Pruitt Research Day

Celebrating the next generation of Biomedical Engineers and Scientists

Monday, November 19th, 2012

Schedule of Events

Welcome	8:45 - 8:55 am
Student Talks	8:55 - 10:15 am
Session 1 Chair: Dr. Huabei Jiang	
Xiaoqi Li – Jiang Laboratory	
David Stanley – Carney Laboratory	
Jihae Bae – Principe Laboratory	
Matthew Maynard – Bolch Laboratory	
Coffee Break	10:15 - 10:40 am
Student Talks	10:40 – noon
Sesion 2 Chair: Dr. Brandi Ormerod	
Matthew Carsten – Keselowsky Laboratory	
Rachel Speisman – Ormerod Laboratory	
Cassandra Juran – McFetridge Laboratory	
Sruthi Bharadwaj – Glover Laoratory	
Lunch Break	noon - 1 pm
Keynote - Dr. David Greenspan	1:00 - 2:00 pm
Poster Session	2:00 – 4:00 pm

Talks will be held in Communicore Room C1-9

Poster Session will be held in the Biomedical Sciences Building Lobby

ENGINEERS *for* LIFE.

Dr. Pruitt was a visionary leader for the J. Crayton Pruitt Family Department of Biomedical Engineering. He made multiple gifts endowing the department, including professorships, to enable our recruiting of world-class talent to Gainesville. The department endowment has been essential to the development of the careers of our faculty and our graduate students, helping us to meet the tremendous need for biomedical engineering research and the demand from students for a first class education.

Unfortunately Dr. Pruitt did not live to see the first undergraduates enroll and graduate from his department – we're sure he would have been very proud of how these young women and men will go out into the world to create new technologies and solve important problems in the delivery of health care.

Dr. Pruitt remained actively engaged with the department. This was clear from his last Advisory Board meeting where he continually engaged the faculty in discussions of their scientific work and its implications for health care delivery.

Dr. Pruitt also leaves a legacy as a Biomedical Engineer, having invented a device, the *Pruitt-Inahara Shunt* that substantially changed the practice of heart surgery. We are mindful that he has inspired us by professional example as well as by his vision for our department.

1:00 – 2:00 pm

KEYNOTE ADDRESS:

The Commercialization of Research
– Musings of a Beaten-up (and Sometimes Successful) Entrepreneur

Dr. David Greenspan

There are hundreds of courses in colleges and universities, even in high schools that focus on entrepreneurism and building businesses. There are literally thousands of books that touch on that subject. Yet, the road to business success is littered with a great many ventures that have failed, or are maimed in some manner. Yet despite the odds and the trials and travails of starting up a company, the numbers show that small businesses are popping up in greater numbers than ever. This lecture is not an attempt to give you a recipe for success – there is no 'recipe'. This talk, rather, will take you through some of the real world experiences in a number of various ventures with the hope that some idea, experience or statement will have an impact on those in the audience that are future (or current) entrepreneurs.

Dr. Greenspan received his Ph.D. in Materials Engineering from the University of Florida. In his 30+ years of experience in biomedical engineering, Dr. Greenspan holds more 20 patents and has served many roles in companies like RTI Biologics, Inc., NovaMin Technologies, Inc. and Tutogen Medical. He is currently a member of Synogen and President of Spinode Consulting.

STUDENT TALKS (8:55 – noon in the Communicore building Room C1-9)

Session 1 Chair: Dr. Huabei Jiang

8:55 am **Integrated diffuse optical tomography and photoacoustic tomography**
Xiaoqi Li
Dr. Huabei Jiang

We designed, fabricated and tested a novel imaging system that fuses diffuse optical tomography (DOT) and photoacoustic tomography (PAT) in a single platform. This platform takes advantages of both DOT and PAT, and can potentially provide dual-modality two-dimensional functional and cellular images of the breast quantitatively.

9:15 am **Circadian dysfunction in a rat model of temporal lobe epilepsy**
David Stanley
Dr. Paul R. Carney

Through a series of studies that include EEG signal analysis, MRI-based structural characterization, and biophysical computer modeling, we provide evidence that circadian regulation becomes disorganized in a pre-clinical animal model of injury-induced temporal lobe epilepsy. We extracted features of neural activity from chronic hippocampal EEG recording and measured the 24-hour rhythms of this activity. We report the following findings: 1) multiple features of the hippocampal EEG, namely low-gamma (20 – 65 Hz) rhythms and also hippocampal EEG SPKs, exhibit a phase shift of ~12 hours following injury; 2) the 24-hour modulation of hippocampal EEG power in the theta frequency band is significantly reduced following injury; 3) global markers of circadian rhythms, such as core body temperature (CBT) and hippocampal state transitions, are unperturbed. Together, these findings suggest that local circadian regulation in the hippocampus is altered, while global rhythms remain intact. We hypothesized that this may be caused by damage to specific centers responsible for relaying circadian information to the hippocampus. To investigate this we first showed using a biophysical model how such damage could translate into a circadian phase shift. Secondly, we provided MRI-based evidence that the medial septum, a putative circadian relay center, experiences significant damage in epileptic rats and may be the source of the disrupted circadian modulation. Together, these findings suggest a specific mechanism by which circadian dysfunction emerges in epilepsy. We conclude by presenting data for animals that received epileptogenic injury, but that did not successfully develop epileptic seizures. We show that, unlike the seizing group, these animals did not exhibit a significant phase shift in the circadian rhythm of their hippocampal neural activity. In light of these findings, we discuss mechanisms by which circadian dysfunction may have direct epileptogenic effects.

9:35 am **Kernel Temporal Differences in Reinforcement Learning Brain Machine Interfaces**
Jihye Bae
Dr. Jose C. Principe

Reinforcement learning brain machine interfaces (RLBMI) allow for co-adaptive learning between the machine and the brain. It has been observed that the RLBMI framework can be used for neural decoding. Nevertheless, it has been noticed that in practice, linear models do not fit well the evolution of neural states, so nonlinear models should be considered. Kernel methods have been shown to be powerful alternatives for solving nonlinear problems and usually bring good generalization. Here, we develop a kernel based approach to temporal difference learning, using a kernel adaptive filter architecture that employs stochastic gradient on temporal differences, kernel Temporal Difference (KTD) (λ), to estimate the value functions in reinforcement learning. We compare the performance of KTD with other kernel based value function approximation methods such as kernel based least squares temporal difference (KLSTD) and Gaussian process temporal difference (GPTD) on a synthetically generated absorbing Markov chain to estimate state value function. Although convergence rate of KTD is slower than KLSTD, KTD has the advantage of lesser computational complexity of learning (O(N^2)), which makes KTD a better candidate for online learning. KTD is applied to two RLBMI experiments performed by a monkey: center-out reaching task and a Go/No go task. First, we apply KTD to open loop RLBMI problems. Results show the method can effectively learn the brain-state to action mapping for the tasks. Also, KTD displays faster convergence in finding the appropriate brain signal mapping as well as improved accuracy than a conventional approach using a time delay neural network (TDNN) trained with backpropagation of the temporal difference error. Finally, KTD is implemented on a closed loop RLBMI problem (Go/No go task) performed by a monkey. The Results show that KTD is able to find proper neural state to action mapping encouraging its application to more realistic scenarios.

9:55 am **Potential Tracking of Fetal Organ Dose During Medical Imaging of the Pregnant Female with the UF Series of Computational Pregnant Female Phantoms**
Matthew Maynard
Dr. Wesley Bolch

Pregnant females may undergo a variety of medical imaging procedures wherein organs of the developing fetus receive doses from ionizing radiation. Quantifying radiation dose to the fetus, from either unintentional or emergency-based medical imaging of the mother, is critical for documenting exposure and for making critical decisions regarding fetal health. This study improves upon previous anatomic and dosimetric models of the pregnant female and developing fetus by constructing a series of pregnant female computational models capable of organ-level and bone-specific radiation dose assessments for both fetus and mother. CT image sets of pregnant mothers at fetal gestational ages spanning normal pregnancy were obtained from the PACS archives of Shands Hospital (Gainesville, FL) and reviewed by a qualified radiologist for normalcy of gross maternal and fetal anatomy. For each image set, soft tissue organs of interest were contoured, reviewed for accuracy, and inserted as 3D volumes into the abdominal region of a computational model of the adult non-pregnant human female previously developed at the University of Florida. A series of eight fetal computational models spanning the range of normal gestational ages was recently developed at UF and is capable of organ-level and bone-specific quantification of radiation doses. Each of these fetal models was inserted into the gravid uterus of the corresponding female model. The completed series of pregnant female computational models accurately represents both maternal and fetal anatomy for the purposes of assessing radiation doses from CT, interventional fluoroscopy, and nuclear medicine imaging, and is therefore a valuable tool for quantifying radiation doses to individual organs during diagnostic imaging.

Session 2 Chair: Dr. Brandi Ormerod

10:40 am **Drug-Eluting Microarrays**
Matt Carstens
Dr. Ben Keselowsky

Microarray technology has emerged as a valuable tool in biological sciences, particularly for high-throughput applications. While small molecule microarrays have demonstrated their capacity to screen a large variety of drugs on a small cell population, a microarray consisting of discreet islands of cells, thereby mitigating potential cross talk and diffusion concerns, has yet to be shown. An application for such technology would be to screen drug efficacy on rare cell populations. Patient-derived colon cancer stem cells are one such population, having only recently been recognized as a potential cause of colon cancer with several cell markers identified. As such, this cell population has been targeted for future therapeutics. One approach to therapy lies in manipulating signaling pathways, which govern self-renewal. Toward this aim, here we report a method for performing such analyses on HCT116 cells, a well characterized epithelial colon cancer cell line, with future studies directed at colon cancer stem cells isolated from human patients. Cellular microarrays can be manufactured in a robust fashion. The tightly controlled specificity of cell attachment allows for co-localization of cells with drug releasing polymer while eliminating cross-talk between islands. Small molecules have been shown to exhibit release profiles consisting of a burst release for 24 hrs, and can be delayed by over-spotting of blank polymer. Proliferation of HCT116 cells was characterized via cell populations on the drug-eluting islands in a dose-dependent manner. Apoptosis was quantified via Annexin V. Ongoing studies are testing the efficacy of drug release and cellular uptake of a library of small molecules on drug-loaded cellular arrays by quantifying apoptosis and proliferation.

11:00 am **Predicting cognitive aging using inflammatory biomarkers**
Rachel Speisman
Dr. Brandi K. Ormerod

Neuroinflammatory genes are upregulated with age most robustly in rats that exhibit impaired memory across spatial tasks. We quantified immunomodulatory cytokines across age in the blood serum and brains of behaviorally characterized rats using BioPlex technology. Specifically, ACTH, CCS, eotaxin, G-CSF, GM-CSF, GRO-KC, IFN-γ, IL-1α, IL-1β, IL-2, IL-4, IL-5, IL-6, IL-9, IL-10, IL-12, IL-13, IL-17, IL-18, IP-10, leptin, MCP-1, MIP-1α, MLT, RANTES, TNF-α and VEGF were quantified in the serum, hippocampal and cortical protein harvested from young (8mo; n=13), middle-aged (14mo; n=41), and aged (20mo; n=24) male Fisher344 rats that were characterized as memory-unimpaired or memory-impaired using a rapid acquisition spatial water maze task. Compared to young rats, probe trial discrimination indices were significantly lower across age (p-values<0.01). Relative to young rats, serum corticosterone and leptin were elevated in middle-age while eotaxin, GRO-KC, IFN-γ, IL-1α, IL-1β, IL-2, IL-4, IL-5, IL-6, IL-10, IL-13, IL-17, IL-18, IP-10, MCP-1, MIP-1α, and RANTES were elevated in aged (p-values<0.05). Within the hippocampus, immunomodulatory cytokine profiles varied with age. In aged rats, MIP-1α, IL-9, IL-18 and RANTES, were elevated (p-values<0.05) while IL-12 was decreased ($p<0.05$) and IL-5 was decreased in both middle-aged and aged rats (p-values<0.001). Cortical IL-1β, IL-4, IL-6, IL-9, MCP-1, MIP-1α and VEGF were elevated in both middle-aged and aged rats (p-values<0.05), while IL-5 and leptin increased only in middle-aged rats and eotaxin (p-values<0.05), GRO-KC and RANTES increased only in aged rats (p-values<0.001). Cluster analyses on Spearman rank correlations between cytokine concentrations and discrimination indices revealed clusters of circulating and central cytokines that were modulated with age and related to memory. We are currently investigating the effects of non-

steroidal anti-inflammatory drug treatment on both memory and cytokine concentrations across age. Our data may reveal immunomodulatory mechanisms behind age-related cognitive decline and could lead to the development of a biomarker assay to predict such decline.

11:20 am **Development of a Laser Micro-Patterned Xenogenic Fibrocartilage Scaffold for the purpose of TMJ disc Tissue Engineering**

Cassandra Juran
Dr. Peter McFetridge

The Temporomandibular Joint (TMJ) disc is susceptible to numerous pathologies that may lead to structural degradation and jaw dysfunction. The limited treatment options and debilitating nature of severe Temporomandibular Disorders has been the primary driving force for the introduction and development of TMJ disc Tissue Engineering as an approach to alleviate this priority clinical issue. This study aimed to evaluate the efficacy of cellular integration into an acellular laser micro-patterned (LMP) freeze-dried porcine TMJ disc scaffold. The LMP is incorporated into the scaffold using a 40W CO2 laser ablation system to drill a 10by10 pattern of 80μm holes. After gamma irradiation sterilization the scaffolds were seeded with 0.75x10^5 fibrochondrocytes/sample and either traditionally or periodic compressive stimulation cultured for 1, 7, and 21 days. The histology, cell proliferation (PicoGreen DNA quantification), and cell metabolism (BrUTP-FuGENE 6 assay) results of these works indicate that the LMP scaffold allow better cellular remodeling than the unworked scaffold over the 21 day culture. Also, the compressive biomechanical ability of the LMP cellularized scaffold cultured with compressive stimulation more closely represents the native mechanics than the non-stimulated cellularized scaffolds. The LMP TMJ disc scaffold is a promising scaffold for recapitulating the native TMJ disc characteristics.

11:40 am **Tissue Topography as a Diagnostic Marker for Colon Cancer**

Shruthi S. Bharadwaj
Dr. Sarah C Glover

Although colonoscopy is the primary diagnostic tool for colon cancer, there are several limitations that make this procedure daunting – especially, the need for several biopsy samples to confirm a diagnosis. Optical biopsy techniques offer an attractive alternative. However, this technique requires an accurate set of parameters that can serve as a diagnostic tool. In this study, we have isolated specific mechanical colonic tissue features that are commonly seen in patients with colon cancer. These micro as well as nano-scaled mechanical features offer a unique pattern, a ‘signature’ that can potentially be used as a diagnostic aid, a mechanical marker. Our data suggest for the first time, that certain topographical features are specific to colon cancer and can easily be classified using mathematical models. Furthermore, we evaluated cellular response, especially Epithelial to Mesenchymal Transition (EMT) of cells, when exposed to these ‘signatures’. Our data confirms our hypothesis that mechanical features do induce EMT and transform ‘normal’ epithelial cells in to a more mesenchymal lineage. This suggests that metastasis, where EMT is a key player, in fact depends on the extra cellular matrix topography. This data in combination with optical biopsy technique may potentially become a diagnostic modality that is clinically accurate as well as one that offers greater comfort to patients.

POSTERS (2:00 – 4:00 pm in the BMS building lobby)

1.	*Finite-Element-Analysis based Intravascular Photoacoustic Functional Imaging*	Jianbo Tang Dr. Huabei Jiang
2.	*Optogenetic inhibition of high frequency epileptiform activity in vivo*	Eric Bennett Dr. Paul Carney
3.	*Sensitivity Enhancement in NMR Spectroscopy using High-Temperature- Superconducting Probes*	Vijaykumar Ramaswamy Dr. Arthur S. Edison
4.	*Diffuse Optical Tomography and Its Applications in Epilepsy*	Tao Zhang Dr. Huabei Jiang
5.	*A Biophysical Analysis of Cell and Nucleus Movements*	Shen-Hsiu Hung Dr. Yiider Tseng
6.	*Affective Picture Processing in Subdural Electrocorticogram Data*	Amy Trongnetrpunya Dr. Mingzhou Ding
7.	*Viscosity of Synovial Fluid using Rotational Dynamics Theory of Magnetic Nanoparticles*	Lorena Maldonado Camargo Dr. Carlos Rinaldi
8.	*Probe Design Issues of MEMS Based Optical Coherence Tomography Endoscopic Imaging*	Can Duan Dr. Huikai Xie
9.	*Modulating Early Remodeling of Decellularized ex vivo Constructs using an Oxygen Gradient*	Marc C. Moore Dr. Peter McFetridge
10.	*Nucleation and Growth of Epithelial Cell Clusters*	Melanie Suaris Dr. Thomas Angelini
11.	*Modulation of In-vitro Cultured Valvular Interstitial Cells with Biomimetic Poly(ethylene glycol) Diacrylate Hydrogels*	Aline Yonezawa
12.	*Estradiol affects neural progenitor cell proliferation but not differentiation in vitro.*	Lan B. Hoang-Minh Dr. Brandi K. Ormerod
13.	*Characterizing the interactions between hippocampal theta generators by combining CSD and Granger Causality*	Daesung Kang Dr. Mingzhou Ding
14.	*Automatic Quantification From CT Scans of Morphological Changes in Pulmonary Arterial Vasculature in Pulmonary Artery Hypertension*	Ankit Salgia Dr. Walter O'Dell
15.	*Quantitative MRI - A tool for design and analysis.*	Aditya Kumar Kasinadhuni Dr. Tom Mareci
16.	*Biomechanical Analysis of Ulnar Wrist Injuries in Tennis Players*	Andrew Hua Dr. Bryan Conrad

17. *Differences in Frontal Plane Running Kinematics* — Andrew Hua, Dr. Bryan Conrad

18. *Dynamic Gait Compensations in a Rat Model of Osteoarthritis* — Heidi Kloefkorn, Dr. Kyle Allen

19. *Spike timing reconstruction from calcium imaging using maximum entropy blind deconvolution* — In Jun Park, Dr. Jose C. Principe

20. *Magneto-Mechanical Actuation of Cell Surface Proteins Using Functionalized Iron Oxide Particles* — Adam Monsalve, Dr. Jon Dobson

21. *Screening M13 Phage Display Libraries to Identify IZO Binding Peptides with Electroactivated Properties* — Ya-Wen Yeh, Dr. Laurie Gower

22. *Delivery of Indoleamine 2,3 Dioxygenase to Dendritic Cells for the Induction of Tolerance* — Evelyn Bracho-Sanchez, Dr. Ben Keselowsky

23. *Molecular breast imaging using limited angle SPECT.* — Olga Gopan, Dr. David Gilland

24. *Genesis of interictal spikes in the CA1: A computational investigation* — Shivakeshavan Ratnadurai Giridharan, Dr. Sachin S. Talathi

25. *Altered Functional Connectivity in Patients with Mild Cognitive Impairment* — Haiqing Huang, Dr. Mingzhou Ding

26. *Intraoperative photoacoustic tumor imaging for breast: An experimental study using a tumor-bearing mice model* — Lei Xi, Dr. Huabei Jiang

27. *In vivo molecular photoacoustic tomography of breast cancer with receptor-targeted magnetic iron oxide* — Lei Xi, Dr. Huabei Jiang

28. *Noninvasive photoacoustic imaging of tumor vasculature development* — Lei Xi, Dr. Huabei Jiang

29. *Quantifying Cell Behavior* — Stephen Hugo Arce, Dr. Yiider Tseng

30. *A combined multiplex and immunohistochemical approach reveals candidate neuroinflammatory cytokines that affect adult hippocampal neurogenesis* — Aditya Asokan, Dr Brandi K Ormerod

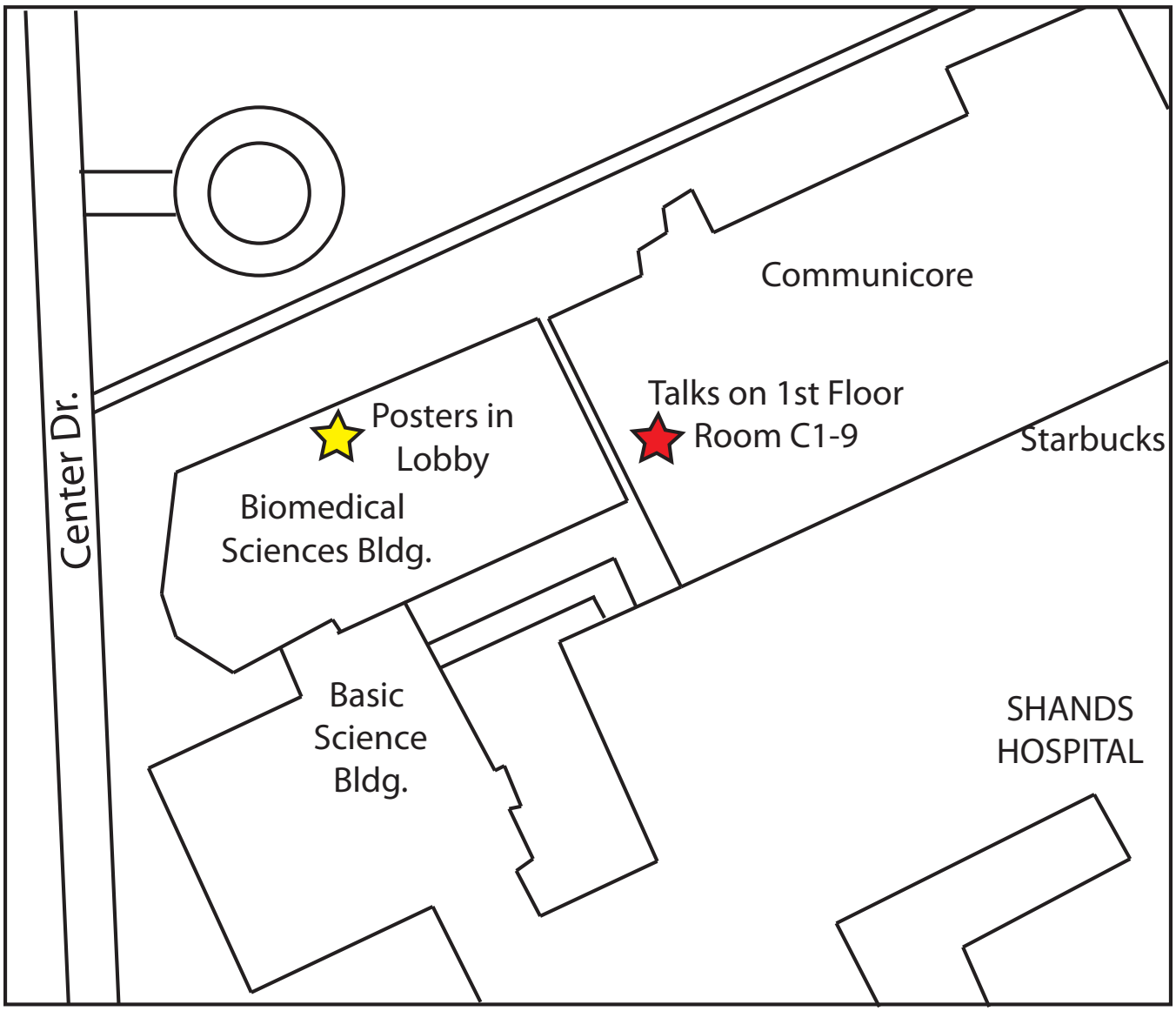
31. *Cyberonics VNS therapy innovation data collection* — Ahmad J Ahmad and Kat M Hylton, Dr. Paul Carney

32. *Coupling between Visual Alpha Oscillations and Default Mode Activity* — Yuelu Liu, Dr. Mingzhou Ding

33. *The human amniotic membrane as a bioscaffold for vascular tissue engineering* — Salma Amensag, Dr. Peter McFetridge

34.	*Automatic segmentation of tumor-laden lung volumes from the LIDC database*	Walter O'Dell, PhD
35.	*A perfused flow phantom of a biological tumor for hyperthermia studies*	Jolin Rodrigues Dr. Jon Dobson
36.	*Prevention of Type 1 Diabetes with an immunosuppressive, PLGA microparticle vaccine*	Jamal S Lewis Dr. Ben Keselowsky
37.	*ICV Injection of Gd-Albumin for In Vivo Drug Delivery Mapping in CSF Regions of Rat Brain*	Christine Girard and Wei Dai Dr. Tom Mareci and Dr. Malisa Sarntinoranont
38.	*Studying nanoparticle-protein interactions in situ*	Ana Bohorquez Dr. Carlos Rinaldi
39.	*A GPU-CUDA method for finite-element-based quantitative photoacoustic tomography reconstruction in time domain*	Shuying Wang Dr. Huabei Jiang
40.	*A GPU-CUDA method for parallel computation in time-domain finite-element-based quantitative photoacoustic tomography*	Shuying Wang Dr. Huabei Jiang
41.	*LPS-induced Neuroinflammation Could Compromise Adult Neurogenesis through Alterations in the Vascular Niche*	Vasanth V. Munikoti Dr. Brandi K. Ormerod
42.	*Cognitive fatigability based on intraindividual performance variability explains self-reported mental fatigue*	Chao Wang Dr. Mingzhou Ding
43.	*Adeno Associated Virus mediated expression of Somatostatin to reduce the severity of Seizures in animal models of Epilepsy*	Gowri Natarajan Dr. Paul R. Carney
44.	*Effect of Z-Ligustilide on the Activities of Rho GTPases of T98G Glioblastoma Multiforme*	Jun Yin Dr. Yiider Tseng & Dr. Spyros A. Svoronos
45.	*Matching Thalamic Microstimulation to Tactile Evoked Potentials in Rat Somatosensory Cortex*	Matthew S. Emigh Dr. Jose C. Principe
46.	*Quantitative photoacoustic tomography assisted by diffuse optical tomography: A simulation study*	Xiaoqi Li Dr. Huabei Jiang

MAP



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