

## Inaugural CIBMI Poster Day / Industrial Board meeting held May 10



A packed house: Members of the CIBMI Industrial Board listen to Erik Sander's introductory presentation.

The inaugural Industrial Advisory Board (IAB) Meeting and Poster Day for the Center for Innovative Brain Machine Interfaces (CIBMI), held May 10, was an unequivocal success. This important event was the first step in our newly funded Partnership for Innovation, National Science Foundation Award No. IIP-0650161.

The NSF Partnerships for Innovation (PFI) program has three primary goals: 1) stimu-

late the transformation of knowledge created by the research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being; 2) broaden the participation of all types of academic institutions and all citizens in NSF activities to meet the broad workforce needs of the national innovation enterprise; and 3) catalyze or enhance enabling infrastructure

necessary to foster and sustain innovation in the long-term. Ten to fifteen PFI grants are awarded each year.

Under the auspices of this grant, our CIBMI has two main goals:

- 1) to exploit UF technologies for technology transfer;
- 2) teaching and immersing graduate students and faculty in innovation and entrepreneurship through a unique experiential learning framework which combines aspects of engineering, business, and medicine.

The IAB meeting and Poster day focused on identifying two technologies which will be developed into "virtual companies." Twelve posters were submitted by students from UF

*Continued on page 2...*

## Principe wins EMBS Career Achievement Award

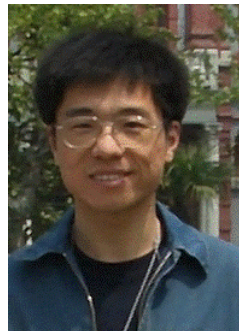


CNEL Director Jose Principe was recently awarded the 2007 Engineering in Medicine

and Biology Society's Career Achievement Award. This honor recognizes "outstanding contribution and achievement in the field of Biomedical Engineering as an educator, researcher, developer, or administrator who has had a distinguished career of twenty years or more in the field of biomedical engineering."

The award will be presented on August 24 in conjunction with the EMBC '07 conference in Lyon, France.

*Congratulations to CNEL Ph.D. student Weifeng Liu, who was presented with a 2007 UF International Student Academic Achievement award in April, 2007.*



### CNEL Seminars

- CNEL SEMINARS ARE CANCELLED FOR THE SUMMER SEMESTER, BUT WILL RESUME IN FALL.

### Inside this issue:

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## IAB meeting and Poster Day, continued from Page 1



Florida International University's College of Engineering and Computing is our partner in the Center for Innovative Brain-Machine Interfaces.

### Technology Testbeds:

The CIBMI has six technology testbeds based on current BMI research capabilities of UF and FIU:

1. Microelectrode Arrays
2. Ultra low power amplification and signal processing electronics
3. Wireless Delivery of Signal and Power
4. Low power high throughput DSP systems and algorithms
5. Animal Facilities to test the technology in vivo
6. Noninvasive Brain-Computer Interfaces.

and FIU. Based on their potential for commercial development, two CNEL-developed new technologies were selected:

*"Flexible Substrate Technology for Hybrid-Packaged Implantable Neural Interfaces"* – by Erin Patrick, supervised by Toshi Nishida and Justin Sanchez.

*"Integrate-and-Fire Signal Representation for Ultra Low Power Sensing Applications"* – by Jie Xu and Manu Rastogi, supervised by John Harris.

Erik Sander, the College of Engineering's Director of Industrial Programs, began the program with an overview of the CIBMI goals and rationale. Bill Rossi, from UF's Warrington College of Business Ad-

ministration, explained the business school's role in the process. UF faculty members John Harris, Rizwan Bashirullah, Toshikazu Nishida, and Justin Sanchez, then introduced the group to UF Brain-Machine Interface (BMI) research. Armando Barreto, of Florida International University summarized FIU BMI research.

After lunch, the IAB reviewed posters and ranked them according to their potential for commercialization. All of the represented technologies were seen as worthwhile; however, some technologies were closer to commercialization than were others, and the two technologies noted above were selected.

Over the summer, business students will further evaluate

these technologies for marketability. In the Fall semester, Engineering and Business students will be combined to form virtual companies around these technologies. They will participate in specific courses, lectures, and research to advance the technological and marketing aspects of the projects. Local and regional biotechnology entrepreneurs have agreed lead these companies as virtual CEOs. UF scientists and engineers will participate as Chief Technical Officers to guide the technological discovery and development. At the end of one year, this effort should result in a business plan and a prototype for each technology, suitable for further commercialization.



Rizwan Bashirulla (left), Assistant Professor, UF-ECE, chats with CNEL grad Armando Barreto of Florida International University.



Aysegul Gunduz discusses her poster with Tracy Cameron, VP, Scientific Affairs, Advanced Neuromodulation Systems, Plano, Texas.

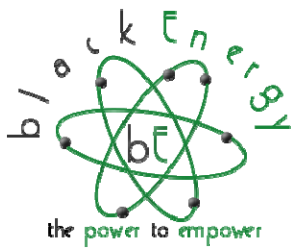


David Cheney explains his concept of wireless, wearable computers at Poster Day.



Justin Sanchez, of UF's Neuroprosthetic Research Group, discusses his lab's translational neuroprosthetic research.

## Where are they now? Sonja Ebron



While the now-infamous response of the Enron Corporation and others to the 2000 power crisis in California has come to define corporate greed, Dr. Sonja Ebron and her colleagues focused instead on corporate responsibility. How can energy deregulation benefit individuals, rather than large companies? This approach led to the development of blackEnergy, an energy cooperative located in Atlanta, Georgia, and headed by Dr. Ebron, a 1992 CNEL doctoral graduate.

“Fundamentally, engineering is about problem-solving,” says Dr. Ebron. “In terms of thought processes, there’s not much difference between designing an electrical device and troubleshooting a business problem. Learning brain theory with Dr. Principe really helped me understand the meaning of ‘biasing’ your thinking proc-

esses in a certain direction through rigorous training.”

This rigorous training prepared Dr. Ebron to parlay innovation, education, and passion into her position as CEO of blackEnergy.

“Many people can take credit for creating blackEnergy, but I’m the one everyone blames when things go wrong,” she adds.

As an energy co-op, blackEnergy negotiates among the 10 natural gas providers in Georgia to obtain the lowest rates in the state for its member households. They also donate a portion of each household’s bill to selected nonprofits working in Black communities.

“This is the best job I’ve ever had, and the work is different each day,” says Dr. Ebron. “I do everything from career day at an elementary school to top-floor customer service. My primary responsibility is to build blackEnergy’s value to our customers, partners and shareholders. That requires me to ensure that our current operations are technically efficient and profitable, and lead the way to new markets.”



Dr. Ebron’s memories of her days in CNEL may sound familiar to current students. Her favorite aspect of being a CNEL student was that “Dr. Principe is such a taskmaster, but he’s great to work with.” What did she like least? “Dr. Principe is great to work with, but he’s such a taskmaster!”

Dr. Ebron’s advice to current and future CNEL students is: “Physician, heal thyself! While you’re building the newest biologically inspired models and circuits, take a look at your own processes from an observer’s position. The best model at your disposal is the one reading these words.”

[www.blackenergy.com](http://www.blackenergy.com).



Cool Girls, Inc. is dedicated to the self-empowerment of girls in low-income communities. They are one of many nonprofit partners of blackEnergy.

“Engineering is a creative and brain-training discipline that prepares us to compete in so many fields. Since there is no shortage of engineers, we should feel comfortable branching out into less traditional areas sooner than earlier generations might have considered wise. Experience in the corporate world is often very useful, as are adequate savings, but entrepreneurship should be the ultimate goal for anyone with the stomach and heart for it.”

- Sonja Ebron, Ph.D. CNEL 1992

## Spring 2007 Dissertations and Research Proposals

### Defenses:

“Ultra-Low Power Analog Circuits for Spike Feature Extraction and Detection from Extracellular Neural Recordings.” Christy Rogers

“Dynamical Computation with Echo State Networks.” Mustafa Can Ozturk

“A Digital Audio Amplifier using Pulse Width Modulation for Portable Applications.” Xiaoxiang Gong

### Proposals:

“Unsupervised Learning: An information theoretic framework.” Sudhir Rao

“Spatiotemporal Filtering method for single-trial ERP estimation.” Ruijiang Li

“A Co-Adaptive Brain Machine Interface: Learning through Reinforcement.” Jack DiGiovanna

“Reproducing Kernel Hilbert Spaces for Point Processes, with Applications to Neural Activity.” Antonio Paiva

“Human Motor Control through Electrocardiographic Brain Machine Interfaces.” Aysegul Gunduz



## IREE Supplement awarded for NSF BMI Grant



Using his IREE Supplement, Jack DiGiovanna will conduct research at the University of Cambridge (above) and Scola Superiore Sant'Anna in Pisa, Italy. In addition to its renowned biorobotics expertise, Pisa is also famous for its leaning tower (below).



Finding a functional relationship between neuronal activity and directed hand or arm movements is essential to the development of motor control brain-machine interfaces. This is the crux of research currently being conducted under the NSF-funded grant, "Dynamic, Data-Driven Brain-Machine Interfaces," abbreviated as DDDBMI. This project is led by Jose Fortes, Jose Principe, Justin Sanchez, Linda Hermer, and Renato Figueiredo. The research goal is to develop enhanced models of the motor control system based on recent neurophysiological theories.

The IREE (International Research and Education and Engineering) supplement granted by NSF will provide an opportunity for international collaboration to further investigate the goals of the project. Jack DiGiovanna, a Ph.D. student working primarily with Dr. Sanchez and Dr. Principe, will use these funds to travel to two laboratories

world-renowned for their work in motor control and neurobotics. This fall, Jack will visit the University of Cambridge, where he will work with Dr. Daniel Wolpert in his Computational and Biological Learning Laboratory. Dr. Wolpert and his colleagues developed the multiple paired forward-inverse model structure that was the inspiration for the original grant. Next spring, Jack will work with Dr. Paulo Dario, a biorobotics expert, at Daria at Scola Superiore Sant'Anna in Pisa, Italy.

"It's an opportunity to gain a new perspective on BMI design," says Jack. "Some of the available datasets and technology are beyond anything I've worked with before."

This collaboration will allow UF scientists to discuss their research on movement with Dr. Wolpert, and the interactions between the robot and the patient with Dr. Dario, potentially achieving a better and faster integration of the final product.



Jack DiGiovanna and one of his friends.

Jack has never been out of North America, so this will greatly broaden his experience.

"I'm excited and nervous to travel to Europe," he says. "I hope to meet some new friends and catch up with some European friends whom I've met in Gainesville. I hope also that my visit fosters future collaborations."

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## Journal Papers

### To Appear

- M.D. Skowronski and John G. Harris. Automatic speech recognition using a predictive echo state network classifier. *IEEE Journal of Neural Networks*, 2007.
- X. Qi and J.G. Harris. A time-to-first-spike imager. *IEEE Sensors Journal*.
- M.D. Skowronski and J.G. Harris. Noise-robust automatic speech recognition using a predictive echo state network. *IEEE Trans. Audio, Speech and Language Processing*.
- W. Liu, P. Pokharel, J. Principe. Correntropy: Properties and Applications in Non-Gaussian Signal Processing. *IEEE Trans. Signal Processing*.
- S. Han, S. Rao, D. Erdogmus, K-H. Jeong, and J. Principe. A Minimum Error Entropy Criterion with Self-Adjusting Step-Size. *Signal Processing*.
- M. Ozturk, J. Principe. "An Associative Memory Readout for ESN and LSM for Dynamical Pattern Recognition," *Neural Networks*, special issue on Echo State Machines.

### Submitted

- W. Liu, P. Pokharel, J. Principe. Kernel Least Mean Square Algorithm. *IEEE Trans. Signal Processing*.
- R. Li, J. Principe, M. Bradley, V. Ferrari. A Novel Spatiotemporal Filtering Methodology for Single-Trial ERP Estimation. *IEEE Trans. Biomedical Engineering*.
- K-H. Jeong and J. Principe. Enhancing the Correntropy MACE Filter with Random Projections. *NeuroComputing*.

## Kudos!



**Christy Rogers**

Congratulations to recent doctoral graduate **Christy Rogers** and Xiao She on their June nuptials. The happy couple will relocate to Dallas, Texas, where Christy has a position with Texas Instruments.

**Noah Harris**, son of CNEL Assistant Director John Harris, and his Oak Hall Lower School teammates have had great success in recent chess tournaments. In March, Noah won 7<sup>th</sup> place in the K-1 division at the Florida State Scholastic Championships in



**Noah Harris (bottom row, second from right) and Team Oak Hall.**

Miami. During the weekend of May 18-20, Noah won 5<sup>th</sup> place in the state at the Florida Invitational All Stars Tournament held in Gainesville. Noah's Oak Hall Chess team were state champions in the K-1 division in both tournaments. Their chess coach, Tim Tusing, was awarded the 2007 Florida State Chess Coach of the Year at the Miami tournament. **Josh Stewart**, son of CNEL



**Josh Stewart**

Research Coordinator Julie Veal, completed his first season as the starting Designated Hitter of the PK Yonge Blue Wave varsity (high school) baseball team as a 13-year-old 8<sup>th</sup> grader. Playing primarily against 11<sup>th</sup> and 12<sup>th</sup> graders, Josh finished the first 13 games with a .323 batting average, and had multiple-hit games against Chiefland (3 for 4), Dixie County, Fort White, and Shorecrest Prep. A true scholar-athlete, Josh will take an all-Honors core curriculum, majoring in College Prep Math, when he enters high school this fall.

## Welcome to Tittletown, USA!

The University of Florida won Best Engineering Council of the Year for best overall programming, leadership development, school and community impact, advancement of the engineering principles, growing the engineering community, encouraging excellence in the classroom and the research lab, overall support and management of our student societies and uniqueness.

-from  
[www.eng.ufl.edu](http://www.eng.ufl.edu)

In March, the UF men's basketball team also performed fairly well.

## Conference Papers

### Submitted—23rd International Conference on Machine Learning (ICML) Corvallis OR USA June 2007

W. Liu, P. Pokharel, J. Principe. Recursively Adapted Radial Basis Function Networks and its Relationship to Resource Allocating Networks And Online Kernel Learning.

### To Appear—Proc. IEEE International Joint Conference on Neural Networks (IJCNN) Orlando FL August 2007

- I. Park, A. Paiva, J. Principe, and J. Harris. A closed form solution for multiple-input spike based adaptive filters.
- A. Paiva, S. Rao, I. Park, and J. Principe. Spectral Clustering of Synchronous Spike Trains.
- R. Sacchi, M. Ozturk, J. Principe, A. Carneiro, I. Silva. Water Inflow Forecasting using the Echo State Network: A Brazilian Case Study.
- N. Deudal, M. Ozturk, J. Sanchez, and J.C. Principe. An Associative Memory Readout in EAS for Neural Action Potential Detection.
- S. Rao, A. Paiva, J. Principe. A Novel Weighted LBG Algorithm for Neural Spike Compression.
- S. Rao, S. Han, and J. Principe. Information Theoretic Vector Quantization with Fixed Point Updates.
- Y. Wang, A. Paiva, J. Principe, J. Sanchez. A Monte Carlo Sequential Estimation of Point Process Optimum Filtering for Brain Machine Interfaces.
- J. Xu, J. Principe, H. Bakardjian, C. Andrzej. A New Nonlinear Similarity Measure for Multichannel Biological Signals.
- S. Darmanjian, A. Paiva, J. Principe, J. Sanchez, "Hierarchical Decomposition of Neural Data Using Boosted Mixtures of Hidden Markov Chains and its Application to a BMI"

### To Appear—Proc. Acoustical Society of America (ASA), Salt Lake City UT June 2007

S. Singh, J.G. Harris, R. Srivastav, and C. Sapienza. An improved distance metric for disordered speech evaluation.

### Published—Proc. IEEE International Conference on Circuits and Systems (ISCAS) New Orleans LA May 2007

- I. Uysal, H. Sathyendra, and J.G. Harris. Spike-based feature extraction for noise robust speech recognition using phase synchrony coding.
- X. Gong and J.G. Harris. A precompensation algorithm for pwm-based digital audio amplifiers for portable applications.

\*This paper has been invited for submission to the Neural Networks Special Issue: Advances in Neural Networks Research.





Box 116130  
University of Florida  
Gainesville FL 32611-6130

Jose C. Principe, Ph.D.  
Distinguished Professor and  
Director  
NEB 451  
352-392-2662  
principe@cnel.ufl.edu

John Harris, Ph. D.  
Professor and Assistant Director  
NEB 453  
352-392-2652  
harris@cnel.ufl.edu

Julie Veal  
Research Coordinator  
NEB 452  
352-392-2585  
julie@cnel.ufl.edu

FAX: 352-392-0044

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](http://www.cnel.ufl.edu)

### Upcoming Events

Conference	Location & Date	Early Registration
International Conference of Engineering in Medicine and Biology Society (EMBS 2007) <a href="http://www.embc07.ulster.ac.uk">www.embc07.ulster.ac.uk</a>	Lyon, France Aug. 23-26, 2007	Jul. 15, 2007
International Joint Conference on Neural Networks (IJCNN 2007) <a href="http://www.ijcnn2007.org/">www.ijcnn2007.org/</a>	Orlando, Florida Aug. 12-17, 2007	Jun. 12, 2007
International Workshop on Machine Learning for Signal Processing (MLSP 2007) <a href="http://mlsp2007.teithe.gr/">mlsp2007.teithe.gr/</a>	Thessaloniki, Greece August 27-29, 2007	Jul. 2, 2007
7th International Conference on Independent Component Analysis and Signal Separation (ICA 2007) <a href="http://www.elec.qmul.ac.uk/ica2007/">http://www.elec.qmul.ac.uk/ica2007/</a>	London, UK September 9-12, 2007	June 14, 2007
International Conference on Artificial Neural Networks (ICANN 2007) <a href="http://www.icann2007.org/">http://www.icann2007.org/</a>	Porto, Portugal September 9-13, 2007	June 29, 2007

### Conference Papers, continued



CNEELers will present eight papers, a plenary talk, and a post-conference workshop at IJCNN in Orlando.

A. Camacho and J.G. Harris. A pitch estimation algorithm based on the smooth harmonic average peak-to-valley envelope. M.D. Skowronski and J.G. Harris. Noise-robust automatic speech recognition using a discriminate echo state network.

R. Bashirullah, J.G. harris, J. Sanchez, T. Nishida, and J.C. Principe. Florida wireless implantable recording electrodes (FWIRE) for brain machine interfaces.

**To Appear—Proc. IEEE Int'l Workshop on Machine Learning for Signal Processing (MLSP) Thessaloniki, Greece, August 07**  
J. Xu, J.C. Principe. "A Novel Pitch Determination Algorithm Based on Generalized Correlation Function"

**Published—Proc. IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) Honolulu HI April 07**  
I. Uysal, H. Sathyendra, and J.G. Harris. A duplex theory of spike coding in the early stages of the auditory system.  
Weifeng Liu, P. Pokharel, J. Principe, "A New information theoretic Measure of PDF Symmetry."  
K-H. Jeong, S. Han, J.Principe. "The Fast Correntropy Mace Filter."  
P. Pokharel, W. Liu, J. Principe. "Kernel LMS"  
P. Pokharel, U. Ozertem, D. Erdogmus, J. Principe. "Recursive Blind source Separation via Eigendecomposition of Cumulant Matrices."

**Published—Proc 3rd International IEEE EMBS Conference on Neural Engineering (NER) Kohala Coast HI May 2007**  
D. Cheney, A. Goh, J. Xu, K. Gugel, J.G. Harris, J.C. Sanchez, and J.C. Principe. Wireless in-vivo neural recording using a custom integrated bioamplifier and pico system. pp. 19-22.  
C.L. Rogers, J.G. Harris, J.C. Principe, J.C. Sanchez. A pulse-based feature extractor for spike sorting neural signals. pp. 490-493.  
A. Gunduz, M. Ozturk, J. Sanchez, J. Principe. Echo State Networks for Motor Control of Human ECoG Neuroprosthetics. pp. 514-517.  
J. DiGiovanna, B. Mahmoudi, J. Mitzelfelt, J. Sanchez, J. Principe. Brain-Machine Interface Control via Reinforcement Learning. pp. 530-533.  
R. Li, J. Principe, M. Bradley, V. Ferrari. Single-trial estimation based on spatio-temporal filtering. pp. 538-541.