

CIBMI has a successful first year

The Center for Innovative Brain Machine Interfaces (CIBMI) enjoyed a productive 2007. The core of CIBMI research is the reformation of our present research enterprise into six technological testbeds, and the formation of two virtual companies based on active research with significant market potential. These companies will use the testbeds for prototype development.

Beginning with our Industrial Advisory Board Meeting and Poster Day in May, two virtual companies have been formed and are actively pursuing the development and marketing of their target technologies.

Flexible Substrate Technology for Hybrid-Packaged Implantable Neural Interfaces: This technology is a flexible neural microelectrode array design that offers a compromise between the best properties of microwire electrodes and MEMS fabrication techniques. The goal is to produce electrode arrays that have high neuronal yield, are highly customizable in terms of geometry/layout, minimize tissue damage, and are easy to fabricate.

Integrate-and-Fire Signal Representation for Ultra Low Power Sensing Applications: This technology combines a low-power low-noise integrated amplifier with a novel integrate-and-fire technology to offer a compact, low power and low-bandwidth implantable neural recording solution. Such an implant will enhance the characterization of brain function via neural recordings in rats in an unrestrained condition. The goal is to produce

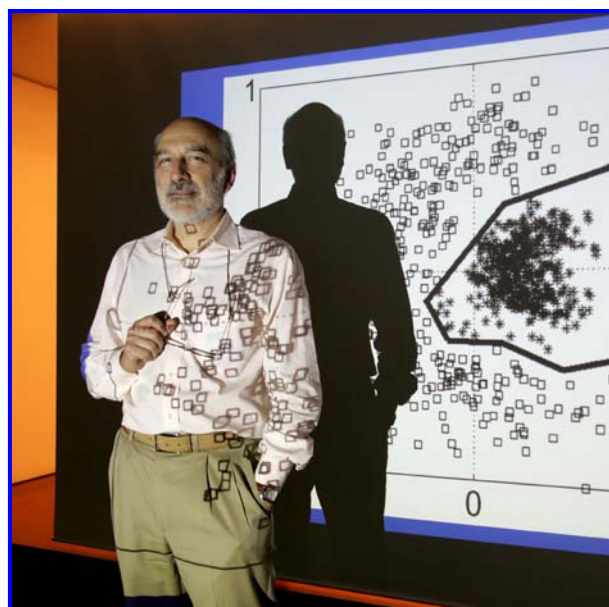
efficient, wireless recording systems that have higher spatial resolution and lower noise than those currently available.

At this time, both startup companies have been staffed by an engineering team and a business team, each advised by engineering and business faculty members, respectively, and overseen by an outside CEO who has extensive investment experience in the biomedical industry. In the startup transient, the engineering students have reviewed the unique features of the technologies. The business students have conducted a detailed industry analysis including competitive technologies, barriers

and costs for entry, regulatory hurdles, and potential eclipsing technologies. Preliminary research regarding FDA and Medicare reimbursement execution is also underway. Potential markets have been identified, and additional market research is ongoing. Simultaneously, the engineering students continue to develop the manufacturing process for both prototypes.

In terms of testbed development, our partners at Florida international University are making significant progress on **Non-Invasive Brain Machine Interfaces**. This work is a combination of two existing developments: eye-

Continued on Page 2



CNEL Director Jose Principe, pictured here during a lecture in Portugal, is named Founding Editor-in-Chief of a new journal, *Reviews in Biomedical Engineering*. Story on Page 2.

CNEL Seminars

- CNEL SEMINARS WILL BE SCHEDULED IN EARLY 2008.
- SEMINARS FEATURE PRESENTATIONS FROM CNEL STUDENTS, FACULTY MEMBERS, AND VISITORS.
- FOR MORE INFORMATION, SEE OUR WEBSITE, WWW.CNEL.UFL.EDU

Inside this issue:

- | | |
|----------------------------------|----------|
| PRINCIPLE TO LEAD NEW JOURNAL | 2 |
| WHERE ARE THEY NOW? NEIL EULIANO | 3 |
| E-FAIR IS COMING! | 4 |
| UPCOMING EVENTS | 5 |



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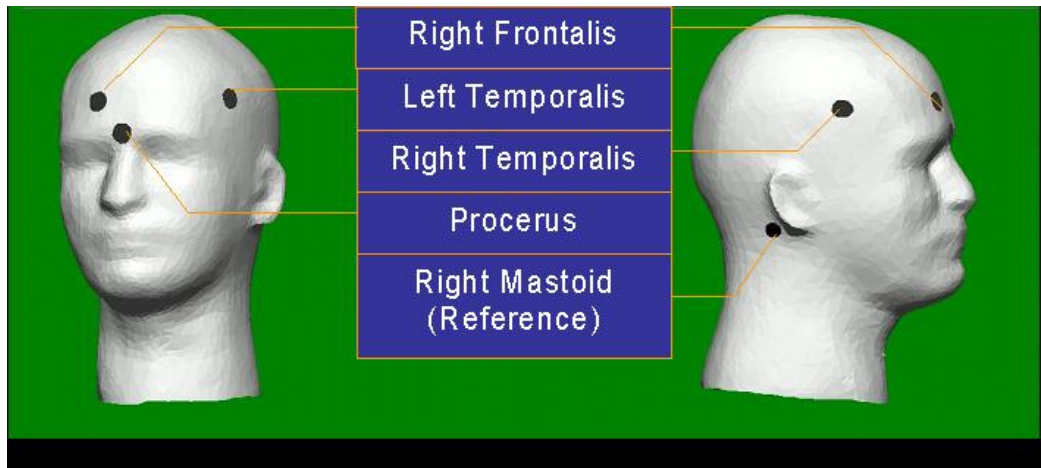
THE CIBMI WILL BE SELECTING NEW TECHNOLOGIES IN 2008. A NEW INDUSTRIAL ADVISORY BOARD MEETING AND POSTER DAY WILL BE HELD IN SPRING. STAY TUNED FOR MORE INFORMATION

CIBMI enters 2008 on a path for success (continued from Page 1)

gaze trackers (EGTs), which are commercially available for individuals who have motor disabilities, and electromyogram (EMG) signals. For more than a decade, systems that estimate the point of gaze of a subject on a computer screen, i.e. EGTs, have been used to provide individuals with severe motor disabilities an alternate screen cursor manipulator system. However; the physiology of eye movement control intrinsically makes the estimated point of gaze

jittery and unstable. Additionally, the blinking or "dwelling" mechanisms used to perform selections (clicks) with EGTs are known to produce unintended selections. Consequently, EGT cursor control has performance limitations for interactions with small graphic user elements; for instance, in web pages. Our team at FIU has developed a prototype of a system that detects and identifies voluntarily-generated EMG signals produced by facial muscles still

under the control of many individuals with motor disabilities. The prototype performs real-time digital signal processing of 4 EMG signals collected by electrodes attached to the temples and the forehead of the user to issue commands to step the cursor up, down, left, or right, and a command to select (click). Recent evaluation showed that augmenting a commercial EGT system with the EMG processing increased the accuracy of the system for positioning and selecting in a statistically significant way.



Electrode locations for the EMG cursor control subsystem developed by Florida International University. Most of the electrodes are covered by a sports headband that provides support and makes the electrodes less apparent. Image courtesy of Armando Barreto.

Principe to lead new journal: Reviews in Biomedical Engineering



RBME will publish critical reviews authored and peer reviewed by leading experts in biomedical engineering.

Jose Principe, CNEL Director, has been selected as Founding Editor-in-Chief of *Reviews in Biomedical Engineering* (RBME). This new journal is directed toward critical reviews in the area of biomedical engineering authored by undisputed experts in the field. The goal of RBME is to provide IEEE colleagues with authoritative reviews of important medical

problems that could help them seek application for their advanced engineering methods. Also, RBME will provide the biomedical field with competent reviews of engineering methodologies being developed at the frontiers of biomedical engineering. RBME will include submitted and invited contributions which, in either case, will be peer reviewed by a set of experts.

In addition to sections on recent advances, methodological reviews, and clinical application reviews, RBME will feature a unique section, called *In the Spotlight*, that will highlight critical advances important to the biomedical engineering readership.

The first edition of RBME will appear in 2008.

Where are they now? Neil Euliano

A short 10 years after he earned his Ph.D. at CNEL, Neil Euliano is president of a successful company, Convergent Engineering, that “applies the concepts of signal processing, information theory, data fusion, and artificial intelligence to biomedical applications.” From its creation in 2004, Convergent Engineering continues its strong ties to CNEL and the College of Medicine.

“Finding the right partners is crucial,” says Dr. Euliano. “Having access to this expertise is critical to any success we have.” Keeping close ties with cutting-edge research at UF has helped Convergent Engineering maintain its success as the type of spin-off that is a model for the virtual companies in the Center for Innovative Brain Machine Interfaces (CIBMI-Page 1). Dr. Euliano is participating in the CIBMI as a co-CEO of one of the virtual companies, thus lends his expertise to the next generation of technology innovators.

While his interest in machine intelligence and advanced signal processing brought him to CNEL, it is the camaraderie among students and the stimulating research environment that he remembers most fondly.

“CNEL does some very exciting research, which makes being an indentured servant – I mean graduate student – much easier.” Easy in that the CNEL environment stimulated new ideas and ways of thinking; the difficulty lay in “finding a problem that

seemed significant and real enough to apply the techniques we were developing. It was difficult to tie together all the things I was working on into something cohesive enough on which to write a dissertation... we had to develop something *unique* that worked *better* than anything else ever done, and then apply it to something that was *useful* before we could even think about writing.”

These struggles were one important part of the collection of knowledge that prepared Dr. Euliano for the complexities of leading a small company.

“Everything in your life helps prepare you for your current position in life, and yet you are never fully prepared. My position involves utilizing cutting edge signal processing and machine intelligence to develop biomedical technology. Obviously my time at CNEL was critical in developing the technical skills for this field. My time at Bell Labs as a system engineer provided experience in seeing the big picture of a project and being able to write clearly and concisely. My software background also provides an ability to break down tasks into manageable pieces and to understand the end-to-end complexities of a project. Nothing in my career prepared me for management responsibilities – although raising kids is a good analogy at times.”

For current and future CNEL students, Dr. Euliano advises cultivating an open mind and a depth of understanding.

“Don’t just listen to Dr. Principe, but try to figure out where he is coming from. Sometimes it seems like he is asking you to do crazy stuff that will never work, but the more important thing is to try to figure out why he thinks it will work.”

“My second piece of advice is based on my experience working with the younger engineers at Convergent Engineering. That advice is to really think and understand what you are doing. With the power of computers – even in my day – it is very easy to just set up the computer to try many combinations of things and not really think about why it should or shouldn’t work. Believe it or not, you will never have enough computing power to solve real-world problems by brute force.”

“Lastly, sticking with the concept of the dangers of computers and calculators, if you don’t understand your results, they’re useless. You have to dig into the data and understand why something did or didn’t work. It is very tempting to create an algorithm, run it on 40GB of data, and then present a simple table summarizing your results. This is ‘monkey work.’ Ninety-five percent of the innovation comes *after* you’ve summarized the results the first time. Don’t look at summary statistics without looking at the data.”

MILESTONES...

Meena Ramani earned her Ph.D. this month by defending her dissertation, entitled, “Noise Robust Algorithms to Improve Cell Phone Speech Intelligibility for the Hearing Impaired.”

Arturo Camacho earned his Ph.D. with the defense of his dissertation, “SWIPE: A Sawtooth Waveform Inspired Pitch Estimator for Speech and Music.”

Weifeng Liu successfully presented his research proposal, entitled “Adaptive Filtering in Reproducing Kernel Hilbert Spaces.”

Champions!



National Champions! Maya Harris (front row, center) was the top player on the Oak Hall chess team that recently won the 2007 national championship in the kindergarten division. The team competed at the K-12 Scholastic Chess Championships in Houston December 7-9. Individually, Maya tied for fourth overall and earned 7th place based on tie breakers. Maya is the daughter of CNEL Assistant Director and Hybrid Lab Director, John Harris.

State Champions! Josh Stewart played this fall for the 16U Florida Hardballers baseball team, which won the Winter Nationals Invitational in Gainesville Nov 30-Dec 2. For the tournament, Josh hit .500, with an on-base percentage of .667. Josh was also part of the 18U Florida Hardballers team which won the 2007 USSSA Fall State Championship. The Hardballers teams include Jake Tillotson and Lavon Washington, both of whom have verbally committed to play college baseball at UF. Josh, a freshman infielder and honor student at PK Yonge, is the son of CNEL research coordinator Julie Veal.

E-Fair is coming!

The Hybrid Lab is gearing up for a run at an unprecedented third win in a row in the University of Florida's Engineering Fair competition. For the last two years, the Hybrid Lab team has won "Overall Outstanding Exhibit." They are this year's team to beat.

The goal of E-Fair is to enlighten and excite kids about science and engineering through interactive learning. Many societies and organizations from several departments in the College of Engineering will have interactive demonstrations and displays, and elementary and high school students from eight counties will be invited to attend.

This year's E-Fair will take place February 18-19 at the Reitz Union on the UF campus. We hope all of CNEL will participate with the Hybrid Lab this year.



Jeremy Anderson shows a participant how his voice can be modulated at the 2007 E-Fair



Professor John Harris, Assistant Director of CNEL and Director of the Hybrid Lab, was selected as Distinguished Lecturer by the IEEE Circuits and Systems Society. CNEL TIMES congratulates Dr. Harris on this significant and well-deserved achievement.

Publications

Accepted Journal Paper:

Liu, W.; Pokharel, P.; Principe, J. 2008. "Kernel Least Mean Square Algorithm." IEEE Trans. Signal Processing, vol. 56, Issue 2.

Submitted Journal Paper:

Liu, W., Principe, J.; "Kernel Affine Projection Algorithms." Signal Processing

Submitted Conference Papers:

Liu, W., Principe, J. "The Wellposedness Analysis for Kernel Adaline." IJCNN 2008

Liu, W.; Principe, J. "Extended recursive least squares algorithm with kernels." ICASSP 2008



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The Computational NeuroEngineering Laboratory explores the principles that guide our ability to comprehend brain function, treat brain disorders, and ultimately to interface directly with the brain. Our researchers combine principles from machine learning, signal processing theory, and computational neuroscience to advance the science of engineering systems. On the horizon is a technological revolution, where machines can be controlled by the brain. We envision a time when brain and machine can interface through conscious thought, enabling normal function in cases of brain injury or disease.

CNEEL's Hybrid Computation Group combines elements of analog/digital and biological/artificial in an effort to develop biologically inspired algorithms for sensory and neural processing.

Visit us on the web:
www.cnel.ufl.edu

Upcoming Events

Table with 3 columns: Conference, Location & Date, Next Critical Date. Rows include IEEE International Symposium on Circuits and Systems (ICSAS 2008), IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2008), IEEE Information Theory Workshop (ITW 2008), 1st IAPR Workshop on Cognitive Information Processing, 12th International Conference on Cognitive and Neural Systems, Brain Inspired Cognitive Systems, and IEEE International Conference on Image Processing (ICIP 2008).

