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Brief Description of Job Duties:

a) **Research**: The goals of my research and the establishment of the Neuroprosthetic Research Group laboratory are to develop state-of-the-art novel neural interface medical treatments. This translational research initiative operates at the crossroads between basic neural engineering research and clinical care. This direction of research is motivated by the potential of *direct neural interfaces* to deliver therapy and restore functionality to disabled individuals using engineering principles. Two clinical outcomes of my lab's mission are to restore movement to the paralyzed patient and to control epileptic seizures. The mechanism by which we can achieve these outcomes is through the sampling of large ensembles of cells from both the cerebral cortex and from deep brain structures. Using new neural engineering technologies that are now becoming clinically relevant, we have a window of opportunity to study the functional relationships of neural systems (motor system, limbic system). The process of transitioning this technology into a clinically useful device requires two parallel paths of research. In the first path, experimental paradigms involving microelectrode array recordings in behaving animals are developed in conjunction with signal processing techniques for studying the unknown aspects of neural coding and functional neurophysiology. These signal processing techniques can then be implemented in portable, low-power, wireless hardware (electrodes, DSPs) that is feasible for a clinical implementation of a Brain-Machine Interface. The second path, high-density array ECoG recordings in humans, provides a less invasive technique for neural interfaces and it has the potential to extract BMI control signatures that are sufficiently spatially and temporally resolved. Moreover, it will be critical to obtain feedback about interactions of the individual's intent and the engineered interface, a necessary condition for improving the performance of a superior interface. Ultimately, my laboratory has contributed new knowledge of functional neurophysiology, neuroprosthetics, signal processing, and has demonstrated the clinical utility for human subjects.

b) **Teaching**: I developed and teach a new multidisciplinary course in the Interdisciplinary Program in Biomedical Sciences (IDP) titled Fundamentals of Computational Neuroscience. This is a highly multidisciplinary course relevant to students in the Colleges of Medicine and Engineering and I regularly have students enrolled from the Departments of Biomedical Engineering (BME), Neuroscience, Materials Science Engineering, and Electrical and Computer Engineering (ECE). I also serve as a mentor to BME, IDP, and ECE students enrolled in clinical shadowing or practical laboratory courses. I serve as on the graduate committees (chair, co-chair, or member) of Ph.D. students (from BME, IDP, and ECE). My teaching duties include providing guidance in the formulation, experimentation, writing of graduate dissertations, daily meetings with students, as well as participation in "core-curriculum" lectures and conferences.

   It is my ongoing goal to create new, leading edge curricula that prepares graduate and undergraduate students for bridging engineering and medical disciplines. I am very interested in creating new courses and practical laboratory experiences that teach students electrophysiological methods, neural signal processing, and *in vivo* experimental techniques.

c) **Administration**: Prior to my joining the faculty in the College of Medicine, there was limited administrative support of multidisciplinary neuroprosthetic program development at UF. One of the initial missions of my program was to create the core administrative infrastructure to support cross College teaching and research. To achieve these goals my program sought to create unique opportunities for interdisciplinary research, education, and training of graduate and medical students in the University of Florida Colleges of Medicine and Engineering. The realization of the mission is the development of new translational (bench to bedside) technologies, new facilities to perform

biomedical research, new biomedical curricula, and new mentoring programs for students and professionals. It is my major objective to help create the new generation of scientists by providing a vibrant research environment, mentoring, seminars, and undergraduate outreach opportunities in the Colleges of Engineering and Medicine. It includes support of scientific, technological, and educational activities. In this direction, I serve as the founding Chair of the Gainesville Section of the IEEE Engineering in Medicine and Biology Society (EMBS). I also serve as Director for Membership Development in the main chapter of the UF IEEE and have served as a representative for the IEEE Section Congress. I participate in curricula development for the IDP and participate as an advisor to medical and graduate students. I am a founding member of the UF Center for Innovative Brain Machine Interfaces where new educational programs are developed to immerse graduate students (and faculty) in innovation and entrepreneurship through a unique experiential learning framework that spans the Colleges of Engineering, Medicine, and Business.

I am also the Director for the PEDS faculty research seminar. This seminar series is motivated by unmet needs in clinical care. The goal is to gather physicians and scientists together to seek out new approaches to therapy and develop novel science that *enables* new therapies. By synergizing multiple Divisions within the Department of pediatrics we can identify controversial perspectives that either enhance collaboration or create barriers for translational research. By overcoming these barriers and innovating our research program, we can move basic science *to* clinical trials and *to* industry. The major objectives are motivated by the NIH roadmap and include:

1) Identify new scientific pathways to discovery and apply them to clinical care
2) Build research teams of the future
3) Re-engineer the clinical research enterprise

Areas of Specialization:

Neuroprosthetics

1. Neural Engineering
    i. Closed-loop neural interface systems for communication and control
    ii. Adaptive Signal Processing
2. Neurophysiology
    i. Multielectrode Array Electrophysiology
    ii. Motor System – Stroke, Paralysis, Movement Disorders
    iii. Limbic System - Epilepsy

Educational Background:

University of Florida	Doctor of Philosophy (Ph.D.) Biomedical Engineering (graduated with specialization in Signal and Image Processing)	2004
University of Florida	Master of Engineering (M.E.) Biomedical Engineering	2004
University of Florida	Bachelor of Science (B.S.) Engineering Science (graduated with minor in Biomechanics)	2000

Employment:

University of Florida Department of Biomedical Engineering	Affiliate Assistant Professor (non-tenure-accruing)	2006-present
University of Florida Department of Pediatrics	Assistant Professor (tenure-accruing)	2005-present
University of Florida	Affiliate Assistant Professor	2005-present

Department of Neuroscience	(non-tenure-accruing)	
University of Florida Department of Pediatrics	Research Assistant Professor (non-tenure-accruing)	2004-2005

Teaching, Advising, and/or Instructional Accomplishments:

a) Integrated Medical and Engineering Education
Through the development of a new neuroprosthetic programmatic theme, my laboratory has offered the opportunity for an educational experience that bridges the clinical and research environments. The goal has been to develop new programs and enhance existing programs around multidisciplinary environments that are free of barriers. The specific goals are as follows:
• Provide medical students and residents with new neural engineering learning experiences with an emphasis on experimental design and data analysis.
• Develop a computational neuroscience curriculum in the Colleges of Medicine and Engineering.
• Provide practical tech transfer experience (development of business plans, patient interaction, real-time wet lab experiments) to undergraduate and graduate students in order to promote careers in biomedical technology research
• Recruit pre-college and college students for neuroprosthetic projects which will be presented in competitions and conferences
• Assist in developing mentoring and leadership training program for female students through the UF Society of Women Engineers (SWE)

PhD students who have graduated under my supervision and program

- Jack DiGiovanna – (Ph.D., 2008) – Changing the Brain Machine Interface Paradigm: Co-Adaptation based on Reinforcement Learning
- Aysegul Gunduz – (Ph.D., 2008) - Human Motor Control through Electrocorticographic Brain Machine Interfaces
- Antonio R. C. Paiva (Ph.D., 2008) - Reproducing Kernel Hilbert Spaces for Point Processes with Applications to Neural Activity Analysis
- Yiwen Wang – (Ph.D., 2008) – Point Process Monte Carlo Filtering for Brain-Machine Interfaces
- Christy Rogers – (Ph.D., 2007) – A Low-Power Analog Spike Detector for Neural Recordings, now working at Texas Instruments.
- Yuan Li – (Ph.D., 2006) – Spike-based neural amplifier, now working at Motorola.

Postdoctoral Associates working under my supervision

- Kun-Ze Lee – (Department of Physical Therapy) - Training Novel Host-Graft Circuits to Enhance Spinal Cord Repair

b) Related Education and Outreach Accomplishments: I am extremely dedicated to education and have accumulated a significant track record of commitment and success in educational and outreach activities (community and under-represented groups). I work extensively with undergraduate, graduate, women, and minority students to ensure they finish their education and remain interested in science and engineering. I am well trained in multidisciplinary work and currently mentor Ph.D. students in the Interdisciplinary Program in Biomedical Sciences (IDP), Biomedical Engineering (BME) and Electrical and Computer Engineering (ECE). The students enrolled participate in clinical shadowing, practical laboratory courses, or research. Within the Department of Neuroscience and the IDP program, I participate in lab rotations where students spend 5 weeks in the wet lab gaining experience, giving seminars, and writing research papers.

Ph.D. students who have participated in laboratory rotations

- Casie Lindsly (Ph.D., Neuroscience) – (2/07-5/07) – Correlating *in vitro* and *in vivo* neuronal hyperexcitability in a rat model of cortical dysplasia.
- Mackenzie Hofmann (Ph.D., Neuroscience) – (2/07-5/07) – What are the mechanisms of pyramidal cell and interneuron neuromodulation in a rat model of temporal lobe epilepsy?

- Jeremiah Mitzelfelt (Ph.D. Neuroscience) – (2/06 – 5/06) – Microstimulation for treating epileptic bursts.
- Ben Nahir (Ph.D., Neuroscience) – (10/04 – 12/04) – Using Recurrent Neural Networks to Classify Epileptic Seizures.

c) Innovative Computational Neuroscience Courses and Curricula: I have developed a new multidisciplinary course in the IDP program titled Fundamentals of Computational Neuroscience. This course is open to students with an interest in systems neurophysiology, neural computation, and experimental neurophysiological analysis and presents the major concepts of neural signaling and communication from the single neuron to systems of neural ensembles. We discuss the role of neural computation for advancing knowledge of information-processing in the brain. Examples are given for how experimental data can be summarized and predicted through computational modeling. Whenever possible, computer simulations are used to provide real examples for student experimentation. The course website is http://nrg.mbi.ufl.edu/courses/FCN/fcn_index.html. In the past two years, 6 of the 19 students were women and the neurobiological and computational topics presented were relevant to registered students of different backgrounds which included neuropsychology, neuroscience, biomedical engineering, materials engineering, and electrical engineering.

d) Medical Resident and Student Education: My research program includes synergistic research partnerships with clinicians to provide practical laboratory experience for medical residents and students who are seeking to add research components to their careers in medicine. I lead small study sections in which students explore and understand the techniques of how engineers affect medicine, and technology by developing design and analysis skills. A second goal is to offer training to overcome many of the communication barriers of medical and engineering interaction. I actively recruit medical students for research projects on movement disabilities and epilepsy in his lab.

Medical student who has participated in this program

- David Wang (Medical Student) – (2/06 – present) – Correlating DBS electrophysiology with motor exams

e) Society of Women Engineers at the University of Florida: In 2004-2005, the national Society of Women Engineers (SWE) named its UF chapter (http://grove.ufl.edu/~sweuf/) the Most Outstanding Student Section. I and my laboratory (Neuroprosthetics Research Group) interface directly with the chapter by offering research opportunities and experience. The interaction of the society and NRG lab is focused on encouraging young women to consider an engineering education and the opportunities open to them in technical careers. I assist in mentoring through the SWE eSWAMP day which is a transition program for incoming female students to engineering.

SWE student working under my supervision

- Elizabeth Wellings (Undergraduate, Mechanical Engineering) – (6/08 – present) – Actor-critic architecture for BMI
- Krystina Subieta (Undergraduate, Mechanical Engineering) – (10/08 – present) – Video analysis for Brain-Machine Interfaces
- Erin Patrick (Ph.D., ECE) – (8/04 - present) – Improved microelectrode arrays for neural recordings.

f) Outreach: The multidisciplinary nature of the neuroprosthetic research proposed naturally draws local, North American, and international students. I provide mentoring for undergraduate and graduate students inquiring about research and education opportunities. To support the demand for neural engineering experience, I have participated in outreach programs to deliver education both locally and abroad. The core mechanisms through which this education will be offered is the UF Distance Learning Program (http://www.distancelearning.ufl.edu/) and the UF EDGE (Electronic

Delivery of Graduate Engineering http://oeep.eng.ufl.edu/). I electronically offer my computational neuroscience course lectures, reading, and testing materials to students who are located abroad. I have already been successful with distance learning in the past year, offering my computational neuroscience course.

- Thomas Ha (Ph.D., Neuroscience, 2006) who was located at the Whitney Laboratory for Marine Bioscience in St. Augustine, FL (http://www.whitney.ufl.edu/) took my course via videoconference and obtained the second highest grade among the students.

g) Undergraduate Research Opportunities: One focus of my accomplishments is to promote undergraduate achievement in research and continued higher education. The interdisciplinary nature of the research topic proposed offers opportunities for undergraduate students to gain experience in a wet lab environment and with data analysis. Moreover, this program has the potential for teaching students the "realities" of developing translational medical devices here at the University of Florida. The knowledge and experience has been used to encourage undergraduate students to pursue higher graduate degrees (PhD) or careers in medicine. As part of the mission of the UF Associate Provost and Director of the Honors Program, I and my lab actively participate in The Undergraduate Research Database. The Undergraduate Honors Program keeps a database of all research projects at the University of Florida that could involve undergraduate students. The database is published on a website so that undergraduate students can have an easily accessible means to find projects that may be of interest to them. Additionally, students interested in the Undergraduate Research Scholars Program http://www.scholars.ufl.edu or those who are writing Senior Theses to graduate with Honors have used the tool when searching for NRG lab projects of interest to them (http://www.honors.ufl.edu/researchdatabase.html).

Undergraduate students working under my supervision

- Nicholas Pavlovsky (Undergraduate, Biological Engineering) – (5/09 – present) – Analysis of spike recordings from an animal model of temporal lobe epilepsy
- Elizabeth Wellings (Undergraduate, Mechanical Engineering) – (6/09 – present) – Actor-critic architecture for BMI
- Rebecca Vogt (Undergraduate Biology) – (10/08 – present) – Spike analysis for Brain-Machine Interfaces
- Krystina Subieta (Undergraduate, Mechanical Engineering) – (10/08 – present) – Video analysis for Brain-Machine Interfaces. Under my supervision, Krystina was awarded a summer research fellowship at Rice University.
- Scott Amerman (undergrad Physics – 5/08 – 12/08) – Design of a 64 channel neural recording system.
- Geoffrey Kvasnok (undergrad Chemical Engineering – 10/07 – 5/08) – Design and testing of a stereotaxic neurosurgery drive arm for microelectrode arrays.
- Alexandra Issa (undergrad BME, Duke University, 06/06 – 08/06), Electrophysiological analysis and identification of human seizure onset zones (The summer research conducted under my supervision was used to gain acceptance to the Pratt Engineering Undergraduate Fellows Program at Duke University).
- Matthew Ordonez (undergrad ECE) – (3/05 – present) – Flexible Neural Probes for Brain Machine Interfaces.
- Jason Pukala (undergrad ECE) – (3/04 – 12/04) – LPC Classification of DBS Neuronal Recordings (the student received highest honors from the Undergraduate Research Scholars Program for his work in Deep Brain Stimulation signal processing and published a paper on the work).

h) UF-Howard Hughes Medical Institute GATOR Science Mentoring Program: The UF-Howard Hughes G.A.T.O.R. Program for Biomedical Science brings together graduate and undergraduate students who work together in research teams under the guidance of faculty advisors. As team leaders, graduate students gain experience in mentoring and project management, skills that will

enhance their success as professional scientists and teachers. As team members, undergraduate students learn about the process of scientific research and scholarship. By doing discovery science, they gain important lab skills along with knowledge of research design and presentation. In addition, the G.A.T.O.R. Program is designed to help students develop a personal network of mentors and colleagues who can help them develop their scientific careers.

- Babak Mahoudi (Ph.D., Biomedical Engineering, 2008) – Both Dr. Sanchez and Babak Mahmoudi serve as mentors to 2 undergraduates enrolled in the program.
- Research Proposal funded – Rebecca Vogt - "Characterization of the Neural Activity in the Nucleus Accumbens During a Reaching Task to Improve Brain-Machine Interfaces" - $500
- Research Proposal funded – Elizabeth Wellings - "Biological Simulator of Reinforcement Learning used in Brain-Machine Interfaces"
- Mentor – ZOO4905 – Rebecca Vogt

h) Multidisciplinary Lecture Series and Translational Research Training:

2008 Organization of Engineering in Medicine and Biology Lecture Series "Frontiers in Biomedical Sciences"

Description: To stimulate cross-cultural interaction among students in the Colleges of Medicine and Engineering, I developed a series of talks called "Frontiers in Multidisciplinary Research." The innovative design of the meetings consist of two, 30-min talks where one student/professor from the College of Medicine and one student/professor from the College of Engineering give head-to-head lectures on how multidisciplinary researchers helped to overcome some of the grand challenges in biomedical research. This is a wonderful mechanism to demonstrate to the students how multidisciplinary interaction is necessary to shape future research. The meeting has been a great success and has sparked involvement from many new students and researchers.

2007 Industrial Board Meeting and Poster Presentation - Center for Innovative Brain Machine Interfaces (Co-organizer), Gainesville, Florida

Description: The purpose of this center is to involve graduate engineering and business students in the development of virtual companies centered on promising new technologies, and to incorporate this into our graduate engineering program. The ultimate goal is to find a way to speed these new technologies from the lab to the private sector, and to give graduate engineering students an entrepreneurial focus to their degree programs. Each year, two technologies are selected to be developed into virtual companies. The selection process takes place at a Poster Day, where students present posters and demos of their technologies, and the technologies are judged on their potential for commercial development.

10. Graduate Committee Activities:

Applicant's Role	Student	Research Topic	Home Dept.	Complete Date
Chair, 3 Ph.D. Committees	Babak Mahmoudi In 2009, Babak received a research fellowship to attend the Thirteenth International Conference on Cognitive and Neural Systems (ICCNS) at Boston University.	Goal-Directed Brain-Machine Interfaces	Biomedical Engineering	2010

	Babak was also a finalist in the 2009 EMBS Student Paper Competition.			
	Jack DiGiovanna (Co-Chair - 70% responsibility)	Reinforcement Learning for Neuroprosthetics	Biomedical Engineering	2008
	Aysegul Gunduz (Co-Chair - 60% responsibility)	Human ECoG Brain-Machine Interfaces	Electrical and Computer Engineering	2008
Member, 7 Ph.D. Committees	Zhiming Xiao	Low-Power Wireless Bio-Systems	Electrical and Computer Engieering	2012
	Sheng-Feng Yen	A Pulse-Based Low Bandwidth Neural Recording System	Electrical and Computer Engineering	2011
	Adam McLeod	Disposable Walking Robots	Electrical and Computer Engineering / MITRE Corp.	2010
	Shalom Darmanjian	Generative Neural Clustering	Electrical and Computer Engineering	2009
	Erin Patrick	MEMS Based Microelectrode Arrays	Electrical and Computer Engineering	2009
	Antonio R. C. Paiva	Reproducing Kernel Hilbert Spaces for Neural Analysis	Electrical and Computer Engineering	2008
	Yiwen Wang	Stochastic modeling for brain-machine interfaces	Electrical and Computer Engineering	2008
	Christy Rogers	Multiscale spike sorting in analog hardware	Electrical and Computer Engineering	2007
	Yuan Li	Pulse based amplifier for neural implants	Electrical and Computer Engineering	2006
Member, 1 M.S. Committee	Girish Singhal	Towards Clinically Viable Neuroprosthesis	Johns Hopkins University, Biomedical Engineering	2009

Research Narrative:

Neural interfaces hold the promise to become one of the great technological advancements of the 21st century because they directly access and interpret brain activity to restore communication and control in patients with damaged nervous systems. Neurotechnology, broadly defined as the integration of engineering with neuroscience, is the enabling mechanism through which we can create and alternative means for the brain to directly influence itself and the environment. Neural interfaces seek to overcome diseases and disabilities of the nervous system by bypassing damaged tissues in the brain's normal biological pathways (motor system, limbic system, peripheral nervous system, muscles) and replacing them with an engineered system. However, this comes at the high price of beyond state-of-the-art technology. Today, engineers and neuroscientists must join forces to face the great biomedical technical design challenges that include problems of *scale* (accessing millions of neural communication channels), *speed* (coping with the parallel processing capabilities of the brain), *biocompatibility* (interfacing electronics with biological neural tissues), and *bio-signal processing* (neural decoding). These topics have the great potential to help hundreds of thousands of patients and have been of great interest among funding agencies. Neural interface technology is projected to be as large or larger than the cardiac-rhythm management industry; however, new enabling technologies (which are the primary focus of my research interests) are needed to advance the field. Projected overall sales of neural interface technology could balloon from $1.6 billion today to $10 billion in 10 to 15 years (Business Week, March 7, 2005). Leading the neural interface technology drive, we have assembled a multidisciplinary team in the Colleges of Engineering and Medicine to develop new therapies of implantable neural interfaces. My role has been to conduct translational research and bridge the gap between tech development in the animal laboratory

and the clinical bedside. I serve as a primary collaborator in the production of publications, seminars, patent applications, and both extramural and intramural funding.

Major clinical application:

Motor Neuroprosthetics: The long-term goal of this study is to perform the basic science research required for developing the next generation of closed-loop brain-machine interfaces that offer alternative means of communication and control to the disabled. Our work addresses two pillars of neuroprosthetic design from a signal processing and neural engineering perspective: distributed sampling of neural activity directly from the brain and optimizing the interpretation of this information. The research plan is part of a *closed-loop* system where the individual has the ability to interact, respond, and adapt to the neuroprosthetic device using intent derived directly from the brain. This experimental paradigm opens many new questions about neural decoding that were previously unable to be addressed with conventional single electrode, acute techniques.

My laboratory focuses on three major enabling technologies:

(1) *Neural-Electrode Interfaces*: The development of translational neuroprosthetics to aid patients who suffer from neurological disorders hinges on the ability to obtain high-quality chronic neural recordings over a period of years. Long-term viability of chronic invasive neural probes is a necessary condition for extracting robust control signals directly from neural tissue in clinical practice. We have shown that (Patrick, et al., 2006, Sanchez et al., 2006) new interfaces (with flexible customized geometries) can be used to overcome the challenges of chronic implantable neural recording systems. Two patent applications have been filed for this technology.

(2) *Neural Decoding*: By obtaining new approaches for understanding of the cellular mechanisms that underlie changes in brain excitability, it is hoped that new treatment protocols can be established. Using sophisticated methodologies to analyze microelectrode array recordings we have developed innovative approaches for the studying normal and abnormal brain function. To date we have begun to quantify the cellular mechanisms that initiate seizures (Sanchez et al., 2006, Mitzelfelt and Sanchez, 2007) and are able to predict goal directed behavior from human ECoG and animal single neuron activity (Sanchez, et al., 2007, Gunduz et al., 2007, DiGiovanna et al., 2008). Hence, the integration of these sources of information to model will improve the performance of the current generation of BMIs and deepen our understanding of systems based computational neurobiology.

(3) *Therapeutics*: Because of the immediate clinical needs, we are developing new technologies to implement neural interfaces in wireless, portable neural recording systems that can interact with many neurons over extended periods of time. At the University of Florida, we are pursuing multiple paths to ultimately achieve a fully implantable wireless neural recording interface. We have developed a fully implantable wireless recording system (FWIRE) that uses a novel integrate and fire pulse representation (Rogers et al., 2007) for brain-machine interfaces (Bashirullah et al., 2007).

Creative Works or Activities:

1. XM Radio Reach MD - 'Future of Medicine' (view article)

   The Brain Machine Interface
   Download Podcast

2. This Week in Tech (TWIT) - Futures in Biotech (FIB) (view article)

   The Brain Machine Interface
   Download Podcast

3. Diagnosis: Paralysis (Ivanhoe Broadcast)

   Video

4. University of Florida Research Report

   Video

5. Neuroprosthetic that Learns with the Brain (view article)

   Engadget - Researchers devise neural implant that learns over time (link)
   G4 TechTv

6. All in the Mind, Medical Device Developments (view article)

6. Melding Mind and Machine, IEEE The Institute (view article)

Patents and Copyrights:

1. Sanchez, J., Nishida, T. N., Harris, J. G., Principe, J. C., Bashirullah, R., *Wireless Implantable Neural Electrode System,* filed May 23, 2008, UF #12879

Significance: The invention is directed to an implantable neural electrode system. More particularly, the neural electrode system, according to various embodiments, can be characterized as an ultra-low-power wireless implantable neural electrode system. In various embodiments, the system can provide a neural interface that serves as a potential therapy for patients suffering from a host of neurological disorders in the central or peripheral nervous system. The system also can provide a neural interface with neural tissue for recording, as well as stimulating, neural activity in a research subject or patent.

2. DiGiovanna, J. F., Mahmoudi, B. M., Mitzelfelt, J., Sanchez, J. C., Principe, J. C., *Co-adaptive brain machine interface control based on reinforcement learning*, filed April 27, 2007.

Significance: A brain machine interface (BMI) architecture that can translate neural activity into goal directed behaviors without knowledge of the physical manifestation of the behaviors themselves for the control of computers or prosthetic devices. The 'state of the art' currently requires a patient to physically make movements to train the BMI control systems (supervised learning based BMI). Here, we have developed a semi-supervised BMI control architecture that uses reinforcement learning (RL) to co-adaptively find the neural state to motor mapping in goal-directed tasks. This invention addresses an unmet need for BMI users: paralyzed patients (or patients with other motor neuropathies) are unable to generate the movement trajectories necessary for BMI training.

3. Nishida, T. N., Patrick, E., Sanchez, J. C., Provisional Application No. pending entitled *MEMS Flexible Substrate Neural Probe and Method of Fabricating Same*, filed September 11, 2006, UF# 12173; Attorney Docket No. 5853-680P

Significance: For brain machine interfaces, the ultimate application of a fully implantable device warrants the need for integration between the amplifiers and electrode arrays. We designed a novel neural microelectrode that leverages the recording properties of conventional micro-wire electrode arrays with additional features such as the precise control of the electrode geometries and bond pad sites and flexible materials via micromachining. The Electrode arrays have high neuronal yield, which improves the accuracy and performance characteristics.

4. Sanchez, J. C., Carney, P. R., U.S. Provisional Application No. 60/716,863 entitled *Closed-Loop Micro-Control System for Predicting and Preventing Epileptic Seizures*, filed September 14, 2005, UF# 11930, Attorney Docket No.: 63815(49163).

Significance: The invention generally relates to the prediction and intervention of seizures in subjects with epilepsy and related disorders. The device could help to revolutionize the treatment of many forms of intractable epilepsy in humans.

This patent is currently being pursued by Roy Chen, CEO Spineview, who is seeking to raise $15 million in venture capital for a startup company.

5. Nishida, T. N., Xie, H., Patrick, E., Sanchez, J. C., Provisional Application No. 60/686,275 entitled *Neural Probe and Methods for Manufacturing Same*, filed June 1, 2005, UF# 11863; Attorney Docket No. 5853-628P.

Significance: This device allows patients suffering from movement disabilities, such as those resulting from spinal cord injury or stroke, to regain mobility. This interface design collects and can actively target neural activity information directly from the cortex, interprets it, and delivers therapy via an electronic interface.

Publications

* after a name indicates a graduate/medical student

Books, Co-Authored:

[1] J. C. Sanchez and J. C. Principe, *Brain-Machine Interface Engineering*. New York: Morgan and Claypool, 2007.

Books, Contributor of Chapter(s):

[1] J. C. Sanchez and J. C. Principe, "Optimal Signal Processing for Brain-Machine Interfaces," in Handbook of Neural Engineering, M. Akay, Ed. New York: Wiley, 2006.

Refereed Publications:

See last section for submitted publications.

Refereed-Journals

[1] Y Wang*, J. C. Principe, and J. C. Sanchez, "Ascertaining Neuron Importance by Information Theoretical Analysis in Motor Brain Machine Interfaces," Neural Networks, vol. in press, 2009.
[2] A. Gunduz*, J. C. Sanchez, P. R. Carney, J. C. Principe, "Mapping Broadband Electrocorticographic Recordings to Two-Dimensional Hand Trajectories in Humans," Neural Networks special issue on Brain-Machine Interfaces, in press, 2009.
[3] J. C. Sanchez, B. Mahmoudi*, J. DiGiovanna, J. C. Principe, "Exploiting Co-Adaptation for the Design of Symbiotic Neuroprosthetic Assistants," Neural Networks special issue on Goal-Directed Neural Systems, vol. 22, pp. 305-315, 2009.
[4] Y. Wang*, J. C. Principe, A. R. C. Paiva* and J. C. Sanchez, "Sequential Monte Carlo Estimation of Neural Spiking Activity for Motor Brain Machine Interfaces," Neural Computation, vol. 21(10), 2009.
[5] J. DiGiovanna*, B. Mahmoudi*, J. Fortes, J. C. Principe, and J. C. Sanchez, "Co-adaptive Brain Machine Interface via Reinforcement Learning," IEEE Transactions on Biomedical Engineering (Special issue on Hybrid Bionics), vol. 56, pp. 54-64, 2009.
[6] D. Wang*, J. C. Sanchez, K. Foote, A. Sudhyadham, T. Bhatti, S. Lewis, M. Okun, "Failed DBS for Palliation of Visual Problems in a Case of Oculopalatal Tremor," Parkinsonism and Related Disorders, vol. 5(1), pp. 71-73, 2009.
[7] J. C. Sanchez, J. C. Príncipe, T. Nishida, R. Bashirullah, J. G. Harris, and J. Fortes, "Technology and Signal Processing for Brain-Machine Interfaces: The need for beyond the state-of-the-art tools," IEEE Signal Processing Magazine, vol. 25(1), pp. 29-40, 2008.

[8] J. C. Sanchez, A. Gunduz*, P. R. Carney, and J. C. Principe, "Extraction and localization of mesoscopic motor control signals for human ECoG neuroprosthetics," Journal of Neuroscience Methods – Special Issue on BCI, vol. 167, pp. 63-81, 2008.
[9] J. Cho, A. R. C. Paiva*, S.-P. Kim, J. C. Sanchez, and J. C. Principe, "Self-organizing maps with dynamic learning for signal reconstruction," *Neural Networks,* vol. 20, pp. 274-284, 2007.
[10] S. P. Kim, J. C. Sanchez, and J. C. Principe, "Real time input subset selection for linear time-variant MIMO systems," Optim. Methods Softw., vol. 22, pp. 83 - 98, 2007.
[11] J. C. Sanchez, N. Alba*, T. Nishida, C. Batich, and P. R. Carney, "Structural modifications in chronic microwire electrodes for cortical neuroprosthetics: a case study," IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 14(2), pp. 217-221, 2006.
[12] J. Graff-Radford*, K. D. Foote, R. L. Rodriguez, H. H. Fernandez, R. Hauser, A. Sudhyadhom, C. A. Rosado, J. C. Sanchez, and M. S. Okun, "Deep Brain Stimulation of the Internal Segment of the Globus Pallidus in Delayed Runaway Dyskinesia," Archives of Neurology, vol. 63, pp. 1181-1184 2006.
[13] J. C. Sanchez, Thomas H. Mareci, Wendy M. Norman, Jose C. Principe, William L. Ditto, and Paul R. Carney, "Evolving into Epilepsy: Multiscale Electrophysiological Analysis and Imaging in an Animal Model," *Experimental Neurology*, vol 198(1), pp. 31-47 2006.
[14] S. P. Kim, J. C. Sanchez, Y. N. Rao, D. Erdogmus, J. C. Principe, J. M. Carmena, M. A. Lebedev, and M. A. L. Nicolelis, "A Comparison of Optimal MIMO Linear and Nonlinear Models for Brain-Machine Interfaces," *Journal of Neural Engineering*, vol. 3, pp 145-161, 2006.
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Refereed - Full Length Conference Papers

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[9] S.-F. Yen*, J. Xu *, M. Rastogi*, J. G. Harris, J. C. Principe, J. C Sanchez, "An integrated recording system using an asynchronous pulse representation," IEEE Neural Engineering Conference, Antalya, Turkey, 2009.
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Abstracts

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Lectures, Speeches Or Posters Presented At Professional Conferences/Meetings Since UF Employment

LECTURES:

a. International:

2009 Invited Panel Member, "Brain Machine Interfaces – A New Research Avenue for Cybernetics and System Science," International IEEE Conference on Systems, Man, and Cybernetics, San Antonio, TX

"Co-Evolution of Human and Machine: How Cybernetics has Impacted Neuroprosthetic Design"

2009 Workshop Beyond Brain Machine Interface: Motor, Cognitive, Virtual, IEEE International Conference of the Engineering in Medicine and Biology Conference, Minneapolis, MN,

"Cognitive Integration of Prosthetic Devices: Is it Feasible?"

2009 Invited Lecture, United Therapeutics – 2nd Annual Unither Nanomedical & Telemedical Technology Conference, Quebec, Canada

"Direct Brain-Machine Interfaces"

This talk will present new neurotechnologies for brain-machine interface (BMI) systems in humans. Included are techniques for neurophysiologic hardware design and methods for determining representation in multiscale signals for deriving communication and control. A new framework for continuous decoding based on reinforcement learning (RL) will be presented and it will be shown how principles of neural control can be studied through co-adaptive interaction between the user and the neural interface.

2008 Invited Lecture, Ohio State University Mathematical Biosciences Institute – Workshop on Real Time Brain Interfacing Applications, Columbus, Ohio

"Continuous Decoding of Intracortical Signals"

Closed-loop neural interfaces are one of the most exciting emerging technologies to impact biomedical research, human health, and rehabilitation. By combining engineering and neurophysiologic knowledge into bio-interactive brain-machine interfaces (BMI), a new generation of medical devices is being developed to functionally link large ensembles of neurons in the central nervous system (CNS) directly with man-made systems. This talk will present overview of the design and analysis of decoding methodologies for closed-loop BMI systems. Included are techniques for neurophysiologic feature detection and methods for determining representation in multiscale signals. Within the context of these traditional decoding approaches, a new method of continuous decoding based on reinforcement learning (RL) will be presented. New principles of neural control will be developed as they are learned through experience and interaction with the environment. It will be shown how a theory and method of co-adaptive shaping using RL to achieve brain control of a prosthetic enables the development of complex tasks while reducing the "learning curve" for patients using a BMI.

2008 Invited Lecture, Ohio State University Mathematical Biosciences Institute – Workshop on Real Time Brain Interfacing Applications, Columbus, Ohio

"The onset of seizure: New perspectives from neural ensemble activity *in vivo*"

The state-of-the-art in clinical epilepsy stimulation is faced with the challenge of specifying why some epileptic individuals respond to stimulation treatment and why others don't. To address this issue, we are investigating a chronic animal model of temporal lobe epilepsy to develop new treatments for the human condition. Here, we seek to advance the knowledge and technologies needed to produce more effective therapeutic stimulation paradigms by studying the onset of seizure from multiple neurophysiologic scales that are simultaneously recorded: single neuron, multiunit activity, and local fields. Our recent studies have shown that abnormal neuromodulation in pyramidal cells, interneurons, and population spikes occur in advance of impending seizures in the animal model.

2007 EMBC Workshop on Brain-Computer Interfaces: Neurotechnology for Artificial Implants and Neural Prosthesis, IEEE Engineering in Medicine and Biology Conference (Co-organizer), Leon, France

Description:

Brain-Computer Interfaces (BCI) communicate directly with the nervous system to provide lost sensory input, repair connectivity between brain structures, or translate intention of movement to treat the paralyzed, blind, and deaf. The development of neural interface technology has grown exponentially over the last decade and continues to attract new researchers from multiple disciplines with expertise in biomaterials, signal processing, neurophysiology, mathematics, psychology, and robotics to name a few. BCIs utilize novel neurotechnologies including MEMS, neural signal processing, VLSI circuitry, and DSPs to bypass and restore function to damaged neural tissue or to augment existing neural systems. The vision of this workshop is to address the next "grand challenges" of brain-computer interfaces for scaling the computational abilities of encoding/decoding systems, innovating the realism of neural engineered systems, and establishing new bi-directional neural signal interfaces. This workshop will also overview the world state-of-the-art in BCI including recent innovations and contributions from in data driven experimental paradigms in special issues of the IEEE TNSRE and TBME, WTEC, and the Wadsworth Center.

2007 Workshop on Innovation in Computational Approaches for Brain-Machine Interfaces, International Joint Conference on Neural Networks (Co-organizer), Orlando, Florida

Description:

Brain-Machine Interfaces (BMI) communicate with the nervous system to provide lost sensory input, repair connectivity between brain structures, or translate intention of movement to treat the paralyzed, blind, and deaf. They require beyond state of the art electronics and data processing methods to effectively interact with the nervous system. Underlying these applications, we will discuss the computational challenges for understanding how individual neurons, neural circuits, and systems interact through spikes, LFPs, ECoGs, EEGs, and EMG to produce behavior. This workshop will also study recent innovations including the use of data driven experimental paradigms in animals and humans to improve the fundamental concepts and computational modeling framework for explaining the physiological relationships in real neural and behavioral datasets. New quantitative tools to extract and represent control features from multivariate datasets will be introduced.

2006 Invited Lecture, "Chronic, Multisite, Microelectrode Recording in Temporal Lobe Epilepsy: Challenges and Implications for the Study of Spontaneous Seizures," Annual Meeting of the American Epilepsy Society, Engineering and Epilepsy Special Interest Group Sensing the Brain in Epilepsy: Materials and Methods, San Diego, CA

2006 Invited Panel Member, "Choosing Multiscale Recordings for Epilepsy Research," NIH sponsored Second International Seizure Prediction Workshop, Seizure Generation: The Role of High Frequency Activity, Bethesda, MD

b. National:

2008 Invited Lecture, "Neuroprosthetic Design for Restoring Motor Function after Spinal Cord Injury," Johns Hopkins University, Baltimore, MD

2006 Invited Lecture, "Selecting State Variables for ECoG Neuroprosthetics," Neuroengineering Now, University of Texas at Dallas, Dallas, TX

2006 Invited Lecture, "Choosing the Appropriate Level of Abstraction for Brain-Machine Interfaces:
Data Collection and Analysis Insights," Conference on Data Mining, Systems Analysis, and Optimization in Neuroscience, University of Florida, Gainesville, FL

c. State:

2008 Invited Lecture, "Brain-Machine Interfaces for Restoring Motor Function after Spinal Cord Injury," Miami Project to Cure Paralysis, University of Miami, Coral Gables, FL

d. Local:

2009 Invited Lecture, "Brain-Machine Interfaces," Department of Physical Therapy, Neuroplasticity and Rehabilitation Course, University of Florida, Gainesville, FL

2009 Invited Lecture, "Translating Thought into Action: A Computational Neuroscience Perspective," Department of Neuroscience, Educational and Research Retreat, University of Florida, Gainesville, FL

2008 Invited Lecture, "Brain-Machine Interfaces for Restoring Motor Function after Spinal Cord Injury," Department of Physical Therapy, Rehabilitation Research Seminar Series, University of Florida, Gainesville, FL

2008 Invited Lecture, "Co-Adaptive Motor Control through Neuroprosthetic Interfaces," Center for Neuropsychological Studies Lecture Series, University of Florida, Gainesville, FL

2008 Invited Lecture, "Brain-Machine Interfaces for Restoring Motor Function after Spinal Cord Injury," Brain Rehabilitation Research Center, University of Florida, Gainesville, FL

2007 Organization of Engineering in Medicine and Biology Society (EMBS) Lecture Series – Guest Speaker Yongmin Kim – Past President of the IEEE EMBS, "Bioengineering, Translational Research, and Technology Commercialization"

2007 Invited Lecture "Translational Neuroprosthetic Research," Howard Hughes Science for Life Seminar Series, University of Florida, Gainesville, FL

2007 Invited Lecture "Overview of Neuroprosthetic Research," Department of Biomedical Engineering, Biomedical Engineering Society, University of Florida, Gainesville, FL

2006 Organization of Engineering in Medicine and Biology Society Lecture Series – Guest Speaker Walter Freeman – Professor of the Graduate School, "Contrasting the Roles of Cognition and Causality in Medicine, Engineering, and Biology"

2006 Workshop on Quantitative Neuroscience: Models, Algorithms and Applications, Guest Rodolfo Llinas (Co-organizer), Gainesville, Florida

2006 Invited Lecture, "Overview of Neuroprosthetic Research," Interdisciplinary Program in Biomedical Sciences Seminar, University of Florida, Gainesville, FL

2006 Invited Lecture, "Neuroprosthetics and Epilepsy: A Multiscale Approach," University of Florida Epilepsy Working Group, University of Florida, Gainesville, FL

2006 Invited Lecture, "Neuroprosthetic Design for the 21st Century," BME Seminar Series, Department of Biomedical Engineering, University of Florida, Gainesville, FL.

2006 Invited Lecture, "Current Controversies in Neuroscience and Behavior, Translating Thought into Action," Department of Psychology, University of Florida, Gainesville, FL

ORAL CONFERENCE PRESENTATIONS:

a. International:

[1] B. Mahmoudi*, and J. C. Sanchez, "Completing the Loop: A Perception-Action Perspective on Neural Interface Design," International Conference of the Biomedical Engineering Society, Pittsburgh, PA, 2009.
[2] J. C. Sanchez, and J. C. Principe, "Prerequisites for Symbiotic Brain-Machine Interfaces," in International IEEE Conference on Systems, Man, and Cybernetics, San Antonio, TX, 2009.
[3] J. C. Sanchez, R. Figueiredo, J. Fortes, J. C. Principe, "Development of symbiotic brain-machine interfaces using a neurophysiology cyberworkstation," International Conference on Human Computer Interaction, San Diego, CA, 2009. (invited)
[4] J. C. Sanchez, J. C. Principe, J. Digiovanna*, and B. Mahmoudi*, "Co-Adaptive Brain-Machine Interfaces via Reinforcement Learning," in Conference on Computational Neuroscience, Gainesville, FL, 2008. (invited)
[5] J. DiGiovanna*, L. Marchal, P. Rattanatamrong*, M. Zhao*, S. Darmanjian*, B. Mahmoudi*, J. C. Sanchez, J. C. Principe, L. Hermer-Vazquez, R. Figueiredo, and J. Fortes, "Towards Real-Time Distributed Signal Modeling for Brain Machine Interfaces," in International Conference on Computational Science, Beijing, China, 2007.
[6] 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 the Pico System," in 3rd International IEEE EMBS Conference on Neural Engineering, Kohala Coast, Hawaii, 2007.
[7] C. L. Rogers*, J. G. Harris, J. C. Principe, and J. C. Sanchez, "A Pulse-Based Feature Extractor for Spike Sorting Neural Signals," in 3rd International IEEE EMBS Conference on Neural Engineering, Kohala Coast, Hawaii, 2007.
[8] J. DiGiovanna*, B. Mahmoudi*, J. Mitzelfelt*, J. C. Sanchez, and J. C. Principe, "Brain-Machine Interface Control via Reinforcement Learning," in 3rd International IEEE EMBS Conference on Neural Engineering, Kohala Coast, Hawaii, 2007.
[9] A. R. C. Paiva*, J. C. Principe and J. C. Sanchez, "Compression of Spike Data Using the Self-Organizing Map" accepted at the IEEE EMBS Neural Engineering Conference, Washington D. C., 2005.
[10] J. Pukala*, J. C. Sanchez, J. C. Principe, F. J. Bova, and M. S. Okun, "Linear Predictive Analysis for Targeting the Basal Ganglia in Deep Brain Stimulation Surgeries," accepted at the IEEE EMBS Neural Engineering Conference, Washington D. C., 2005.
[11] J. C. Sanchez, J. C. Principe, and P. R. Carney, "Is Neuron Discrimination Preprocessing Necessary for Linear and Nonlinear Brain Machine Interface Models?" accepted to 11th International Conference on Human-Computer Interaction, 2005
[12] J. C. Sanchez, P. R. Carney, and J. C. Principe, "Analysis of Amplitude Modulated Control Features for ECoG Neuroprosthetics," in IEEE International Conference of the Engineering in Medicine and Biology Society, 2006.
[13] Y. Wang*, J. C. Sanchez, J. C. Principe, J. D. Mitzelfelt*, and A. Gunduz*, "Analysis of the Correlation between Local Field Potentials and Neuronal Firing Rate in the Motor Cortex," in

IEEE International Conference of the Engineering in Medicine and Biology Society, New York, 2006.

POSTER PRESENTATIONS:

a. International:

[1] B. Mahmoudi*, J. DiGiovanna, J. C. Principe, J. C. Sanchez, "Extracting Goal Information from Nucleus Accumbens for Brain-Machine Interface Design," International Conference on Cognitive and Neural Systems, Boston, MA, 2009.
[2] S. Yen*, D. Shoonover*, J. C. Sanchez, J. C. Principe, J. G. Harris, "Differential EEG," IEEE Neural Engineering Conference, Antalya, Turkey, 2009.
[3] S. Craciun*, D. Cheney*, K. Gugel, J. C. Sanchez, J. C. Principe, "Compression of neural signals using discriminative coding for wireless applications," IEEE Neural Engineering Conference, Antalya, Turkey, 2009.
[4] S.-F. Yen*, J. Xu *, M. Rastogi*, J. G. Harris, J. C. Principe, J. C Sanchez, "An integrated recording system using an asynchronous pulse representation," IEEE Neural Engineering Conference, Antalya, Turkey, 2009.
[5] E. Patrick*, V. Sankar*, W. Rowe*, J. C. Sanchez, T. Nishida, "Design of an implantable intracortical microelectrode system for brain-machine interfaces," IEEE Neural Engineering Conference, Antalya, Turkey, 2009.
[6] J. Digiovanna*, B. Mahmoudi*, J. Fortes, J. C. Principe, J. C. Sanchez, "Co-Adaptive Brain-Machine Interfaces via Reinforcement Learning," in NIH Neural Interfaces Conference, Cleveland, OH, 2008.
[7] B. Mahmoudi*, J. Digiovanna*, J.C. Principe, J. C. Sanchez, "Neuronal Shaping in a Co-Adaptive Brain-Machine Interface," in Computational and Systems Neuroscience, Salt Lake City, UT, 2008.
[8] J. Mitzelfelt*, W. Yan*, J. C. Principe, J. C. Sanchez, "Simultaneous Analysis of Population Spikes and Single Neuron Activity *In Vivo* at the Onset of Seizure," in 3rd International Workshop on Epileptic Seizure Prediction, Freiberg, Germany, p. 45, 2007.
[9] J. Mitzelfelt* and J. C. Sanchez, "Are the Spatio-Temporal Firings of Pyramidal Cells and Interneurons Markers of Impending Seizures?," in 3rd International IEEE EMBS Conference on Neural Engineering, Kohala Coast, Hawaii, 2007.
[10] J. C. Sanchez, Z. Liu, and P. R. Carney, "Identifying the Seizure Onset Zone using Amplitude Modulated Slow Potentials, Gamma, Fast Gamma, and Neural Ensemble Activity," in 60th Annual Meeting of the American Epilepsy Society, San Diego, CA, 2006.
[11] G. Cieslewski*, D. Cheney*, K. Gugel, J. C. Sanchez, and J. C. Principe, "Neural Signal Sampling via the Low Power Wireless Pico System," in IEEE International Conference of the Engineering in Medicine and Biology Society, New York, 2006.
[12] J. C. Sanchez, P. R. Carney, T. H. Mareci, and W. M. Norman, "Multiscale Electrophysiological Analysis and Imaging in an Animal Model of Limbic Epilepsy," in 59th Annual Meeting of the American Epilepsy Society, Washington, D.C., 2005. (invited to the Investigators Workshop)

Contracts and Grants:

a. Funded Externally

Title: DDDAS-TMRP: Dynamic Data-Driven Brain-Machine Interfaces
Effective Dates: 2006-2008
Funding Agency: NSF (CNS-0540304)
Total Award: $936,000

Title: An Ultra-Low Power Wireless Neural Recording Implant Based on a Novel Pulse Representation
Effective Dates: 2007-2011
Funding Agency: NIH/NIBIB (1R01- NS053561-01A2)
Total: $1,610,076

Title: MRI: Acquisition of Biocomputing Cyberinfrastructure for Coupled Experimental-Computational Research
Effective Dates: 7/1/2008-6/3/2012
Funding Agency: NSF (MRI NSF 08-503)
Total Award: $1,311,108

b. Funded Internally

Title: A Neuroprosthetic Training System (NETS): Using Virtual Reality to Treat Paralysis
Effective Dates: 6/1/2009-6/1/2011
Funding Agency: UF
Total Award: $63,271

Title: Development and Initial Validation of a Swallow Frequency Meter
Effective Dates: 6/1/2009-6/1/2010
Funding Agency: UF Clinical and Translational Science Institute
Total Award: $24,720

Title: Howard Hughes Medical Institute: Group Advantaged Training of Research
Effective Dates: 1/1/2009-1/1/2010
Funding Agency: HHMI
Mentor to Babak Mahmoudi
Total Award: Half-time summer research assistantship with tuition waiver

Title: Restoration of Interneurons in an Animal Model of Cortical Dysplasia
Effective Dates: 2006
Funding Agency: McKnight Brain Institute Research Initiative, University of Florida
Total Award: $30,000

Title: Neurorehabilitative Technologies for the Treatment of Neurologic Disorders
Effective Dates: 2005
Funding Agency: Children's Miracle Network (CMN)
Total Award: $18,000

Title: Neurorehabilitative Technologies for the Treatment of Neurologic Disorders
Effective Dates: 2005
Funding Agency: Brain and Spinal Cord Injury Rehabilitation Trust Fund (BSCIRTF)
Total Award: $15,000

University Governance and Service:

University of Florida College of Engineering

2006-Present	Advisory Board Member, Data Mining, Systems Analysis and Optimization in Neuroscience, University of Florida, College of Engineering and McKnight Brain Institute

University of Florida College of Medicine

2005-Present	Ad Hoc Interviewer, Interdisciplinary Program in Biomedical Sciences, University of Florida

Editor of Scholarly Journal Service on an Editorial Advisory Board or Reviewer for a Scholarly Journal:

Associate Editor:

2009-Present	*IEEE Transactions on Neural Systems and Rehabilitation Engineering*
2006-Present	*Open Biomedical Engineering Journal*
2005-Present	*Computers in Biology and Medicine*

Reviewer:

2009-Present	*Frontiers in Physiology* (1-2 papers/yr)
2009-Present	*Computational Intelligence and Neuroscience* (1-2 papers/yr)
2009-Present	*IEEE Transactions on Signal Processing* (1-2 papers/yr, 2.335)
2009-Present	*EURASIP Journal on Advances in Signal Processing* (1-2 papers/yr, 1.055)
2008-Present	*NeuroImage* (1-2 papers/yr, 5.694)
2008-Present	*Spinal Cord* (1-5 papers/yr, 2.071)
2008-Present	*Journal of Biological Chemistry* (1 paper/yr, 5.520)
2006-Present	*Open Biomedical Engineering Journal* (1-5 papers/yr)
2005-Present	*Computers in Biology and Medicine* (5-10 papers/yr, 1.272)
2005-Present	*Journal of Neural Engineering* (reviewer, 1 - 3 papers/yr, 2.737)
2005-Present	*Neurocomputing* (reviewer, 0-3 papers/yr, 1.234)
2004-Present	*IEEE Trans Neural Networks* (reviewer, 0-3 papers/yr, 3.726)
2004-Present	*IEEE Trans Neural Systems & Rehabilitation Engineering* (reviewer, 1-3 papers/yr, 2.934)
2003-Present	*IEEE Trans Biomedical Engineering* (reviewer, 1-3 papers/yr, 2.496)
2003-Present	*International Joint Conference on Neural Networks* (reviewer, 5-15 papers/yr)
2003-Present	*Engineering in Medicine and Biology Conference* (reviewer, 5-15 papers/yr)
2003-Present	*Neural Engineering Conference* (reviewer, 5-25 papers/yr)

Service to Schools

2007-Present	School Advisory Committee – Terwilliger Elementary, Gainesville, FL
2006	Terwilliger Elementary: Careers in Science Day, Gainesville, FL

Membership and Activities in the Profession:

<u>Professional Societies</u>

2007-Present	Member, InnerSpace Foundation
2005-Present	Member, American Epilepsy Society
2000-Present	Member, Institute of Electrical and Electronics Engineers (IEEE)
2000-Present	Member, Engineering in Medicine and Biology Society (EMBS)

Technical and Scientific Committees

2009	Program Committee: 4th International Conference on Neural Engineering
2006	Program Committee: 3rd International Conference on Neural Engineering
2006	Associate Editor: 3rd International Conference on Neural Engineering
2006	Session Co-Chair, Engineering in Medicine and Biology Conference, Neuromuscular Control: Central Mechanisms

Grant Review

2009	Grant Review Panel: ZRG1 ETTN-A (58) R RFA OD09-003 Challenge Grants Panel # 12
2009	Grant Review Panel: NIH ZRG1 ETTN-C (02) M, Clinical Neurophysiology, Devices, Auditory Devices and Neuroprosthesis SEP
2009	Grant Review Panel: US Army Medical Research and Material Command (USAMRMC)
2008	Grant Review Panel: NIH ZRG1 ETTN-E 10 S, Clinical Neurophysiology, Devices, Auditory Devices and Neuroprosthesis Small Business SEP
2008	Grant Review Panel: The Wellcome Trust
2007	Grant Review Panel: Portuguese Science and Technology Ministry
2005	Grant Review Panel: National Sciences and Engineering Research Council of Canada

Professional Institutes

2005	Active Member, McKnight Brain Institute, University of Florida

Honors:

2005	American Epilepsy Society Young Investigator Award
2005	IEEE Excellence in Neural Engineering Award

Further Information:

Refereed-Journals – Submitted

[1] S Craciun*, D Cheney*, K. Gugel, J. C. Sanchez, and J. C. Principe, "Wireless Transmission of Neural Signals using Feature-Based Compression," IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. submitted, 2009.
[2] C. L. She, J. G. Harris, J. C. Principe, and J. C. Sanchez, "An Ultra-low Power Pulse-Based Feature Extractor for Spike Sorting Neural Signals,", submitted, 2009.
[3] J. DiGiovanna*, P. Rattanatamrong*, M. Zhao*, B. Mahmoudi*, L. Hermer-Vazquez, R. Figueiredo, J. C. Principe, J. Fortes, and J. C. Sanchez, "Cyber-Workstation Architecture for Computational Neuroscience," Frontiers in Computational Neuroscience, vol. submitted, 2009.