-related macular degeneration (AMD).

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Now available for individuals with severe vision loss due to End-Stage AMD - the CentraSight™ treatment program using the Implantable Miniature Telescope (by Dr. Isaac Lipshitz).

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- November 10, 2011
  First Patient Receives FDA-Approved Telescope Implant for End-Stage Macular Degeneration
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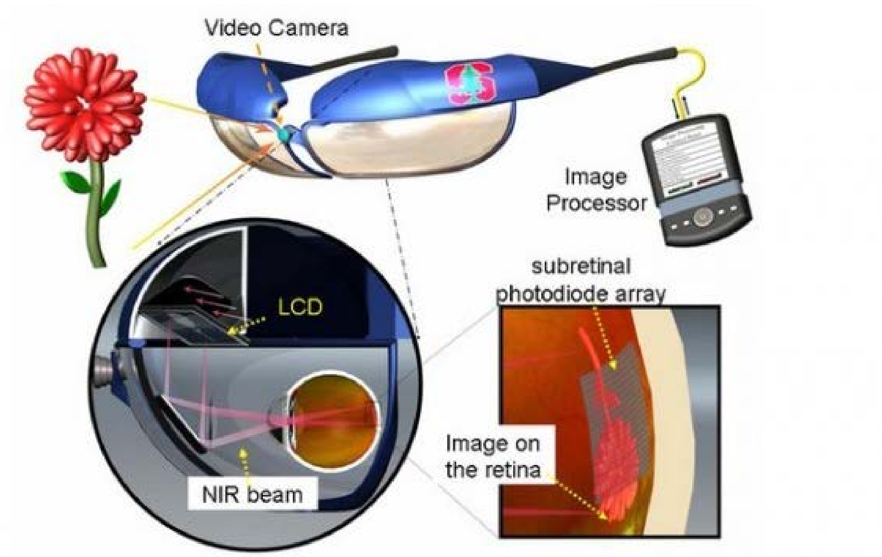
Medicare Establishes Reimbursement for VisionCare's Implantable Telescope for Macular Degeneration

The Implantable Miniature Telescope is referred to as "the IMT (by Dr. Isaac Lipshitz)" or as "the Implantable Miniature Telescope (by Dr. Isaac Lipshitz)." Hereinafter, this device may be referred to "the product", "the device", "the telescope", "intraocular telescope", or similar terms which cannot be read as the name of the product. Restricted device: U.S. Federal Law restricts this device to sale, distribution, and use by or on the order of a physician or other licensed practitioner.

Wireless, solar-powered bionic eyes benefit from sub-retinal placement

By John Hewitt on June 21, 2013 at 7:31 am | 0 Comments



A team of Engineers from Stanford, and Glasgow, Scotland, have made some incredible advances on their earlier designs for a photovoltaic bionic eye. Their new paper, published in Nature Communications, describes how they can now create a pocket underneath the retina, and pop in a wireless visual processor that is fed by infrared pulses from an external camera. Ultimately, the hardware race for the coveted intra-eyeball space will face its greatest challenge from all-biological advances that threaten to cure photoreceptor-based blindness once and for all. When that happens, we will be left some powerful new hardware needing to adapt to a market — and that market will be everyone.

The common surgical need to fix detached retinas has led to some pretty cool tricks to manipulate the thin and fragile tissue deep inside the eye. Microbubble prods, thermal nudges, and laser bonds can be used to move things around, and stitch them back up. Sub-retinally placed hardware is more firmly attached than chips laid on the surface, and will remain in register with the cells it stimulates as the eye torques about. It is also better poised to access retinal circuitry at the front end, to provide for some natural bio-processing before signals are transmitted to the brain. The researchers were able to test implants having pixel sizes of 280, 140 and 70 μm in rats, and elicit strong cortical responses after IR stimulation. These characteristic "visually evoked potentials" are the hallmark signature that a light signal has made it to the brain. For babies, or test subjects that can not otherwise communicate what they are seeing, they work well.

Several other bionic implant designs have recently come to market. While their hardware resolutions are improving, it is difficult to match those performance increases at the level of actual perception. It is at once exciting to see so many new approaches to restoring vision, and also frustrating that no one method has emerged as the clear winner to be developed on a massive scale. Those waiting for a vision solution are understandably anxious. Regulatory bodies have done a good job in pushing through promising devices, but still, the pace must quicken.

Designs that manage to put the whole camera inside the eye are ideal because they permit natural eye movements and focusing mechanisms to be brought to bear. If, however, missing photoreceptors can be naturally replaced, a significant fraction of the full resolution of the original eye could potentially be restored. One such approach is being developed by optogenetics pioneer Ed Boyden, who spoke this past weekend at the GF2045 conference in New York. Ed's plan is to treat patients who have compromised photoreceptors by converting the next cells up the the visual train, the bipolar cells, into light sensors.

Like photoreceptors, it is known that these bipolar cells also have the high-speed synaptic machinery, namely the "synaptic ribbons" that photoreceptors use to rapidly and accurately encode changes in light level. Adding the light detection machinery to bipolar cells may enable these patients to see at a level of detail that would not be possible with cameras or other sensor systems. When these methods succeed, all is not lost for the hardware consortium. Just as cochlear implant surgery may soon become an elective procedure used to augment natural abilities, elective eye implants should eventually be possible as well.

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One might ask why you would want to mess with something that works so well? Suppose you are a pigeon that, in order to navigate under any environmental condition, would benefit from an additional sense, let's say, a magnetic sense. The best natural tooling, and greatest variety of raw materials at your disposal are probably those already found in and around the eye. Indeed evolution piggybacked magnetoreception in these creatures, and also polarization detection, mostly within the eye. Humans are not tuned in to magnetic fields but it has been recently discovered that our eyes do contain bits of the magnetosensitive protein, cryptochrome-2.

There is also mounting evidence that pigeons have magnetoreceptive components in the nose, beak, and perhaps even inner ear for detection of field direction, intensity and polarity. Although we needn't limit ourselves anymore to all-natural precursors and construction methods, the dense sensory enervation, and fine motor enervation of the eye, still make it the prime position. Having tissue-compatible wireless access to this space now opens up unlimited opportunities for enhancement of our innate sensory abilities.

Now Read: The past, present, and future of bionic eyes

Research paper: doi:10.1038/ncomms2980 - "Cortical responses elicited by photovoltaic subretinal prostheses exhibit similarities to visually evoked potentials"

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