UNIVERSITY of HOUSTON | ENGINEERING

Department of Electrical & Computer Engineering

10 TH Annual Capstone Design and Graduate Research Conference

Abstracts for GRC*

* listing by the first author

PROCESSING MOTION INFORMATION VIA THE NON-FIXATING EYE IN MONKEYS WITH STRABISMUS

Sevda Agaoglu*[1,2], Mehmet N. Agaoglu[1,2] and Vallabh Das[1]
[1]College of Optometry, University of Houston
[2]Electrical and Computer Engineering, University of Houston

Patients with strabismus perceptually suppress information from one of their eyes in order to avoid double vision. However, fixation-switch behavior in strabismic patients provides evidence that not all parts of the visual field of the deviated eye are suppressed. The purpose of this study was to investigate if motion information supplied only to specific regions of the visual field of the deviated eye can lead to oculomotor responses. Results show that a moving stimulus that is presented to the foveal region of the deviated eye can generate optokinetic nystagmus (OKN) responses even without an apparent fixation switch. This suggests that the oculomotor system might have access to visual error signals although there is perceptual suppression of the deviated eye.

CONTRIBUTIONS OF ENDOGENOUS AND EXOGENOUS REFERENCE FRAMES TO THE PERCEPTION OF MOTION DIRECTION

Mehmet N. Agaoglu*[1], Michael Herzog[2] and Haluk Ogmen[1,3]
[1]Department of Electrical and Computer Engineering,
University of Houston, Houston, TX, USA
[2]Laboratory of Psychophysics, Brain Mind Institute,
Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland
[3]Center for Neuro-Engineering and Cognitive Science,
University of Houston, Houston TX USA

In physics, motion is defined as a change in position over time. However, perceptual motion is not strictly tied to change in position, but it itself forms an independent dimension of perception. Perception of motion requires a reference frame. There are several reference frames available to the perceptual system: Those originating from within the organism (endogenous) and those external to the organism (exogenous). In this study, we quantified the contributions of endogenous (retinotopic) and exogenous (spatiotopic and motion-based) reference frames on perceptual judgments of motion direction. Our results indicate that exogenous motion-based reference frame dominates perceptual judgments of motion direction, and that the weight of this reference frame decreases as the distance between moving targets increases. Retinotopic and spatiotopic reference frames have modest contributions to perceptual judgments. We suggest that these findings can be explained by the Reference Frame Metric Field Theory.

POWER SYSTEM ASSET MANAGEMENT FOR HURRICANE-PRONE INFRASTRUCTURE DAMAGES

Ali Arab*[1], Amin Khodaei[2], Suresh K. Khator[1], and Zhu Han*[3]
[1] Department of Industrial Engineering, University of Houston
[2] Department of Electrical and Computer Engineering, University of Denver
[3] Department of Electrical and Computer Engineering, University of Houston

This paper presents a model to optimally allocate repair crews to damaged transmission infrastructure in order to minimize the cost and customer load interruptions. The criticality of each load to be restored in the system is represented via value of lost load. In addition, the transmission repair is coordinated with generation units repair while the time to repair for damaged generation units is obtained from GENCOs

and considered as a constraint in the model. The problem is formulated using mixed-integer programming; and the impact of the number of crews on load interruption duration is analyzed.

NON-INVASIVE RAPID THERMAL ANNEALING OF NANOPOROUS GOLD DISKS (NPGDs)

Md Masud Parvez Arnob and Wei-Chuan Shih
Nanobiophotonics Research Group
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

A fast, non-invasive thermal annealing technique of NPGDs has been reported using ultrafast laser pulses. The laser annealing engenders structural alterations of NPGDs, which ensues the LSPR peak shifts. With increasing laser intensity, average pore size of NPGDs increases, while mean disk diameter lessens. The changes in NPGDs structure lead to blue shifting of the LSPR peaks, which brings about the step-up in SERS intensity. Hence this non-invasive, rapid laser annealing technique is of great importance for annealing nanomaterials to optimize different plasmonic dependent optical biosensing methods.

A RELIABLE, HIGH THROUGHPUT APPROACH FOR FABRICATION OF OPTRODES FOR OPTOGENETIC STUDIES IN PRIMATES

Apeksha Awale*[1], Mufaddal Gheewala[1], Pratik Motwani[1], Wei-Chuan Shih[1],
Gopathy Purushothaman[2], and John C. Wolfe[1]
Nanosystem Manufacturing Center
[1] Department of Electrical and Computer Engineering, University of Houston,
Houston, TX 77204-4005
[2] Cell and Developmental Biology, Vanderbilt University, Nashville, TN 37232

The mammalian brain is beyond compare in its complexity. Our limited insight and lack of appropriate techniques hinder the search for cures for some diseases that are a cause of years of life lost to death or disability. Optogenetics is an approach that combines genetics and optics to control well-defined events by targeting specific cells. This paper addresses a high throughput manufacturing process for the fabrication of a neural probe with an optical channel for exciting the intricate network of targeted neurons and electrode arrays for their localization and specific readouts. Multi-channel optrodes have been fabricated starting with a highly sustainable plasma deposited resist, followed by ion beam proximity lithography. Preliminary in-vivo recordings confirm the ability of the optrodes to perform accurate stimulation and mapping of neuronal dipoles in the target region.

BRAIN MACHINE INTERFACE CONTROLLED ROBOTIC REHABILITATION FOLLOWING STROKE

Nikunj A. Bhagat*[1], James French[2], Anusha Venkatakrishnan[1], Nuray Yozbatiran[3], Gerard E. Francisco[3],
Marcia K. O'Malley[2], and Jose L. Contreras-Vidal[1]
[1]Dept. of Electrical & Computer Engineering, University of Houston
[2]Dept of Mechanical Engineering, Rice University,
[3]TIRR Memorial Hermann and University of Texas Health Sciences Center.

Rehabilitation robots are being increasingly used for upper limb motor recovery in stroke patients. Although, robotic therapy has the advantage of providing repetitive practice, superior therapy outcomes can be obtained by keeping the patient involved during therapy. Patient's movement intent detection

provides a unique way for actively engaging them during therapy. Here, we present preliminary findings demonstrating successful movement intention detection from scalp electroencephalography (EEG) during robotic rehabilitation using the MAHI Exo-II in an individual with hemiparesis following stroke. These findings have strong clinical implications for development of closed-loop brain-machine interfaces (BMI) to robotic rehabilitation systems.

A CYLINDRICAL DIELECTRIC SURFACE-WAVE ANTENNA

Nicholas A. Boggs*, Stuart A. Long, and David R. Jackson
Applied Electromagnetic Research Group
[1] Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

A new type of dielectric surface-wave antenna (DSWA) has been proposed using a tapered cylindrical dielectric structure. The structure is radially tapered in permittivity to produce a directive endfire beam that is omnidirectional in the azimuth direction. Unlike a dielectric resonator antenna (DRA) that uses a cavity mode to achieve radiation, this antenna uses a radially-propagating surface wave to create an endfire beam.

REACTION KINETICS OF SURFACE LIMITED REDOX REPLACEMENT OF LEAD UPD STUDIED BY SURFACE REFLECTIVITY AND CONVENTIONAL ELECTROCHEMICAL METHODS

Ela Bulut*[1] and Stanko R. Brankovic[1,2,3]
Electrochemical Nanofabrication and Nanomaterials Synthesis Group
[1] Department of Electrical and Computer Engineering
[2] Department of Chemical and Biomolecular Engineering
[3]Department of Chemistry
University of Houston, Houston, TX 77204-4005

The objective of this research is to study reaction kinetics of underpotential deposition (UPD) of lead monolayer and surface-limited redox replacement (SLRR) reaction on Au(111) single crystal by using surface reflectivity measurements. UPD monolayer served as a sacrificial material for the deposition of a more noble metal, gold, on the crystal via SLRR reaction.

RAMAN AND PHOTOLUMINESCENCE SPECTROSCOPY OF CVD SYNTHESIZED SINGLE CRYSTAL WS_2

Su-Chi Chang*[1, 2], Yanan Wang[3], R Mithun Kumar[1, 3], Rabi Ebrahim[1, 4], Viktor Hadjiev[5], Alex Ignatiev[1, 4], Jiming Bao[3] and Shin-Shem Pei[1, 3]
[1]Center for Advanced Materials, [2]Materials Engineering Program
[3]Department of Electrical and Computer Engineering,
[4]Department of Physics, [5]The Texas Center for Superconductivity,
University of Houston, Houston, TX 77024

Single and few layers tungsten disulfide (WS_2) with grain size up to 20 mm have been successfully synthesized on SiO_2/Si substrates by chemical vapor deposition (CVD). The number of WS_2 layers and uniformity of the thickness and quality of the single crystal grain are verified by Raman spectroscopy. For the WS_2, the 532 nm laser excitation generates a second-order Raman resonance involving the longitudinal acoustic mode (LA (M)). This resonance results from a coupling between the electronic band structure and lattice vibrations [1]. For the single layer WS_2, a 1.96eV direct band-gap was also confirmed by photoluminescence (PL). The PL weakens with increasing number of layers due to a transition from direct band gap in a monolayer to indirect gap in multilayers.

[1] A. Berkdemir, et al, "Identification of individual and few layers of WS_2 using Raman Spectroscopy," Sci. Rep., vol. 3, pp. 1755-1762, 2013.

SUB-MILLISECOND DYNAMIC OPTICAL PATH SETUP IN DWDM MULTIMODE SWITCHING NETWORKS

Wenhao Chen*, Lei Wang, Dmitriy Chenchykov, Linsen Wu, and Yuhua Chen
Systems Research Laboratory
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

DWDM multi-mode switching network provides a unified approach to DWDM-based communications by allowing electronic packet switching (EPS), optical burst switching (OBS) and optical circuit switching (OCS) to be carried in the same network, and on the same router platform. In this paper, we present a sub-millisecond dynamic optical path setup scheme for the multi-mode switching router. The performance of the proposed integrated scheduler has been verified using OBS-ns2 simulator as well as in a hardware testbed. In particular, we have implemented the proposed integrated multi-mode scheduler in FPGA hardware in an optical switching testbed, and have demonstrated application triggered real-time sub-millisecond optical path setup.

PREDICTIVE MODELING OF THE FEMALE TORSO DURING BREAST RECONSTRUCTION

Audrey Cheong*[1] and Fatima Merchant[2]
Computational Biology and Medicine Lab
[1]Department of Electrical and Computer Engineering
[2]Department of Engineering Technology
University of Houston, Houston, TX 77204-4005

We will be developing a model for predicting outcomes from different breast reconstruction procedures. Using 3D image data collected from breast cancer patients undergoing breast reconstruction over a six-month span, a template for different breast reconstructions, such as implants and TRAM, will be made. These breast templates can be tailored by making adjustable parameters and overlaid on a female subject's 3D torso data for a realistic appearance.

SMART CHARGING FACILITIES FOR PLUG IN HYBRID ELECTRIC VEHICLES IN A DC MICROGRID

Preetham Goli[1], Wajiha Shireen*[1, 2]
Power Electronics Research Laboratory
[1] Department of Electrical and Computer Engineering
[2] Department of Engineering Technology
University of Houston, Houston, TX 77204-4005

Plug-in hybrid electric vehicles (PHEVs) have already hit the consumer automotive market. PHEVs will be proliferating at a rate that requires local utilities to upgrade the distribution transformers in order to

handle the additional load. To mitigate the challenges posed to the distribution network, charging PHEVs using renewable energy is an ideal option. This paper proposes a PHEV charging station architecture for workplace parking facilities using renewable energy sources (wind and/or PV) coupled with smart grid technologies that can reduce the stress imposed on the grid at the distribution level during peak load hours.

COMPREHENSIVE COMPUTATIONAL ANALYSIS OF TISSUE REMODELING IN THE RAT BRAIN AFTER TRAUMATIC INJURY

Kedar Grama[1], Yanbin Lu[1], and Murad Megjhani[1]
[1] Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

A mild traumatic brain injury (mTBI) can result from the transfer of energy to the brain from pathologic initiators such as a rapid change in acceleration/deceleration, a direct impact to the head, or an explosive blast. Here we will employ an automated immunocytochemical analysis method to comprehensively detect and quantify pathological changes in distinct cell populations (astrocyte, microglia, oligodendrocytes, neurons, and endothelial cells), determine their functional state, and assess cytoarchitectural changes throughout the rostrocaudal axis of the brain 24 hr and 14 d after a mTBI. These results will be compared to the changes detected 14 d after mTBI in an animal that received the combination treatment of lithium+valproic acid to determine which mTBI-associated pathological changes were altered by the combination treatment.

TIME-REVERSAL PPM FOR STRESS WAVE COMMUNICATION IN CONCRETE STRUCTURES

Qing Ji*[1], Rong Zheng[3], Zhi Ding[4] and Gangbing Song[1,2]
[1]Department of Electrical Engineering, University of Houston, Houston, TX, *USA*
[2]Department of Mechanical Engineering, University of Houston, Houston, TX, USA
[3]Department of Computing and Software, McMaster University, Hamilton, ON, Canada
[4]Department of Electrical Engineering, University of California, Davis, Davis, CA, USA

Large concrete structures are prone to cracks and damages over time from human usage, weathers, and other environmental attacks such as flood, earthquakes, and hurricanes. The health of the concrete structures should be monitored regularly to ensure safety. A reliable method of real time communications can facilitate more frequent structural health monitoring (SHM) updates from hard to reach positions, enabling crack detections of embedded concrete structures as they occur to avoid catastrophic failures. By implementing an unconventional mode of communication that utilizes guided stress waves traveling along the concrete structure itself, we may be able to free structural health monitoring from costly installation of communication wires. In stress-wave communications, piezoelectric transducers can act as actuators and sensors to send and receive modulated signals carrying concrete status information. The new generation of lead zirconate titanate (PZT) based smart aggregates cause multipath propagation in the homogeneous concrete channel, which presents both an opportunity and a challenge for multiple sensors communication. We propose a time reversal based pulse position modulation (TR-PPM) communication for stress wave communication within the concrete structure to combat multipath channel dispersion. Experimental results demonstrate successful transmission and recovery of TR-PPM using stress waves. Compared with PPM, we can achieve higher data rate and longer link distance via TR-PPM. Furthermore, TR-PPM remains effective under low signal-to-noise (SNR) ratio.

MANIPULATION OF NANOPARTICLES USING *AC* MAGNETIC FIELDS TO TRIGGER TUMOR CELL APOPTOSIS

Dhivya Ketharnath,[1,2] Leiming Xie,[2] Biana Godin,[3] and Jarek Wosik[1,2]
[1]Electrical and Computer Engineering Department
[2]Texas Center for Superconductivity, University of Houston, Houston, TX 772042
[3]Department of Nanomedicine, The Methodist Hospital Research Institute, Houston, Texas, 77030

A novel method to target and manipulate the cancer cell membrane was developed to induce force on the mechanosesnsitve ion channels of the cell membrane thereby triggering apoptosis. An *ac* gradient magnetic field generator was designed to study the movement of the nanoparticles (NPs) and the force exerted on the cell membrane. The NPs movement following the *ac* gradient magnetic field is verified using a laser light modulation experiment. We test iron oxide nanorods (Fe_2O_3) of width 30-100 nm and length 400-700 nm for movement in our gradient field generator. Finite element method simulations of the *ac* magnetic field generator are used to correlate and verify the experimental light intensity modulation results with the field gradient generated. The tested iron oxide NPs are functionalized to adhere on the cancer cell membrane which is then exposed to the *ac* field gradient causing a force on the cell membrane due to NPs movement thereby triggering apoptosis.

AN INVESTIGATION OF MULTIBAND FABRY-PÉROT RESONANT CAVITY ANTENNAS

Krishna Kota*, David R. Jackson, and Stuart A. Long
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

A multiband version of the Fabry-Pérot resonant cavity antenna is presented. The implementation of multiple FSS layers in the proposed structure is discussed and its transverse equivalent network (TEN) model is explained.

COMPREHENSIVE QUANTITATIVE PROFILING OF BRAIN CYTOARCHITECTURAL ALTERATIONS CAUSED BY BINGE ALCOHOL

Prathamesh Kulkarni[1], Leigh Leasure[2], Emily Barton[2], William Shain[3], Yanbin Lu[1], Yan Xu[1], Murad Megjhani[1], and Badrinath Roysam[1]
[1]Department of Electrical & Computer Engineering ,
[2]Department of Psychology, University of Houston, Houston, TX , USA
[3]Neurosurg., Seattle Children's Res. Inst., Seattle, WA

Alcohol can inflict complex, widespread, and multi-scale alterations to brain cytoarchitecture. Alterations differ based on the cell's type (neurons, astrocytes, microglia, oligodendrocytes, endothelials), its maturation state, cellular microenvironment, location in the brain, vascular proximity, connectivity, and location relative to the injury site. At the next level, alcohol inflicts changes to functionally important multicellular microenvironments (e.g., stem-cell niches). Current tissue imaging methods reveal only a tiny fraction of the full range of brain alterations that occur. There is a compelling & long-standing need to advance histology to detect and quantify brain cytoarchitectural alterations in a manner that is far more sensitive and comprehensive compared to current methods to enable large-scale hypothesis testing, screening, and data-driven discovery. FARSIGHT (www.farsight-toolkit.org) is an open source bio-image

analysis toolkit that can provide a detailed quantitative profile of brain cellular alterations. We will report the novel ability to computationally sense changes in microglial and astrocytic arbor morphologies from multiplex immuno-labeled confocal image montages on a large scale.

ENHANCEMENT OF EPIR SWITCHING CHARACTERISTICS OF PCMO RERAM USING OXYGEN DEFICIENT AL_2O_X DIFFUSION BARRIER

R. Mithun Kumar[1,3*], Rabi Ebrahim[1,2], and Alex Ignatiev[1,2,3]
[1]Center for Advanced Materials, University of Houston, Houston TX 77204-5004
[2]Department of Physics, University of Houston, Houston TX 77204-5005,
[3]Department of Electrical and Computer Engineering
University of Houston, Houston TX 77204-4005

Resistive random access memory has gained lots of interest in the last decade as a promising replacement for non-volatile memory. Device retention stability and electric pulse induced resistance switching (EPIR) ratio (percent of change in resistance between the low and high resistance states) are very important characteristics of any resistive memory devices. $Pr_{0.7}Ca_{0.3}MnO_3$ (PCMO) is one of the most promising materials which exhibit EPIR switching, however it suffers some shortcomings as low retention stability and low EPIR ratio. This work investigated the effect of oxygen ion/vacancy buffer layer of Al_2Ox in metal/buffer layer/PCMO/Metal heterostructure. The internal Al_2Ox barrier is placed between the "bulk" PCMO region of the sample and a top PCMO active interface region. The Al_2O_3 layer is believed to reduce/prevent change in the ion/vacancy concentration in the interface region after a certain concentration is set by the application of a short electric pulse, and also enhances the EPIR switching ratio. This work also addressed a model for the enhancement of the switching.

LASER-ASSISTED DEALLOYING LITHOGRAPHY

Jingting Li*[1] and Wei-Chuan Shih[1]
NanoBioPhotonics Group
[1] Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

We present a laser-assisted dealloying lithography method for patterned nanoporous gold (NPG) film by projecting a series of highly focused laser spots (1.5µm in diamater) onto the ready-to-use Ag-Au alloy sample immersed in diluted nitric acid using a spatial light modulator (SLM). The heat accumulation induced by laser allows the irradiated area to be selectively dealloyed into NPG while the surroundings remain intact. The lithography method enables us to parallelize the dealloying process and the patterning process which was never investigated before.

AIR-PULSE OCE FOR ASSESSMENT OF AGE-RELATED CHANGES IN MOUSE CORNEA IN VIVO

J. Li*[1], S. Wang[1], M. Singh[1], S. Aglyamov[2], S. Emelianov[2], M. Twa[3], and K. V. Larin[1, 4, *]
[1] Department of Biomedical Engineering, University of Houston, Houston, TX 77004,
[2] Department of Biomedical Engineering, University of Texas at Austin,
Austin, TX 78712
[3] College of Optometry, University of Houston, 505 J. Davis Armistead Bldg., Houston, TX 77204-2020,
[4] Department of Molecular Physiology and Biophysics, Baylor College of Medicine, One Baylor Plaza,
Houston, TX 77030, USA

We demonstrate the use of phase-stabilized swept source optical coherence elastography (PhS-SSOCE) to assess the relaxation rate of deformation created by a focused air-pulse in tissue-mimicking gelatin phantoms of various concentrations and mouse corneas of different ages in vivo. The results show that the relaxation rate can be quantified and is different for the varying concentrations of the gelatin phantoms and ages of the mice. The results also indicate that higher concentration of gelatin phantoms as well as older mouse corneas have faster relaxation rates. This non-contact and noninvasive measurement technique utilizes minimal force for excitation (in µm scale) of the tissue that can be potentially used to study the biomechanical properties of ocular and other sensitive tissues.

SODIUM ION INTERCALATION FOR 2-D MATERIALS AS ADVANCED BATTERIES

Yifei Li*, Yanliang Liang, Hyun Deog Yoo and Yan Yao
Energy Materials and Devices Research Group
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

This work aims to develop high volumetric energy density and safe Na^+ ion battery cathode materials by nanostructural engineering of MoS_2, which has two-dimensional layered structure and serve to be an ideal benchmark host for cation intercalation. We will use PEO to tune the interlayer spacing of MoS_2 precisely by a chemical delamination–restacking method. Then MoS_2-PEO nanocomposites with varying interlayer spacing will be used as cathode materials for the intercalation of both sodium and lithium. Such a systematic comparison will disclose the relationship between the polarization strength of cations and the layer morphology of intercalation host.

IMPROVEMENT OF TISSUE ANALYSIS AND CLASSIFICATION USING OPTICAL COHERENCE TOMOGRAPHY COMBINED WITH RAMAN SPECTROSCOPY

Chih-Hao Liu*[1], Ji Qi[2], Shang Wang[1], Chen Wu[1], Wei-Chuan Shih[2], Kirill V. Larin[1, 3],
[1]Dept. of Biomedical Engineering, University of Houston, Houston, Texas 77204,
[2]Dept. of Electrical and Computer Eng., University of Houston, Houston, Texas 77204
[3]Dept. of Molecular Physiology and Biophysics, Baylor College of Medicine, One Baylor Plaza, Houston, Texas 77584

Fast and accurate tissue characterization is required for the prediction and diagnosis of multiple diseases. Optical coherence tomography (OCT) has been demonstrated to be an effective high-resolution imaging tool for characterizing the tissue types based on their optical properties, e.g. refractive index and scattering coefficient. However, the resemblance of the microscopic and optical characteristics of tissues requires the combined imaging modalities for advanced assessment of tissue types. Raman spectroscopy (RS) provides the information about the chemical composition of tissue at the molecular level. Here, we report a two-dimensional computational method that combines the slope of OCT intensity signal with the Principal component (PC) of RS. Based on these two parameters, the classification of tissue types relies on the optical attenuation coefficient and the chemical ingredients of tissue. For the feasibility study, our pilot experiments were performed on mouse kidney, liver and small intestines (*in vivo* for OCT measurement and *ex vivo* for RS assessment). Results demonstrate a good differentiation among these three types of tissues with this combination. Also, an improvement of the tissue classification is observed compared with the analysis only based on the OCT detection (slope and standard deviation analyses of

OCT intensity signal). With further development and more experiments on normal and pathological tissues, this combined OCT/RS method may potentially offer advanced optical biopsy of cancer and normal surrounding tissues.

A DISTRIBUTE PARALLEL APPROACH FOR BIG DATA SCALE OPTIMAL POWER FLOW WITH SECURITY CONSTRAINTS

Lanchao Liu* and Zhu Han
Wireless Networking, Signal Processing and Security Lab
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

This paper presents a mathematical optimization framework for security-constrained optimal power flow (SCOPF) computations. The SCOPF problem determines the optimal control of power systems under constraints arising from a set of postulated contingencies. This problem is challenging due to the significantly large problem size, the stringent real-time requirement and the variety of numerous post-contingency states. In order to solve the resultant big data scale optimization problem, the alternating direction method of multipliers (ADMM) is utilized. The SCOPF is decomposed into independent subproblems correspond to each individual precontingency and post-contingency case. Those subproblems are solved in parallel on distributed nodes and coordinated through dual variables. As a result, the algorithm is implemented in a distributive and parallel fashion. Numerical tests validate the effectiveness of the proposed algorithm.

MODELING AND FABRICATION OF GaAs SOLAR CELLS WITH HIGH DISLOCATION TOLERANCE

A. Mehrotra*[1], W. Wang[2], and A. Freundlich[1,2]
Center for Advanced Materials, Photovoltaics Research Group
[1] Department of Electrical and Computer Engineering
[2]Department of Physics, University of Houston, Houston, TX 77204-4005

In this work we have evaluated thickness dependent efficiency for GaAs solar cells in presence of high dislocations using MBE. These results agree with drift-diffusion modeling results, which shows that by thinning solar cells with defects, efficiency degradation could be prevented; thus improving the efficiency of hetro-epitaxial and metamorphic solar cells, without having need to grow thick buffers and/or using defect filtering techniques. Isc measurement with etching technique has been discussed, to find most of device parameters, such as SRH lifetime, surface recombination velocities and minority carrier lifetimes, without having need to grow multiple growths or TRPL structures; this technique could be extended to any III-V devices to find out efficiency limiting device parameters.

NON-PARAMETRIC BAYESIAN LEARNING FOR INFERRING HIDDEN CAUSES WITH POTENTIALLY INFINITE LAYERS

Erte Pan* and Zhu Han
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

We address the hidden factor analysis problem from a non-parametric Bayesian point of view and present

an infinite hierarchical non-parametric Bayesian model to infer the hidden factors based on the statistical property of the observed data. Under the proposed approach, the number of hidden factors for each layer is unknown and can be potentially infinite. Moreover, the number of layers can also be infinite. Unlike conventional non-parametric Bayesian methods, we do not assume binary values for neither hidden factors nor weights. In contrast, we propose a real-valued model structure, which makes the model suitable for more applications. We perform the inference of the number of hidden factors by the Metropolis-Hastings method. The probabilistic inference is done by the derived closed form equations, which make it efficient.

MICROFLUIDIC LABEL-FREE MONITORING OF DNA HYBRIDIZATION

Ji Qi*[1], Jianbo Zeng[1], Fusheng Zhao[1], Steven Hsesheng Lin[2], Uli Strych[3],
Richard C. Willson[3], and Wei-Chuan Shih[1]
NanoBioPhotonics Group
[1] Department of Electrical and Computer Engineering
[2] Department of Radiation Oncology, MD Anderson Cancer Center
[3]Department of Chemical and Biomolecular Engineering
University of Houston, Houston, TX 77204-4005

Improving the sensitivity and speed of DNA biosensors is of great interest and importance in clinical diagnostics, gene therapy, and a variety of other biomedical and environmental studies. Surface-enhanced Raman scattering (SERS) provides high sensitivity and has been an attractive approach for rapid DNA sensing. Here, we report label-free SERS detection of DNA hybridization at single-molecule level on nanoporous gold (NPG) disk substrates using molecular sentinel assay. We were able to monitor in situ individual DNA hybridization events and observe quantized SERS intensity changes as early as ~10 min after introducing complementary target oligonucleotides to the sensor.

MICROWAVE CHARACTERIZATION OF YBCO FILMS ON RIGID AND FLEXIBLE SUBSTRATES

K. Qin*[1,3], D. Ketharnath[1,3], E.Galstyan[2,3], V. Selvamanickam[2,3], and J. Wosik[1,3]
[1]Electrical and Computer Engineering Dept
[2]Mechanical Engineering Dept
[3]Texas Center for Superconductivity
University of Houston, Houston, TX 77204-4005

We have used a microwave non-contact, non-destructive dielectric resonator technique to characterize complex conductivity of different quality YBCO films with the aim to develop such technique as a potential quality control method for fabrication of YBCO films. Two configurations of dielectric resonators (DR), the single post dielectric resonator (SPDR) consisting of high-permittivity barium zirconium titanate (BZT) ceramic operating at 13 GHz in TE_{011} mode and the rod dielectric resonator (RDR) consisting of rutile operating at 9 GHz in $TE_{01\delta}$ mode were designed to measure the complex conductivity of the superconductor at the normal and superconducting states, respectively. Numerical simulations are done using Finite Element Method (FEM) to accurately evaluate the Q-factor and resonant frequency shifts for different conductivity values in a commercial electromagnetic simulator HFSS.

THE SIMULATION OF ESAKI TUNNELING DIODE I-V CHARACTERISTICS AND STUDY OF PARAMETERS IMPROVING THE DEVICE ELECTRICAL BEHAVIOR

Kaveh Shervin[1] and Alex Freundlich*[1, 2]
Photovoltaic and Nanostructures Laboratories, Center for Advanced Materials
[1] Department of Electrical and Computer Engineering
[2] Department of Physics
University of Houston, Houston, TX 77204-4005

In this work, I-V characteristics of the Esaki tunneling diode has been investigated and calculated using equations describing the physics of the device. The diode's current is divided into three components describing different physical effects including tunneling, excess carrier and thermal current. Simulation is based on the equations given by E. O. Kane for GaAs diode. The purpose of this research is to lower series resistance and increase peak current densities in tunnel diodes by the study of several parameters such as device structures, doping, and material properties and defects on tunneling and excess current densities

EXAMINATION OF RADIATION FROM 2D PERIODIC LEAKY-WAVE ANTENNAS

Sohini Sengupta*, David R. Jackson, and Stuart A. Long
Applied Electromagnetics Group
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

In this work, a two-dimensional (2D) periodic leaky-wave antenna has been studied and analyzed. The antenna is formed by a 2D periodic arrangement of rectangular conductive patches on a grounded dielectric substrate. This arrangement is excited by a single horizontal magnetic dipole source at the center of the array. This structure is optimized for maximum radiation at broadside, and the nature of the resulting beam is explored. With proper design highly directive beams is obtained at broadside. Two different theoretical methods are used here to analyze this structure – (1) Periodic Spectral Domain Method of Moments together with Reciprocity, and (2) Periodic Spectral Domain Method of Moments along with the Array Scan Method.

AN ADAPTIVE MAXIMUM POWER POINT TRACKING ALGORITHM FOR WIND ENERGY CONVERSION SYSTEMS

Wajiha Shireen and Shyam Janakiraman*'
[1] Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

This paper presents a novel new mechanical sensorless adaptive control algorithm for maximum power point tracking (MPPT) in wind energy systems. The proposed control algorithm allows the generator to track the optimal operation points of the wind turbine system under fluctuating wind conditions by a two-step efficient process. This algorithm does not require the knowledge of turbine mechanical characteristics such as its power coefficient curve, power characteristic or torque characteristic. This paper also aims at designing a scaled laboratory prototype that is necessary to replicate the characteristics of a wind turbine for any wind speed in a controlled test environment without depending on natural wind resources and actual wind turbine. The Wind Turbine Test Bench System (WTTBS) uses an induction motor as a prime mover to replicate the behavior of a wind turbine shaft. The brain of WTTBS is a Digital

Signal Processor (DSP) based algorithm which controls the motor. The simulations were carried out in MATLAB/SIMULINK and PSCAD/EMTDC. Test bench system is prototyped using a TI DSP F28035.

DEEP IMAGING OF MOUSE EMBRYO BY ROTATIONAL IMAGING

Narendran Sudheendran[1], Chen Wu[1], Irina V. Larina[2],
Mary E. Dickinson[2], and Kirill V. Larin[12*]
[1]Department of Biomedical Engineering, University of Houston
[2]Department of Molecular Physiology and Biophysics, Baylor College of Medicine

Here we propose a new method, rotational imaging OCT (riOCT), to improve the imaging depth and provide full-body embryonic imaging. Results indicate that this method is able to improve the visualization of structural information of mouse embryo compared to conventional OCT.

MULTI-FUNCTIONAL NANOPOROUS FILTER FOR TYLENOL AND UREA SENSING IN URINE

Yu-Lung Sung*[1], Fu-Sheng Zhao[1], and Wei-Chuan Shih[1]
NanoBioPhotonics Group
[1] Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

Tylenol overdose accounts for more deaths than all other over-the-counter pain relievers combined [1]. Current overdose detection methods utilizing serum toxicological assays require up to 2 hours processing time, delaying vital treatment time. A new detection method has been devised by employing low power laser light on a nanoporous filter combined with a surface-enhanced Raman spectroscopy (SERS) substrate[2]. The substrate contains silver-gold alloy nanoparticles to adsorb Tylenol molecules, allowing for a near real-time SERS detection. In addition, the filter is capable of processing large quantities of sample (1ml) in seconds, and has been demonstrated to be reusable after simple cleaning procedures.

[1] A. D. Manthripragada, E. H. Zhou, D. S. Budnitz and M. E. Willy, "Characterization of acetaminophen overdose-related emergency department visits and hospitalizations in the United States." *Pharmacoepidemiol Drug Saf.* vol. 20, no. 8, pp. 819-26, Aug. 2011.
[2] A. Otto, Surface-Enhanced Raman Scattering, *Springer*, 1982.

SHEAR WAVE IMAGING OPTICAL COHERENCE TOMOGRAPHY (SWI-OCT)

Shang Wang* and Kirill V. Larin
Department of Biomedical Engineering
University of Houston, Houston, Texas 77204

In this presentation, we describe a low-coherence optical phase-based elastographic method, termed shear wave imaging optical coherence tomography (SWI-OCT), for noncontact measurement of tissue biomechanical properties. SWI-OCT combines a focused air-puff system and a phase-sensitive Fourier domain OCT system. Low-pressure short-duration air stream is used to load the tissue with micro-scale deformation, and phase-resolved detection with OCT provides the measurement of localized tissue displacement with nano-scale sensitivity. Based on 1-D transverse scanning of the M-mode OCT imaging which is precisely synchronized with the air-puff excitation, 2-D depth-resolved visualization of the elastic wave propagation inside the tissue can be achieved with ultra-high frame rate. The tissue elasticity can thus be obtained based on the estimation of the elastic wave velocity. The feasibility of this method in assessing the tissue biomechanics is demonstrated with experiments on tissue-mimicking phantoms and *ex vivo* rabbit corneas. Results indicate the potential of SWI-OCT for depth-resolved high-resolution quantitative elastography of tissue, which enables advanced tissue characterization.

THE UNDERPOTENTIAL DEPOSITION of Pb on Ru(0001)

Dongjun Wu*[1], Qiuyi Yuan[1], and Stanko R. Brankovic[1,2]
ECNFG Research Group
[1] Department of Electrical and Computer Engineering
[2] Department of Chemical and Biomolecular Engineering
University of Houston, Houston, TX 77204-4005

The underpotential deposition (UPD) has attracted research attention for many years due to its fundamental and practical importance [1]. Development of scanning probe methods (STM and AFM), and X-ray scattering techniques has enabled mechanistic in situ studies for many substrate-adlayer systems with great insight in details of UPD adlayer formation and structure, alloying and anion co-adsorption [2]. However, in some cases, the noble metal surfaces with complex reactivity and interaction with water based electrolytes have rendered UPD studies a very difficult endeavor. One example is Ru surface for which a just few UPD studies have been reported. Our talk presents a study of Pb UPD on Ru(0001). The Ru(0001) surface was prepared by annealing at 1400C for one hour in Ar+H2 atmosphere (96:4). After cooling the Ru surface was protected by CO-saturated 0.1 M HClO4 solution and transferred to the electrochemical cell or STM cell for further studies. The potential has been gradually changed towards the region where Pb UPD on Ru(0001) occurs and high resolution/quality STM images were recorded.
30, 2001.

DYNAMIC ASYMMETRIC SCHEDULING FOR EDGE ROUTERS IN RECONFIGURABLE ASYMMETRIC OPTICAL BURST SWITCHING NETWORKS

Linsen Wu*, Chenxing Ma, and Yuhua Chen
Systems Research Laboratory
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

The utilization of bandwidth is optimized by Reconfigurable Asymmetric Optical Burst Switching (RA-OBS) technology. The wavelength channels are dynamically reconfigured into the electronic packet switching (EPS), optical circuit switching (OCS), or optical burst switching (OBS) mode. In this paper, we propose a dynamic asymmetric scheduling algorithm for edge routers. The proposed algorithm takes into account different requirements at different ports, and performs asymmetric resource distribution dynamically. The proposed method is implemented on FPGA hardware, as well as verified in simulation.

WIRELESS ENERGY TRANSMISSION FOR GEOPHYSICAL APPLICATIONS

Xiyao Xin*[1], David Jackson[1], Ji Chen[1] and Paul Tubel[2]
Applied Electromagnetics Research Group
[1] Department of Electrical and Computer Engineering, University of Houston
Houston, TX 77204-4005
[2] Tubel Energy, Inc., 25907 Oak Ridge Dr, The Woodlands, TX 77380

Wireless power transmission is beneficial for geophysical applications, where it is desired to transfer power from one point to another along a pipe or between two pipes with an obstruction in between. This investigation focuses on optimizing the achievable range and power transfer efficiency when transmitting wirelessly between two coils that are wrapped around pipes in a lossy environment. A CAD model for the transmitting and receiving coils is used to calculate the power transfer efficiency and study the eddy current loss in the lossy environment. Encapsulating the coils with an insulated casing increases the power transfer efficiency by reducing eddy currents, and it also makes the system less sensitive to the surrounding environment.

UNSUPERVISED DISCOVERY OF SUBSPACE TRENDS IN HIGH DIMENSIONAL DATA

Yan Xu*[1], Peng Qiu[2], and Badrinath Royam[1]
[1]Bio-image Analytics Lab, Department of Electrical and Computer Engineering
University of Houston
[2]Department of Biomedical Engineering
Georgia Tech and Emory University

The goal of this project is to develop scalable automated algorithms for discovering previously unknown hidden trends in massive high-dimensional data sets for hypothesis generation, knowledge discovery, and prediction. In real-world applications, trends are often obscured by the presence of irrelevant dimensions, noise, and missing data points, and therefore cannot be revealed by data visualization using current dimension reduction and embedding methods. Our preliminary work has resulted in a novel graph-theoretic measure for sensing concordant progressive changes across data dimensions relevant to hidden subspace trends. Using this measure, we have prototyped an unsupervised subspace trend discovery algorithm that successfully identified verifiable subspace trends in diverse real-world biomedical datasets including time-dependent gene expression arrays, cell morphology changes over the cell cycle, and brain microglia arbor morphology data.

MONOLITHIC NANOPOROUS GOLD NANOPARTICLEs

Fusheng Zhao*[1], Jianbo Zeng[1], and Wei-Chuan Shih[1]
BioNanoPhotonics Research Group
[1] Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

We propose nanoporous gold disk (NPGD) released from substrate as novel gold nanostructure. Patterned or mechanically stamped NPG has been reported has an excellent Surface enhanced Raman spectroscopy (SERS) enhancement factor.[1-3] The effective nanoporous surface area of NPGD is estimated to be ~10 times of its projected area, thereby provides more attachment sites for analyte adsorbates. The proposed NPGD can be fabricated with controlled size, shape and they could also be released from substrate and recovered into NPGD colloidal. By using polystyrene beads with different diameter as etching mask, NPGD with size ranges from 300nm to 700nm are made.

SOCIAL NETWORK AWARE DEVICE-TO-DEVICE COMMUNICATION IN WIRELESS NETWORKS

Yanru Zhang*, Erte Pan, and Zhu Han
Wireless Networking, Signal Processing and Security Lab
Department of Electrical and Computer Engineering
University of Houston, Houston, TX 77204-4005

A tremendous amount of data is circulating over today's wireless networks, thus requiring novel approaches for network design. Device-to-device (D2D) communication is seen as a major technology to overcome the imminent wireless capacity crunch. We propose a social-aware approach for optimizing D2D communication by exploiting two layers: the social network layer and physical wireless network layer. We formulate the physical layer D2D network according to users' encounter histories. Subsequently, we propose an approach, based on the Indian Buffet Process (IBP) to model the distribution of contents in online social networks. Given the social relations, we propose the traffic offloading algorithm in D2D communication

ENSEMBLE MULTIPLE KERNEL ACTIVE LEARNING FOR CLASSIFICATION OF MULTI-SOURCE REMOTE SENSING DATA

Yuhang Zhang* adn Saurabh Prasad
Hyperspectral Image Analysis Group
Department of Electrical and Computer Engineering
University of Houston
Houston, TX 77204-4005

Incorporating disparate features from multiple sources can provide valuable diverse information for remote sensing data analysis. However, multi-source remote sensing data require large quantities of labeled data to train robust classifiers, which in reality is often difficult and expensive to acquire. In this paper, we propose an ensemble multiple kernel active learning (MKL-AL) framework that incorporates different types of features extracted from multi-sensor remote sensing data (hyperspectral imagery and LiDAR data) for robust classification. The experiment in a multi-source environment validates the efficacy of the proposed approach