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In this Issue:

Brain-Computer Interface in Media Spotlight

widespread applications attract worldwide attention

Speculative futures of mind-reading smart phones captivated the global press this spring. Brain-computer interface technology developed at the Swartz Center for Computational Neuroscience attracted worldwide attention from numerous media outlets in April. The system, developed by Swartz Center associate director Tzyy-Ping Jung, and associates Yu-Te Wang and Yijun Wang, captured the imaginations of journalists and the public with an interest the futuristic possibilities of brain-computer interaction applying Bluetooth technology. The wireless EEG headband is a portable interface that can be used to monitor brain activity, as well as use brain activity to control external devices. The EEG technology, which has been available since the 90s, has been made compact and affordable, as well as being easy to use. The primary application for the interface is in support of the severely disabled, who would have a greater range of functional possibilities for communication. Other possible applications for the monitoring element of the system could have real world applications in circumstances where alertness, focus, and other attention-centered brain functions are of critical importance to safety or crucial tasks. ABC News highlighted the relevance of this technology to the air traffic control, publishing a story on the system, which noted the resignation of an FAA official after more reports of drowsy air traffic controllers on the job the same week. Dr. Jung sees additional applications for truck drivers, members of the military, or any role where alertness is crucial to job performance could be alerted when the headband detected signals of drowsiness or inattention in brain function.

The group's study, published in the Journal of Neural Engineering has demonstrated 70% of users can attain 100% accuracy entering a ten-digit number using a visual keypad displayed on a computer screen. Each number (and key) flashed at a different rate. The box containing the number 1, for example, might flash at 9 times per second, while the box containing the number 2 flashed at a slightly higher rate. Using EEG, the minute changes in oscillation corresponding those frequencies in the visual cortex are detected by sensors attached to the EEG headband, which transmits the

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signal wirelessly to a Nokia cell phone that processes the signals using algorithms. The mobile and wireless EEG system that incorporates EEG electrodes, battery-powered bioamps, filters, analog-to-digital converters and wireless telemetry circuits to enable imaging of participants actively performing ordinary tasks in natural body positions and situations in operational environments.

News of the hands-free technology captured the interest and attention across the globe, leading to publications and diverse multimedia features on network and local news, across the blogosphere, international newspapers and news organizations worldwide. Although the technology dates to the early 90s, the development of portable hands free systems that can be adapted to a variety of situations advancing the possibility of high quality portable monitoring, and brain controlled systems that could eventually be used in widely used technologies to control devices and play games.

Jung notes that the use of EEG in cognitive monitoring is ready for application in practical circumstances, but that people may not be ready to use it. "One of the difficulties is people don't want to be watched," he said. "It's sort of like Big Brother watching you all the time."

Researchers are translating the system to real world applications for individuals, and in the workplace, step-by-step.

"Our study shows it is feasible to use a ubiquitous cell phone as a data logger and on-line processor for aBCI, which will open up numerous applications of BCI in real-world environments."

Tzyy-Ping Jung

"While most BCI systems to date have used invasive or implantable devices for patients with inoperative or malfunctioning external body parts or internal organs, a much larger population of 'healthy' people who suffer episodic or progressive cognitive impairments in daily life can benefit from non-invasive BCI."

Tzyy-Ping Jung

Citation: A cell-phone-based brain–computer interface for communication in daily life

Yu-Te Wang et al 2011 J. Neural Eng. 8 025018

Additional coverage

Technology Review
http://www.technologyreview.com/communications/37357/?mod=chfeatured&a=f

Asian American
http://goldsea.com/Text/index.php?id=10751

Huffington Post
http://www.huffingtonpost.com/2011/04/12/mental-dialing_n_848134.html

ABC News
http://inc.ucsd.edu/more_news.html

San Diego Channel 10 News [video]
http://www.10news.com/video/27647911/index.html

SF World Journal [Chinese]
http://sf.worldjournal.com/view/full_sf/12891110/article-%E9%8D%BE%E5%AD%90%E5%B9%B3%E8%85%A6%E6%A9%9F%E7%95%8C%E9%9D%A2%E7%A0%94%E7%A9%B6-%E8%A6%96%E6%8E%A7%E6%92%A5%E9%9B%BB%E8%A9%B1?instance=sf1

Terrence Sejnowski Elected to NAE
rare achievement for INC Co-Director

INC Co-Director and Salk Institute professor Terrence J. Sejnowski, Ph.D., has been elected to the National Academy of Engineering. This places him in a remarkably elite group of only ten living scientists to have been elected also to the Institute of Medicine of the National Academy, as well as the National Academy of Sciences. UCSD and INC congratulate Dr. Sejnowski on this prestigious appointment and exceptional achievement.

The primary mission of the National Academies is to provide groundbreaking research in science, engineering and medicine for the nation's public and policy makers. In a recent interview with the major publication of the National Academies, The Proceedings of the National Academy of Sciences (PNAS) Dr. Sejnowski discussed the way in which robots and machine learning mimic the brain function in order to create memories. This form of machine learning prefigures the development of machines which are capable of interacting with humans based on their facial expressions and other social cues.

Salk Institute press release :
http://www.salk.edu/news/pressrelease_details.php?press_id=468
Complete interview at : http://www.pnas.org/cgi/doi/10.1073/pnas.1015459107

Cauwenberghs and Lee Elected IEEE Fellows
multiple roles for INC Co-Director

INC Co-Director Gert Cauwenberghs and former INC researcher Te-Won Lee have been selected as fellows by the Institute of Electrical and Electronics Engineers (IEEE). Dr. Cauwenberghs' work and leadership in biomedical circuits and systems, marks the field as a is a key interdisciplinary node linking several life science and engineering fields, in addition to the central position of the neurosciences in his research.

Cauwenberghs' selection as a 2011 fellow of the Institute of Electrical and Electronics Engineers (IEEE) attends multiple honors and leadership responsibilities in the coming years. IEEE Fellows are selected for their exceptional record of achievements within fields of electrical engineering. Dr. Cauwenberghs has been named Editor in-Chief of *IEEE Transactions on Biomedical Circuits and Systems* (TBCAS). In addition to guiding major publications in the field, he will serve as the Chair of two annual conferences. His role as General Chair of the IEEE Biomedical Circuits and Systems Conference (BioCAS) in 2011 is followed by additional distinguished service to the field in 2012 as Technical Chair of the IEEE Engineering in Medicine and Biology Conference.

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Swartz Center Researchers Lead $25 Million Collaborative Technology Project in Human-Systems Interaction

Scott Makeig named lead scientist

Scott Makeig, and Tzyy-Ping Jung, researchers at INC's Swartz Center for Computational Neuroscience will lead the UCSD team anchoring a $25 million Collaborative Technology Alliance project to study cognition and neuroergonomics. The project includes neurosciences, cognitive scientist and engineers, collaborating at 5 universities, with the participation of the US government and an industry partner. The 5-year research program will bring together eight scientists from 5 UCSD departments supported by 13.8 million of the collaborative funding.

The goal of the five year project is to develop and demonstrate basic cognitive neuroscience principles guiding development of improved human-systems interactions in complex information environments. The goals of the alliance are to optimize information transfer between operators and advanced communication and control systems; to facilitate decision-making in complex, high-risk environments; and to implement advanced tools and techniques to perform individualized physiological and behavioral assessment in operational contexts -- for example, while interacting with complex information displays in advanced robotic vehicles.

Specialists in neuroergonomics and cognition at the University of Michigan at Ann Arbor, the University of Texas at San Antonio, the University of Osnabrück of Germany, and National Chiao Tung University of Taiwan will collaborate with technology transition specialists DCS Corporation, with support from government researchers at the Army Research Laboratory in Aberdeen, Maryland.

According to chief scientist Makeig, "This is the largest category of basic research project the Army supports, and is intended to create a working alliance among university basic researchers, Army basic researchers, and applied research-and-development groups from industry and the Department of Defense.

The Army Cognition and Neuroergonomics project is designed to accelerate progress in this direction at the basic level, hopefully leading to early tests of practical applications."

Human-Systems interaction research is both interdisciplinary and international, facilitating collaborations between university, industry and government scientists and engineers.

prototype Advanced Crew Station vehicle

photo credit: USAASC

Javier Movellan Wins $749K NSF Grant
MPLab's international RubiNet on track

Javier Movellan has a vision for the Machine Perception Lab. He would like to see 1000 Rubis in the classroom. Rubi is a prototype tutor-robot he and his research team have developed over the past several years in conjunction with educators from the Early Childhood Education Center.

The RubiNet project will develop resources for early childhood education at national and international levels, bringing children, teachers, parents, and researchers together. A unique feature of the project is the use of low-cost, sociable robots as network interfaces. At the heart of each new Rubi lies an Ipad. In addition to supporting education and data gathering, the robots will allow children to exchange objects across international boundaries using the robots as intermediaries.

Movellan, one of INC's Machine Perception Laboratory (MPLab) Principle Investigators, has been awarded a grant of $749,998 by the National Science Foundation (NSF) to support development of RubiNet. The transnational social network will support and extend the functionality of social robot. For example, children in the United States to look around a classroom in Japan, find their friends, and initiate a hug using the robot's child-safe arms.

In addition to the use of RubiNet to transform educational practice, the network could allow the collection of large amounts of scientific data on early education, significantly accelerating the progress of research at a low cost with high levels of detail.

Read more about Dr. Movellan's research into the use of robots in early childhood education at: http://www.wired.com/gadgetlab/2010/10/children-robots/

Javier Movellan with Qrio Robot at UCSD's Early Childhood Education Center.

Temporal Dynamics of Learning Center
An NSF Science of Learning Center

TDLC Researcher György Buzsáki at the forefront

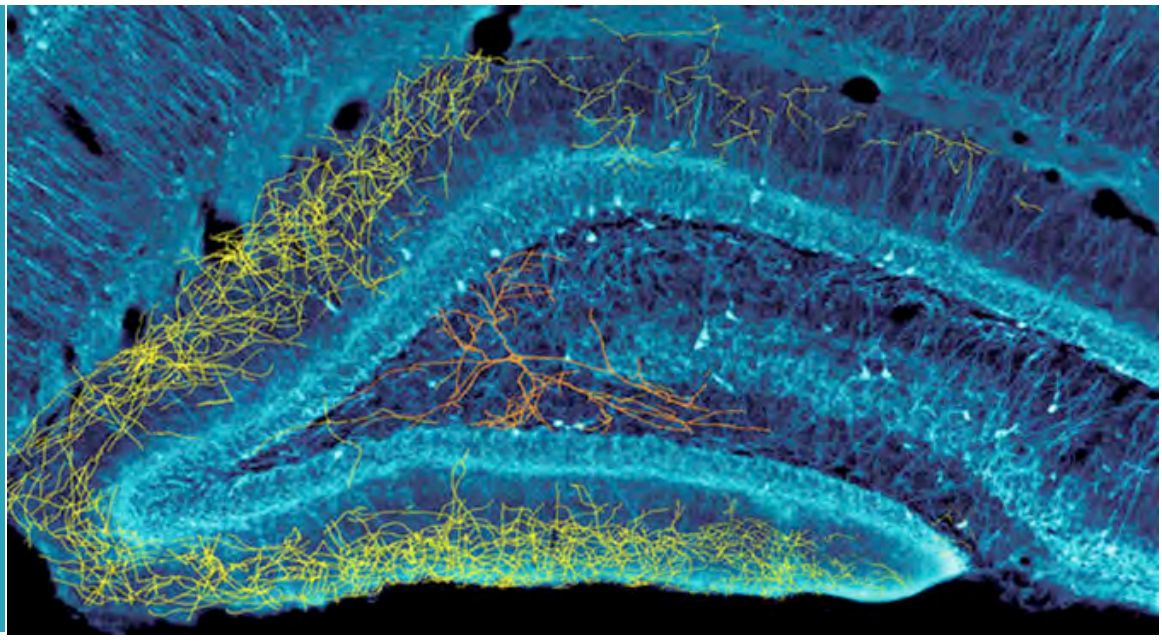
When it comes to motivation, Rutgers Professor György Buzsáki has enough for an army of researchers. He is at the forefront of research in the study of how neuronal circuitries of the brain support its cognitive capacities. Buzsáki is a member of the Interactive Memory Systems Network of INC's Temporal Dynamics of Learning Center (TDLC), a multi-university consortium, funded by the National Science Foundation's Science of Learning Centers. TDLC brings together investigators who study how time and timing influence learning.

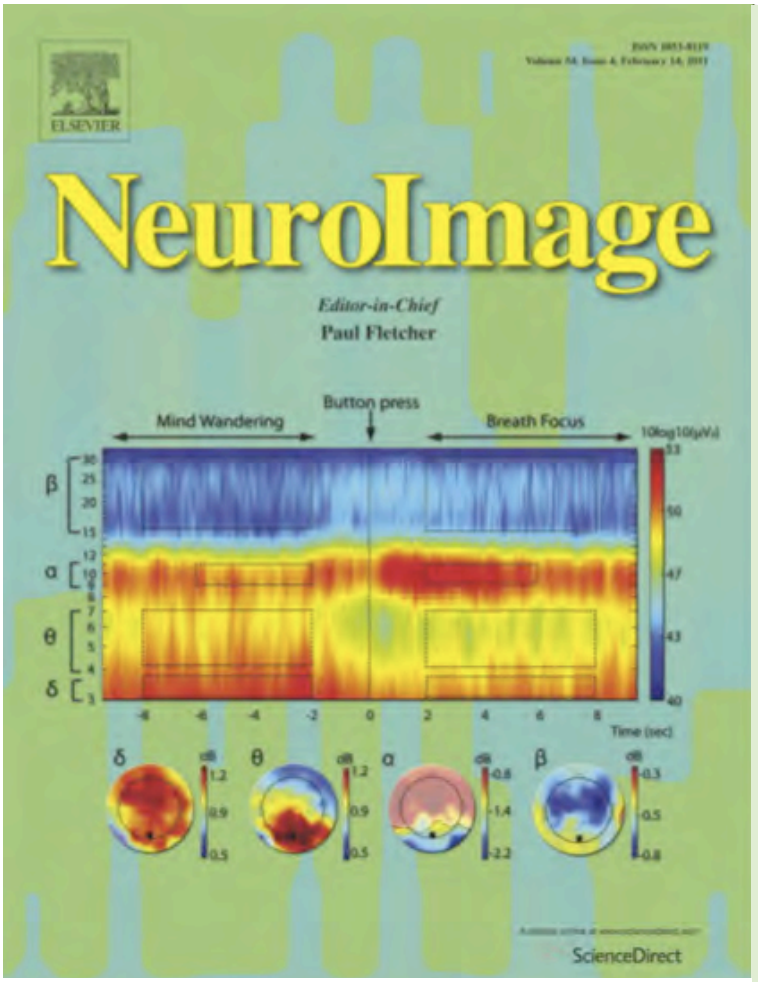
Professor Buzsáki gave a keynote lecture at the recent TDLC All Hands Meeting in San Diego in January 2011 on how Self-organized Assembly Sequences Support Cognition. Some of his images of neuronal circuitries were highlighted in a New York Times feature "An Odyssey Through the Brain, Illuminated by a Rainbow."

On March 3rd, Dr. Buzsáki, was awarded "The Brain Prize," by the Grete Lundbeck European Brain Research Foundation. He share the one million Euro prize with two other Hungarian scientists, Tamas Freund and Peter Somogyi. "The Brain Prize" is awarded annually to researchers who have made significant contributions to European neuroscience.

The foundation honored the winners "*for their wide-ranging, technically and conceptually brilliant research on the functional organization of neuronal circuits in the cerebral cortex, especially in the hippo¬campus, a region that is crucial for certain forms of memory.*"

brain image by Dr. György Buzsáki





INC on the Cover
Neuroimage

The February 14, 2011 cover of *NeuroImage: A Journal of Brain Function,* featured an image from a related publication by Arnaud Delorme of EEEGLab and his student Claire Braboszcz from their related article, "Lost in thoughts: Neural markers of low alertness during mind wandering." The experiment is one of the first neuro-imaging studies that relies purely on subjects' introspective judgment, and shows that such judgment may be used to contrast different brain activity patterns.

NeuroImage: A Journal of Brain Function

"Lost in thoughts: Neural markers of low alertness during mind wandering."

citation: 2011 Feb 14;54(4):3040-7.

INCEVENTS

Osaka/UCSD Workshop
03/15/11
On computational neuroscience, humanoid robotics, human-brain interface, and learning technologies

Rockwood Memorial Lecture
04/04/11 **Rodney Douglas**
Constructive Cortical Computation

Annual NIMH Neuroscience Retreat
05/14/11 **KIBM Symposium on Innovative Research**

17th Joint Symposium on Neural Computation
06/04/11 Keynote Speakers
Kwabena Boahen
Toby Berger
Confirmed Speakers
Dean Buonomano
Alyssa Brewer
Tansu Celikel

Neuron Summer Course
06/18-22/11

TDLC Bootcamp
08/08/11

For more information on current events, please contact Kristen Michener
kmichener@ucsd.edu

INCEVENTS

KIBM Workshops

02/23/11 **Primer on human gene mapping** Nik Schork
Autism Dan Geschwind

02/24/11 **Psychiatric genetics** Jonathan Flint

03/02/11 **Brain architecture** Anders Dale and Eric Halgren

03/09/11 **Development** Terry Jernigan, Stephanie Bielas, Anders Dale

03/16/11 **Epigenetics and the human brain** Alysson Muotri

03/23/11 **Williams Syndrome** Ursula Bellugi, Ralph Greenspan, Eric Halgren

INC Chalk Talks

02/03/11 **Muhammad Akhtar**: Active noise control and biosignal processing

02/24/11 **Marius Buibas:** Mapping functional connectivity in cellular networks

03/10/11 **Bill Kristan:** Leech electrophysiology and functional connectivity

03/24/11 **Tom Liu**: Multimodal imaging of resting-state functional connectivity

04/07/11 **Marni Stewart Bartlett:** Modeling natural facial behavior

05/05/11 **Yu Mike Chi:** Wireless non-contact EEG

05/19/11 **Ruey-Song Huang:** Mapping multisensory representations of peripersonal space

06/09/11 **Jamie Lukos:** Brain dynamics in Parkinson's

Local Students Visit INC/SCCN

Community outreach activities in April at the Swartz Center for Computational Neuroscience (SCCN) gave local students from Vista Christian School of North County an opportunity to learn about current research in the MoBI Lab. Sixteen students visited UCSD for a science field trip culminating in a brief demonstration and multimedia presentation by Dr. Tzzy-Ping Jung with the support of five MOBI Lab members. During the demonstration on "balance", the students observed the relationship between brain dynamics and body movement through the use of the brain imaging modality with a Motion Capture suit. Afterwards, Dr. Jung explained the neural activity associated with human cognition. Yu-Te Wang assisted Dr. Jung with a slide presentation on EEG, MEG and fMRI experiments. Examples of research technology were presented, including wireless dry EEG electrodes attached to a human head prototype. In addition to the 7th and 8th graders, Ms. Rachel Torres, their teacher, and two parents also listened with interest. Despite the drizzle and rain of the grey day, students, teacher and parents agreed their visit to SCCN's Mobile Brain/Body Imaging Laboratory (MoBI) was very interesting. Campus tours and lab visits introduce young students to practical research, and future possibilities built on science studies in the classroom.

Above
Dr. Tzzy-Ping Jung discusses the use of dry wireless EEG electrodes in observing neural activity.

Left
Vista Christian School students gather for a photo with UCSD's sculpture of Dr. Theodore "Seuss" Geisel and his famous character The Cat in the Hat.

Cauwenberghs
cont'd from Pg 4

In keeping with his focus on real world solutions, Dr. Cauwenberghs' collaborative research with student Mike Chi is an outstanding example of the research priorities and accomplishments that are the primary goals of the emerging field of biomedical circuits and systems. Their development of cost effective biosensors has been recognized by IEEE as well as being featured in *MIT Technology Reviews*. The biosensor allows long-term monitoring with greater ease of use and increased comfort.

The low cost sensor can be mass produced and used outside the hospital environment greatly expanding the potential for conditions which may not manifest in the time period of normal hospital observations. The capacitave sensor is particularly distinctive for making the use of existing technology cost effective

through the use of widely available components and novel circuitry.

IEEE Transactions on Biomedical Circuits and Systems
http://ewh.ieee.org/soc/cas/tbcas/

Read the MIT Technology review at:
http://www.technologyreview.com/biomedicine/25701/?a=f

NIMH Training Program in Cognitive Neuroscience 2011-12

The INC supports training programs for graduate students and postdoctoral fellows in Cognitive Neuroscience (NIMH). The Center converges neurobiological, cognitive science, computational and engineering resources for understanding the relationship between the mind and the brain. The Center develops new models of brain dynamics, new signal processing techniques based on these models, and the experimental methods to test them. One goal is to study brain activity that supports social interactions.

The primary goal of the Training Program for Cognitive Neuroscience at San Diego is to promote multi-level approaches to the neural bases of cognition. The program integrates three broad approaches: cognitive science, neuroscience, and computation.

More information at: http://inc.ucsd.edu/training_grant2011.html

New Collaborations
i-Rice + Taiwanese Scholars @ INC

In collaboration with the Institute for Engineering Medicine, INC will host students and post docs to work with INC and IEM researcher. Tzyy-Ping Jung, of the Center for Advanced Neurological Engineering (CANE) participated in the development of the proposal recently approved by Taiwan's National Science council. The students and researchers visiting from Taiwan will be participation in an International Center in Advanced Bioengineering Research.

The Center for Advanced Neurological Engineering (CANE) is a collaborative initiative between INC and IEM, the Institute of Engineering in Medicine at UCSD. Co-directed by Bill Mobley and TP Jung and with participation of key investigators in INC and IEM, as well as the Department of Neurosciences in the School of Medicine and the Department of Bioengineering in the School of Engineering.

http://inc.ucsd.edu/cane.html

Congratulations to all INC researchers for their exceptional achievements

Award and Honors

Gert Cauwenberghs and Te-Won Lee

- Selected as IEEE Fellows for 2011

Scott Makeig

- Named chief scientist of $25 million collaborative project in human-systems interactions

Javier Movellan

- Awarded $749,998 NSF grant for RubiNet

Terrence Sejnowski

- Elected to National Academy of Engineering

INC Researchers Awards and Honors

INC at a glance

INC Research Groups and staff

Institute for Neural Computation (INC)
http://www.inc.ucsd.edu
Terrence Sejnowski and Gert Cauwenberghs, Co-Directors
Shelley Marquez, Executive Director

Swartz Center for Computational Neuroscience at INC
http://www.sccn.ucsd.edu
Scott Makeig and Tzyy-Ping Jung, Co-Directors

Machine Perception Laboratory at INC
http://mplab.ucsd.edu/
Javier Movellan, Marian Stewart Bartlett, and Glen Littlewort, Principal Investigators

Temporal Dynamics of Learning Center (TDLC) Motion Capture/ Brain Dynamics Facility at INC
http://inc.ucsd.edu/~poizner/motioncapture.html
Howard Poizner and Scott Makeig, Co-Directors

Office of Naval Research (ONR) Multidisciplinary University Initiative (MURI) Center
http://inc.ucsd.edu/~poizner/onr_muri/
Howard Poizner, UCSD (PI); Gary Lynch, UCI (Co-PI); Terrence Sejnowski, Salk Institute/UCSD (Co-PI)

Mobile Brain Imaging Laboratory (MoBI) at INC
Scott Makeig, Principal Investigator

Poizner Laboratry at INC
http://inc2.ucsd.edu/poizner/
Howard Poizner, Principal Investigator

Dynamics of Motor Behavior Laboratory at INC
http://pelican.ucsd.edu/~peter/
Peter Rowat, Principal Investigator

Data-Intensive Cyber Environments (DICE) Group at INC
Wayne Schroeder, Principal Investigator
http://diceresearch.org/DICE_Site/Home/Home.html

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