# CNEL TIMES

UNIVERSITY OF FLORIDA COMPUTATIONAL NEUROENGINEERING LABORATORY

Volume 2, Issue 2 July 2008

## Universidade Federal do Maranhão, São Luís do Maranhão, Brazil, bestows the degree of "Doctor Honoris Causa" to Prof. Jose C. Principe

In a ceremony directed by the Rector of the Universidade Federal do Maranhão (UFMA) held on June 23, 2008 in the Cristo Rei Palace in Sao Luis, the honorary degree of "Doutor Honoris Causa" was presented to CNEL founder and director, Jose Principe, for his contributions to academic excellence, neuroengineering research and its clinical impact. Dr. Principe has a long and productive collaboration with Dr. Allan Kardec Barros of the ECE Dept, UFMA which has included joint papers, co-supervision of students and joint organization of international conferences in Brazil. The degree of "Doctor Honoris Causa" is approved by the University Council, the highest governing body of the university, to honor an outside scientist who has made superior contributions to science and engineering in the areas of interest to UFMA.

### CNEL Seminars

- SEMINARS WILL RESUME IN FALL 2008

## Congratulations to our graduates!


Aysegul Gunduz


Ruijiang Li


Weifeng Liu


Antonio Paiva


Sudhir Rao


Ismail Uysal


Yiwen Wang

*Gunduz, Aysegul. Human Motor Control Through Electrocorticographicsl Brain Machine Interfaces.*

*Li, Ruijiang. "Spatiotemporal Filtering Methodology for Single-Trial ERP Component Estimation."*

*Liu, Weifeng. "Adaptive Filtering in Reproducing Kernel Hilbert Spaces."*

*Paiva, Antonio. "Reproducing Kernel Hilbert Spaces for Point Processes, with Applications to Neural Activity Analysis."*

*Rao, Sudhir. "Unsupervised Learning: An Information Theoretic Framework."*

*Uysal, Ismail. "A Biologically Plausible Approach for Noise Robust Vowel Recognition."*

*Wang, Yiwen. "Point Process Monte Carlo Filtering for Brain Machine Interfaces."*

### Inside this issue:


| | |
|---|---|
| WHERE ARE THEY NOW? CRAIG FANCOURT | 2 |
| DIGIOVANNA RETURNS | 3 |
| WSOM 2009 SET FOR JUNE 8-10 | 3,5 |
| PUBLICATIONS | 4 |
| UPCOMING CONFERENCES | 6 |

# Where are they now? Q&A with Craig Fancourt

**"The first time you invent a new algorithm, write a paper, and go to a conference to present it, is an incredible thrill."**

*Craig Fancourt, Ph.D.*
*Senior Research Associate*
*Applied Computer Science and Mathematics Dept.*
*Merck Research Laboratories*

**1. What interested you in becoming a CNEL student?**

Several interests came together. Prior to CNEL, I had an M.S. in Physics from the Univ. of South Florida. As a measurement engineer with General Electric, I had a project in vibration analysis using the short-time Fourier transform, which begat an interest in signal processing. I also had a casual interest in all things related to artificial intelligence and symbolic processing. But then I went to a lecture on artificial neural networks, and saw for the first time that you could also do really intelligent things with machine learning and numerical processing. Finally, I wondered into CNEL not really knowing where I was, started talking with some graduate students, and later Dr. Principe, and the rest is history.

**2. What did you like most about being in CNEL? Least?**

I most liked the camaraderie with the other graduate students, the weekly seminars, and the brainstorming sessions with Dr. Principe. I least liked the feeling of never knowing when you're finally going to graduate.

**3. How did your educational and professional background, especially your time at CNEL, prepare you for your current position?**

At CNEL, we were exposed to a broad range of advanced signal processing and machine learning concepts that have been useful throughout my career. For my dissertation, I worked on an NSF grant concerning non-linear and non-stationary signals, which certainly applies to most of the biological signals I work with now. Plus, Dr. Principe's interest in neuroscience and close ties with the medical community meant we were constantly surrounded by interesting people and projects from the bio-medical area.

Then at my first job post-CNEL, for the Sarnoff Corp., a contract research company in Princeton NJ, I worked on several bio-engineering projects, such as registration of low- and high-resolution MRI images, an EEG thought classifier, iris recognition at-a-distance, an in-the-ear vital signals monitor, and a next-generation medical ultrasound system.

**4. What does your current position entail? What do you enjoy most about it?**

I work in the Applied Computer Science & Mathematics (ACSM) Dept. at Merck, a pharmaceutical company, in Rahway NJ. Working with other Merck scientists, our group builds models for many different types of biological data, including genomic, proteomic, metabalomic, and physiological. Some members of the group design mathematical models, others design algorithms to extract biomarkers from biological measurements (often inspired by the models), and some do both. Our department also helps develop and evaluate new technologies and bioinformatics capabilities, and does optimization and operations research. In most of our projects, the ultimate goal is discovering a new drug, or measuring the efficacy and safety of one in development.

In my particular role, I design and extract biomarkers from imaging data, such as from ultrasound and MRI, and physiological time series, such as ECG, pressure, and respiration. I also work closely with a colleague who designs fluid dynamical models of the cardio-vascular circulatory system. I particularly enjoy getting to use all of my education and training for improving human health, plus learning something new every day in the process.

**5. Do you have any special memories of being a CNEL/ Principe student?**

The first time you invent a new algorithm, write a paper, and go to a conference to present it, is an incredible thrill. The 1998 IJCNN in Anchorage was an exciting trip. And when Dr. Principe suggested my dissertation for a chapter in a Simon Haykin book, it was a great honor. I also have good memories of playing golf with Frank Candocia, and hanging out in downtown Gainesville with fellow students.

**6. What advice would you give current or future CNEL students?**

Try to absorb as much as you can from all the research going on around you; you never know what you might end up doing when you graduate.

When you do mathematical derivations or manipulations,

*...Continued on page 4*

## Digiovanna returns to the States after IREE-funded international research

From new research directions to new cultures and customs, international travel always adds flavor to one's life experience. In his first trip abroad, Jack DiGiovanna, a CNEL Ph.D. student working under Drs. Sanchez and Principe, found this to be unequivocally true.

Funded by NSF's IREE (International Research and Education in Engineering) program, Jack traveled to the University of Cambridge in Cambridge, England, and to Scuola Superiore of Sant' Anna, in Pisa, Italy. The IREE travel grant was a supplement to the current NSF-funded project, "Dynamic, Data-Driven Brain-Machine Interfaces," or DDDBMI, led by Jose Fortes, Jose Principe, Justin Sanchez, Linda Hermer-Vazquez, and Renato Figueiredo.

While at Cambridge, Jack worked with Dr. Daniel Wolpert in his Computational and Biological Learning (CBL) Laboratory which focuses on human motor control. Dr. Wolpert and his colleagues developed the multiple paired forward-inverse motor control model structure that was part of the inspiration for the original DDDBMI grant. Since then, Dr. Wolpert's work "has moved towards single models and Bayesian inference in the sensorimotor system," said Jack. The experience broadened DiGiovanna's thinking on motor control research.

"CNEL is focused heavily on neural activity, while the CBL lab focuses on behavior. Both labs are interested in the same system but use very different experimental designs." Jack was also able to spend time with Drs. Gharamani and Rasmussen's machine learning groups to discuss advanced reinforcement learning topics

Culturally, Digiovanna lived in an area already accustomed to gas prices more than twice the $4.00 per gallon that has U.S. residents reeling.

"I lived in a four bedroom house with a common kitchen," he said. "It was about a mile from the lab." While there, DiGiovanna bought a bicycle. "You can bike everywhere in Cambridge; it is the only place I have ever been that is more bike-friendly than Gainesville."

Next, Jack traveled to Italy to work with Professor Silvestro Micera in Dr. Paolo Dario's Advanced Robotics Technology and Systems (ARTS) Laboratory in Pontedera. There he worked on BMI using Peripheral Nervous System (PNS) inputs. Jack learned the state of the art in this particular branch of BMI and then modified techniques he learned at CNEL so they could be applied to the problem. Jack hopes that these new techniques will help the ARTS lab to control their advanced Cyber-Hand prosthetic.

Digiovanna enjoyed the European working culture, and appreciated the differences among the countries he visited. "During working hours, you work," he said. "In the evenings and on weekends, you're not. You have time to enjoy with your friends and relax. So when you're at work, you're focused. It seems more efficient and healthy."

Trying new foods is always an interesting and fun component of international travel, and DiGiovanna partook of the local cuisine. "The food in Italy was wonderful," he said. On the other hand, the "mushy peas" – a lumpy green concoction commonly served in the UK with fish and chips – is remembered less favorably.

DiGiovanna's advice to future IREE grant recipients is to "pick one place." While visiting two highly regarded laboratories in two different countries provided a tremendous learning opportunity, "it was difficult to move to a new country, get adapted to the culture of the lab, and then start and finish a research project in 3 months." Overall, Jack felt the visit to the CBL and ARTS labs was a fantastic opportunity and he found it extremely beneficial as both a student and a citizen of the world.

Yummy! According to Wikipedia, **mushy peas** are dried marrowfat peas soaked overnight in water and sodium bicarbonate, then simmered in salt and sugar. Green coloring is added to form a thick green lumpy soup. The dish is considered part of traditional British cuisine, and is often served with fish and chips.

## WSOM 2009 set for June 8-10

The 7th International Workshop for Self-Organizing Maps (WSOM 2009) is scheduled for June 8-10, 2009, at the Casa Monica hotel in historic St. Augustine, Florida. This conference, chaired by Dr. Jose Principe, with Dr. Risto Miikkulainen as Program Chair, will bring togther researchers and practitioners in the field of self-organizing systems, with a particular emphasis on neural networks and self-organizing maps. It will highlight key advances in these and related fields. in Helsinki in 1997. Please see the Call for Papers on Page 5 of this newsletter.

## Fancourt, Continued from Page 2

try to think about what they mean physically; every equation tells a story!

When you develop a new algorithm, put it to the test with as much real data as you can find; no algorithm works perfectly out of the box all the time.

Write your code professionally, with good organization and comments, as if you were coding for a pacemaker that could never fail. This increases the chance that others will find it useful. And when they inevitably use it in a way you never intended, it might actually work!

Try to enjoy writing; whether it be papers or proposals, the quality of your writing will have a direct impact on your career, so you might as well enjoy it (and it will show).

And last but not least, listen to Dr. Principe. He has great insight!

## Finally! CNEL Website has a new look, new functionality

http://www.cnel.ufl.edu

**After two years of effort, we are proud to unveil the new and improved CNEL website! Improvements include news update functionality, enhanced security, CSS support, browser support (IE5, IE6, IE7, Opera 9, Firefox 2 and 3, Safari) and no more frames.**

**We invite you to take a look at what we've done so far, and hope you will help us to continually improve the site. Thanks to everyone who worked on this important project.**

## Publications

***Journal Papers To Appear:***

Camacho A., and J.G. Harris. A sawtooth waveform inspired pitch estimator for speech and music. J. Acoustical Society of America.

Ravinuthula, V., V. Garg, J.G. Harris, and J.A.B. Fortes. Time-mode circuits for analog computation. International Journal of Circuit Theory and Applications.

DiGiovanna, J., B. Mahmoudi, J. Fortes, J. Principe, J.C. Sanchez. Co-adaptive Brain Machine Interface via Reinforcement Learning. Trans. Biomedical Engineering.

Li, R.; J. Principe, M. Bradley, V. Verrari. "A Novel Spatiotemporal Filtering Methodology for Single-Trial ERP Estimation." IEEE Trans. Biomedical Engineering.

Liu, W., J. Principe. "Kernel Affine Projection Algorithms." J. Signal Processing, Special Issue on Machine Learning for Signal Processing.

Darmanjian, S.; J. Principe. "Boosted and Linked Mixtures of HMMs for Brain Machine Interfaces. J. Signal Processing, Special Issue on Maching Learning for Signal Processing."

Wu, H-C., Y. Wu, J. Principe, X. Wang. "Robust Equalizer for Wireless Cognitive Receivers." IEEE Trans. Wireless.

Jeong, K-W. and J. Principe. "Enhancing the Correntropy MACE Filter with Random Projections." Neurocomputing.

Xu, J.; A. Paiva, I. Park, J. Principe. "A Reproducing Kernel Hilbert Space framework for Information Theoretic Learning." IEEE Trans. Signal Processing

Xu, J.; J. Principe. "A Pitch Detector Based on a Generalized Correlation Function." IEEE Trans. Audio, Speech, and Language Processing.

Gunduz, A.; J. Principe. "Correntropy as a Novel Measure for Non-linearity Tests." Signal Processing.

Paiva, A.; I. Park, J. Principe, T. DeMarse. "An Information Measure of Synchrony for Multichannel Spike Trains." Neural Computation.

***Published Journal Papers:***

Xu, J.; H. Bakardjian, A. Cichocki, J. Principe. "A New Non-Similarity Measure for Multichannel Signals." Neural Networks (invited paper) 21(2,3), pp. 222-231.

Park, I.; A. Paiva, T. DeMarse, J. Principe. "An efficient algorithm for continuous time cross correlogram of spike trains." J. Neuroscience Methods, 168(2) pp. 514-523.

Hegde, A.; J. Principe, C. Sackellares. "A Clustering Approach to Quantify Long Term Dependencies in Epileptic EEG" J. Computational Intelligence in Neuroscience, special issue on EEG/MEG analysis. Article iD 83416.

Sanchez, J.; A. Gunduz, P. Carney, J. Principe. "Extraction and Localization of Mesoscopic Motor Control Signals for Human ECoG Neuroprosthetics." N. Neuroscience Methods—Special Issue on BCI, vol. 167 no. 1, pp. 1-126.

Sanchez, J.C., J.C. Principe, T. Nishida, R. Bashirullah, J.G. Harris, J.C. Principe, and J.A.B. Fortes. Technology and Signal Processing for Brain-Machine Interfaces: The need for beyond State-of-the-Art Tools." IEEE Signal Processing Magazine, 25(1), pp. 29-40.

***Accepted Conference Papers:***

*Accepted to Third International Brain-Inspired Cognitive Systems Conference, Sao Luis, Brazil, June 2008.*

Garg, V., J.G. Harris, and J.C. Principe. A time-based computation architecture.

Mahmoudi, B., J. DiGiovanno, J.C.Principe, and J.C. Sanchez. Co-Adaptive Learning in Brain-Machine Interfaces.

*Accepted to EMBC 2008, Vancouver, Canada, August 20-24, 2008:*

Goh, Aik., S. Craciun, S. Rao, D. Cheney, K. Gugel, J.C. Sanchez and J.C. Principe. Wireless Transmission of Neuronal Recordings using a Portable Real-Time Discrimination/Compression Algorithm.

Paiva, A.R.C., I. Park, J.C. Sanchez, and J.C. Principe. Peri-event Cross-Correlation over Time for Analysis of Interactions in Neuronal Firing.

Paiva, A.R.C., W. Yan, A. Gunduz, J.Gao, J.C. Sanchez, and J.C. Principe. Fractal Analysis of Micro-Electrode Neural Activity Recordings.

Digiovanna, J., L. Citi, K. Yoshida, J. Carpaneto, J. C. Principe, J.C. Sanchez and S. Micera. Inferring the Stability of LIFE through Chronic Brain-Machine Interface Decoding Performance.

Wang, Y.W. and J. C. Principe. Tracking the Non-Stationary Neuron tuning by Dual Kalman Filter for Brain Machine Interfaces Decoding.

Principe, J.C., Y. Wang, and J.C. Sanchez. Point Process Models for Motor BMIs: An Assessment.

Zhao, M., P. Rattanatamrong, J. DiGiovanna, B. Mahmoudi, R. J. Figueiredo, J.C. Sanchez, J.C. Principe, J.C. Fortes. BMI Cyberinfrastructure.

Patrick, E., V. Sankar, W. Rowe, S.-F Yen, J.C.Sanchez, and T. Nishida. Flexible Polymer Substrate and Tungsten Microelectrode Array for an Implantable Neural Recording System.

**…..Continued on Page 6**

# WSOM 2009
## 7th International Workshop on Self-Organizing Maps

***June 8-10, 2009***
**Casa Monica Hotel, St. Augustine, Florida, USA**
**http://www.casamonica.com/**

***Registration information coming soon!***
**http://www.cnel.ufl.edu/conferences/WSOM2009/**

Organizing Committee:
General Chair: Jose Principe [principe@cnel.ufl.edu]
Program Chair: Risto Miikkulainen [risto@cs.utexas.edu]

**OBJECTIVES**

**WSOM'09** will be bringing together researchers and practitioners in the field of self-organizing systems, with a particular emphasis on neural networks and self-organizing maps. It will highlight key advances in these and related fields. It is the seventh conference in a series of bi-annual international conferences started with WSOM'97 in Helsinki.

**CALL FOR PAPERS**

The workshop will feature keynote addresses and technical presentations with recent advances in the area which will be collected in a CD-ROM distributed at the conference and that will be included in the registration. Papers are solicited for, but not limited to, the following areas:

- •Bioinformatics
- •Cognitive Modeling
- •Data visualization, mining and sonification
- •Financial analysis
- •Hardware and architecture
- •Neuroscience
- •Optimization
- •Robotics and Intelligent Systems
- •Self-organization
- •Signal processing, image processing and vision
- •Text and document analysis
- •Theory and extensions
- •Time-series analysis
- •Unsupervised learning (including PCA/NLPCA, ICA/NLICA, Principal Curves/Surfaces)

**SCHEDULE**

| | |
|---|---|
| Submission of full papers: | Jan 15, 2009 |
| Notification of acceptance: | March 1, 2009 |
| Camera-ready papers and author registration: | April 2, 2009 |
| Advance registration deadline: | April 15, 2009 |

**PAPER FORMAT**

All papers must be in PDF format prepared for US letter size, double column. The standard number of pages is 6. To ensure an overall homogeneity of the proceedings, submitted papers must be prepared according to the style guidelines. To this end, each author is encouraged to use the prepared style and examples files:

* LaTeX style and examples files: wsom09.cls, wsom09.tex
* Microsoft Word example file: wsom09.doc or wsom09.rtf

**REVIEW PROCEDURE**

All papers will be peer reviewed on the basis of a full length manuscript and acceptance will be based on quality, originality and relevance. Accepted papers will be published in an electronic proceedings volume and be made available at the conference in CD-ROM.

**VENUE**

The conference will be held in the classic Casa Monica Hotel in St. Augustine Florida, the oldest city in the United States. A block of rooms has been reserved for the conference rate, and participants are encouraged to book them. Instructions will be posted in the website. St. Augustine is surrounded by beautiful beaches and is located 45 miles South of the Jacksonville International Airport, and 150 miles north of Orlando, its many attractions, and international airport.

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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.*

*CNEL'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.*

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## Upcoming Events

| Conference | Location & Date | Next Critical Date |
|---|---|---|
| IEEE Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS) http://www.embc2008.com/ | Vancouver, BC, Canada August 20-25 | Conference begins August 20 |
| IEEE International Conference on Image Processing (ICIP 2008) http://www.icip08.org | San Diego, California, USA October 12-15, | Advance Registration August 8 |
| IEEE International Conference on Machine Learning for Signal Processing (MLSP 2008) | Cancun, Mexico October 16-19 | Hotel Reservation September 24 |
| Neural Information Processing Systems Conference (NIPS 2008) | Vancouver, BC December 8-11 | Early Registration Sept. 10 |
| 7th International Workshop on Self-Organizing Maps (WSOM 2009) http://www.cnel.ufl.edu/conferences/WSOM2009/ | St. Augustine, FL, USA June 14-17, 2009 | Paper Submission: Jan 15, 2009 |

WSOM 2009 will be held in historic St. Augustine, Florida.

**…...Continued from Page 6**

Gunduz, A., J.C. Sanchez, and J. C. Principe. Electrocorticigraphic Interictal Spike Removal via Denoising Source Deparation for Improved Neuroprosthesis Control.
*Accepted to IEEE International Conference on Machine Learning for Signal Processing, Cancun, Mexico, October 2008*
Gunduz, A., J.C. Sanchez and J.C. Principe. Analysis for ECoG Features for Movement Execution using Denoising Source Separation.

***Published Conference Papers:***

*Proc. IEEE International Symposium on Circuits and Systems (ISCAS), Seattle, WA, May 2008.*
Xu, J., and J.G. Harris. The time derivative neuron, pp. 436-439.
Harris, J.G., J. Xu, M. Rastogi, A. Singh-Alvarado, V. Garg, J.C. Principe, and K. Vuppamandla. Real time signal reconstruction from spikes on a digital signal processor, pp. 1060-1063
Harris, J.G., J.C. Principe, J.C. Sanchez, D. Chen and C. She. Pulse-based signal compression for implanted neural recording system, pp. 344-347.