UNIVERSITY of HOUSTON | ENGINEERING

Department of Electrical & Computer Engineering

14th Graduate Research Conference

April 27, 2018

The Hilton UH Hotel & Conference Center

Houston, Texas

8:30 - 8:55 am	Registration, Conrad, Ballroom, Lobby
8:55 - 9:00 am	Opening Remarks by Dr. Wanda Wosik, Classroom 180
9:00 - 10:05 am	Technical Program - Oral Session **A**, Classroom 180
10:05 -10:30 am	Welcoming Remarks, Conrad, Ballroom • Dr. Joe Tedesco, Dean, College of Engineering • Dr. Suresh Khator, Associate Dean, College of Engineering • Dr. Badri Roysam, Chairman, Electrical and Computer Engineering
10:30 - 10:45 am	*Coffee Break*, Conrad, Ballroom, Lobby
10:45- 11:50 am	Technical Program - Oral Session **B**, Classroom 180
11:50- 12:45 pm	Lunch, Conrad, Ballroom
12:30 - 1:15 pm	Keynote Presentation, "Lost in Translation: A Tragedy of our Times", *Dr. Mauro Ferrari,* President & CEO, Houston Methodist Research Institute; Director, Institute for Academic Medicine; Executive Vice President, Houston Methodist; Senior Associate Dean and Professor of Medicine, Weill Cornell Medical College, New York
1:15 - 2:20 pm	Technical Program - Oral Session **C**, Classroom 180
2:20 - 2:30 pm	*Coffee Break,* Conrad, Ballroom, Lobby
2:30 - 3:35 pm	Technical Program - Oral Session **D**, Classroom 180
3:35 - 5:30 pm	Technical Program - Poster Session, Conrad, Ballroom
5:30 - 6:00 pm	Elevator Talks by CDC students, Conrad, Ballroom
6:00 - 6:30 pm	Awards Ceremony Conrad, Ballroom

TECHNICAL PROGRAM

Session A: Numerical Computing and Optimization, Deep Learning; Power Energy Systems and Batteries

Session Type: Oral
Time: 9:00 – 10:05 am
Faculty Chair: Dr. David Jackson

		Poster #
9:00 – 9:05 am	**SEMI-SUPERVISED DEEP LEARNING FOR HYPERSPECTRAL IMAGE CLASSIFICATION** *Souvick Mukherjee and Saurabh Prasad*	A1
9:06 – 9:11 am	**PARALLEL MCMC FOR LARGE-SCALE GEOSTEERING INVERSION AND UNCERTAINTY QUANTIFICATION** *Han Lu, Qiuyang Shen, Xuqing Wu, Jiefu Chen, and Xin Fu*	A2
9:12 – 9:17 am	**APPLICATION OF PSO METHOD ON GEOSTEERING INVERSE PROBLEMS** *Li Yan, Han Lu, Qiuyang Shen, and Jiefu Chen*	A3
9:18 – 9:23 am	**NUMERICAL OPTIMIZATION, DESIGN, AND TESTING OF AN UNDERWATER-FIRING SELF-ASSEMBLED GAUSS GUN** *Mohammad M. Sultan, Jarrett Lonsford, Javier Garcia, Julien Leclerc, Mohamad Ghosn and Aaron T. Becker*	A4
9:24 – 9:29 am	**ENERGY EFFICIENT FOG COMPUTING WITH ARCHITECTURE OF SMART TRAFFIC LIGHT SYSTEM** *Yawen Luo and Yuhua Chen*	A5
9:30 – 9:35 am	**SOLID STATE AUTO-TRANSFORMER CONCEPT FOR MULTI-PULSE RECTIFIERS** *Srikanth Yerra and Harish S. Krishnamoorthy*	A6
9:36 – 9:41 am	**COUPLED INDUCTOR HYBRID CIRCUIT BREAKER FOR HVDC GRID APPLICATION** *Anindya Ray, Satish Naik, and Kaushik Rajashekara*	A7
9:42 – 9:47 am	**A MATRIX CONVERTER BASED SINGLE STAGE DC AC CONVERTER WITH REDUCED DEVICE COUNT** *Parthasarathy Nayak, Sumit Pramanick and Kaushik Rajashekara*	A8

9:48 – 9:53 am	**MODELING THE STRUCTURE OF SODIUM SOLID STATE ELECTROLYTES** *Haotian Zheng and Yan Yao*	A9
9:54 – 9:59 am	**AQUEOUS RECHARGEABLE BATTERIES UTILIZING VERSATILE ORGANIC REDOX ELECTRODES** *Michael de la Torre, Saman Gheytani, and Yan Yao*	A10
10:00 –10:05 am	**DEVELOPING PLASMONIC IMAGING FOR IN-SITU UNDERSTANDING OF SOLID ELECTROLYTE INTERPHASE FORMATION** *Chaojie Yang and Xiaonan Shan*	A11
10:05 –10:30 am	**Welcoming Remarks and Addresses, Classroom 180** • Dr. Joe Tedesco, Dean, College of Engineering • Dr. Suresh Khator, Associate Dean, College of Engineering • Dr. Badri Roysam, Chairman, Electrical and Computer Engineering	
10:30 – 10:45 am	***Coffee Break***	

Session B: Fabrication Methods, Design, and Control of Micro- and Nano Probes, Structures, and Microrobots

Session Type: Oral
Time: 10:45 – 11:50 am
Faculty Chair: Dr. Jiming Bao

10:45 – 10:50 am	**A WATER DROPLET SMARTPHONE MICROSCOPE** *Yulung Sung, Zhenyu Hu, and Wei-Chuan Shih*	B1
10:51 – 10:56 am	**PB^{2+} DETECTION IN DRINKING WATER USING DARK FIELD SMARTPHONE MICROSCOPE** *Hoang Nguyen and Wei-Chuan Shih*	B2
10:57 – 11:02 am	**SUPPRESSION OF HYDRATE FORMATION DURING PALLADIUM DEPOSITION USING LEAD** *M. Yarali, K. Ahmadi, W. Yang, and S. R. Brankovic*	B3
11:03 – 11:08 am	**DO-IT-YOURSELF VEIN-MAPPING WITH A SECURITY CAMERA AND INFRARED LEDS** *Mohsen Rakhshanderoo, Yulung Sung, and Wei-Chuan Shih*	B4
11:09 – 11:14 am	**DESIGNING SYNTHETIC MICROVASCULAR MODELS WITH REALISTIC STRUCTURE AND FLOW** *Jiaming Guo, Paul Ruchhoeft, and David Mayerich*	B5
11:15 – 11:20 am	**MAGNETIC MANIPULATION OF UNTETHERED MINIATURE ROBOTS FOR SURGICAL APPLICATION** *Julien Leclerc and Aaron T. Becker*	B6

11:21 – 11:26 am	**FABRICATION OF ULTRA-SENSITIVE GOLD NANOPARTICLES WITH FAR FIELD COUPLING AND UNDERCUTTING** *Ibrahim Misbah and Wei Chuan Shih*	B7
11:27 – 11:32 am	**STUDY OF CAVITATION DYNAMICS OF MICROBUBBLES THROUGH PHOTOTHERMAL EFFECT ON NANOPOROUS GOLD DISC (NPGD)** *Abu Farzan Mitul, and Wei-Chuan Shih*	B8
11:33 – 11:38 am	**HYDROGEN ADSORPTION AND HYDROGEN EVOLUTION REACTION ON SINGLE CRYSTAL Au(111), Ru(0001),Pd(111) and Pt(111) ELECTRODES STUDIED BY IN-SITU ELECTROCHEMICAL INFRARED SPECROSCOPY** *Mehrnaz Shirazi and Stanko Brankovic*	B9
11:39 – 11:44 am	**STUDY OF ELECTROLESS DEPOSITION OF PB MONOLAYER ON GOLD BY EQCM** *W. Yang, S.R.R. Brankovic, and F. C. Robles Hernández*	B10
11:45 – 11:50 am	**A UAV FOR DESTRUCTIVE SURVEYS OF MOSQUITO POPULATION** *An Nguyen, Dominik Krupke, Mary Burbage, Shriya Bhatnagar, S´andor P. Fekete, and Aaron T. Becker*	B11
11:50 – 12:45 pm	**Lunch**, Conrad Ballroom	
12:30 – 1:15 pm	**Keynote Presentation**, **"Lost in Translation: A Tragedy of our Times", *Dr. Mauro Ferrari,*** President & CEO, Houston Methodist Research Institute; Director, Institute for Academic Medicine; Executive Vice President, Houston Methodist; Senior Associate Dean and Professor of Medicine, Weill Cornell Medical College, New York	

Session C: Broad Engineering Tools at nano-, micro-, and macro-scale for Biomedical Diagnostics, Treatment, and Rehabilitation of Patients

Session Type: Oral
Time: 1:15 – 2:15 pm
Faculty Chair: Dr. Jack Wolfe

1:15 – 1:20 pm	**A STATE-SPACE APPROACH FOR DETECTING STRESS FROM ELECTRODERMAL ACTIVITY** *Dilranjan S. Wickramasuriya, Chaoxian Qi, and Rose T. Faghih*	C1
1:21 – 1:26 pm	**SYSTEM IDENTIFICATION OF ELECTRODERMAL ACTIVITY VAI HARTLEY MODULATING FUNCTION** *Md. Rafiul Amin and Rose T. Faghih*	C2

1:27 – 1:32 pm	**HIGH RANGE PORTABLE BIOIMPEDANCE SPECTROMETER WITH FOUR ELECTRODE ANALOG FRONT END FOR CHARACTERIZATION OF MITOCHONDRIA BIOENERGETICS** *Uday Kiran Karlapudi, Joe Charlson, Jarek Wosik, Jinghong Chen and Wanda Wosik*	C3
1:33 – 1:38 pm	**A WIDEBAND COMPLEMENTARY NOISE AND DISTORTION CANCELING LNA FOR HIGH-FREQUENCY ULTRASOUND IMAGING APPLICATIONS** *Yuxuan Tang, Yulang Feng, Qingjun Fan, and Jinghong Chen*	C4
1:39 – 1:44 pm	**OBSERVATION AND STATISTICS OF THE MECHANICS OF MEMBRANE VIBRATIONS IN HELA CELLS USING SPR IMAGING** *Suraj Khochare and Xiaonan Shan*	C5
1:45 – 1:50 pm	**COMPUTATIONAL METHODS FOR PROFILING CELLULAR HETEROGENEITY & SPATIAL PATTERN DISCOVERY IN WHOLE BRAIN RAT SLICES AFTER TRAUMATIC BRAIN INJURY** *Jahandar Jahanipour and Badri Roysam*	C6
1:51 – 1:56 pm	**PREDICTING HAND GRIP FORCES FROM NONINVASIVE ELECTROENCEPHALOGRAPHY** Andrew Y. Paek, Alycia Gailey, Pranav Parikh, Marco Santello, and Jose Contreras-Vidal	C7
1:57 – 2:02 pm	**Prediction of joint angles during treadmill walking using EEG and LSTM** *Sho Nakagome, Trieu Phat Luu, Yongtian He and Jose L. Contreras-Vidal*	C8
2:03 – 2:08 pm	**DEVELOPMENT OF A PEDIATRIC LOWER-EXTREMITY GAIT SYSTEM** *David Eguren, Atilla Kilicarslan, Trieu Phat Luu, Samuel Akinwande, Marianna Zanovello, Anirudh Arunkumar[1] and Jose L. Contreras-Vidal*	C9
2:09 – 2:14 pm	**CHARACTERIZATION OF IMPROVISATIONAL CREATIVE PROCESS IN THE VISUAL ARTS THROUGH MOBILE BRAIN-BODY IMAGING** *Jesus G. Cruz-Garza and Jose Luis Contreras-Vidal*	C10
2:15 – 2:20 pm	**DESIGN OF AUTOMATED SYSTEM FOR EMOTIONAL CONTENT RETRIEVAL IN IMAGES** *Saikiran Ambati and Bhavin R. Sheth*	C11
2:20 – 2:30 pm	***Coffee Break***	

Session D: Cellular Imaging Techniques and Inverse Problems Solving; Mapping and Controlling Particles and Robot Motions.

Session Type: Oral
Time: 2:30 – 3:35 pm
Faculty Chair: Dr. Aaron Becker

2:30 – 2:35 pm	**DIGITAL STAINING OF FTIR SPECTROSCOPIC IMAGES** *Mahsa Lotfollahi, Sebastian Berisha, Davar Daeinejad, David Mayerich*	D1
2:36 – 2:41 pm	**MITIGATING FRINGING IN DISCRETE FREQUENCY INFRARED IMAGING USING TIME-DELAYED INTEGRATION** *Shihao Ran, Sebastian Berisha, Rupali Mankar, Wei-Chuan Shih, and David Mayerich*	D2
2:42 – 2:47 pm	**SECOND-GENERATION GPU-BASED SEGMENTATION FOR HIGH-THROUGHPUT TIME-LAPSE IMAGING MICROSCOPY IN NANOWELL GRIDS (TIMING 2)** *Jiabing Li, Leila Saadatifard, Navin Varadarajan, Badri Roysam, and David Mayerich*	D3
2:48 – 2:53 pm	**ACTIVE LEARNING FOR EFICIENTLY TRAINING CONVOLUTIONAL NEURAL NETWORKS** *Aditi Singh, Hien Nguyen, and Badri Roysam*	D4
2:54 – 2:59 pm	**A FULLY-AUTOMATED DEEP LEARNING TECHNIQUE FOR DETECTING AND CLASSIFYING CELLS IN PHASE-CONTRAST TIME-LAPSE IMAGES** *Leila Saadatifard, Melisa Martinez, Navin Varadarajan, and David Mayerich*	D5
3:00 – 3:05 pm	**STUDIES ON A TRANSMISSION MECHANISM OF CONDUITS FILLED WITH RIGID MEDIA** *Haoran Zhao, Aaron T. Becker, and Nikolaos V. Tsekos*	D6
3:06 – 3:11 pm	**EXPLOITING NON-SLIP WALL CONTACTS TO POSITION TWO PARTICLES USING A SHARED INPUT** *Shiva Shahrokhi, Jingang Shi, Benedict Isichei and Aaron T. Becker*	D7
3:12 – 3:17 pm	**ASSEMBLY AND SORTING OF POLYOMINOES UNDER UNIFORM CONTROL INPUTS** *Sheryl Manzoor, Aaron T. Becker, Li Huang, Arne Schmidt, Phillip Keldenich, Dominik Krupke, and Sándor P. Fekete*	D8
3:18 – 3:23 pm	**ROBOT MOTION PLANNING USING GLOBAL INPUTS AND OBSTACLE INTERACTION** *Parth Joshi and Aaron Becker*	D9

3:24 – 3:29 pm	**MAPPING AN UNKNOWN REGION USING HOMOGENEOUS AND HETEROGENEOUS PARTICLES** *Arun V. Mahadev, Daniel Bao, and Aaron T. Becker*	D10
3:36 – 3:41 pm	**AUTOMATED LABEL-FREE MEASUREMENT OF TRABECULAR BONE IN BONE MARROW** *Rupali Manakr, Mustafa Kansiz, Carlos Bueso-Ramos and David Mayerich*	D11

Session E: POSTER PRESENTATIONS

Time: 3:30 – 5:30 pm, Conrad, Ballroom

All posters will match talks presented by the graduate students in oral sessions.

5:30– 6:00 pm	**Elevator Talks by CDC Students**, hosted by Dr. Len Trombetta, Conrad, Ballroom
6:00 – 6.30 pm	**Awards Ceremony and Reception**, Conrad, Ballroom

ABSTRACTS

A 1. SEMI-SUPERVISED DEEP LEARNING FOR HYPERSPECTRAL IMAGE CLASSIFICATION

Souvick Mukherjee and Saurabh Prasad, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

The limited availability of labeled data makes the branch of semi-supervised learning very important in the field of classical machine learning. Recently, deep learning based classification methods have gained popularity due to their effectiveness in supervised classification tasks. Supervised classification for deep learning requires a large number of labeled samples in order to prevent over-fitting. Due to this reason semi-supervised methods have gained popularity in this field. We propose a metric distance based semi-supervised-deep-learning method for hyperspectral-image classification.

A 2. PARALLEL MCMC FOR LARGE-SCALE GEOSTEERING INVERSION AND UNCERTAINTY QUANTIFICATION

Han Lu[1], Qiuyang Shen[1], Xuqing Wu[2], Jiefu Chen[1], Xin Fu[1], [1]Department of Electrical and Computer Engineering, [2]Department of Information and Logistics Technology, University of Houston, Houston, TX 77204-4005

Geosteering is the dynamic directional control of a well based on the downhole measurements. Inversion methods make it possible to know the subsurface structure of earth. Compared with traditional deterministic methods, statistical inversion is more capable of finding global optima of nonlinear inversion problems. In this paper, we use parallel Markov chain Monte Carlo (MCMC) method to solve geosteering problems and analyze corresponding uncertainty. A clustering method is used to select the most possible solution among many solutions. The simulation results indicate that this method achieve the similar inversion accuracy with a much shorter running time.

A 3. APPLICATION OF PSO METHOD ON GEOSTEERING INVERSE PROBLEMS

Li Yan, Han Lu, Qiuyang Shen, and Jiefu Chen, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

With the development of extra-deep reading logging while drilling (LWD) tools, the task to reconstruct the earth model becomes increasingly difficult due to more unknown parameters required to be inverted, which results in the high non-linearity of inverse problems. It is known that the conventional deterministic methods are prone to be trapped in local minima. Therefore, an alternative approach called particle swarm optimization (PSO) is recommended to solve the complex inversion in this study. An example will be presented in the end to illustrate the excellent global searching performance of PSO method.

A 4. NUMERICAL OPTIMIZATION, DESIGN, AND TESTING OF AN UNDERWATER FIRING SELF-ASSEMBLED GAUSS GUN

Mohammad M. Sultan, Jarrett Lonsford, Javier Garcia, Julien Leclerc, Mohamad Ghosn, and Aaron T. Becker, Department of Electrical and Computer Engineering , University of Houston, Houston, TX 77204-4005

MRI-based navigation and propulsion of millirobots is a new and promising approach for minimally invasive therapies. The strong constant magnetic field inside the scanner precludes torque-based control. Here it shows numerical analysis and results for optimizing the kinetic energy generated by a Gauss gun to penetrate tissue, deliver a drug or remove a clot. This analysis based on the equations of energy for an MRI Gauss gun. The numerical method used for this optimization is Nelder Mead, implemented in Mathematica software. Also it shows experiments done inside and outside the MRI, in air and underwater.

A 5. ENERGY EFFICIENT FOG COMPUTING WITH ARCITECTURE OF SMART TRAFFIC LIGHT SYSTEM

Yawen Luo, Junchao Wu, and Yuhua Chen, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Compared to cloud computing, newly evolved fog computing is still in its infancy, especially the energy consumption field. In this paper, we propose a Smart Traffic Lights System (STLS), based on which we studied fog computing energy consumption by comparing it with cloud computing. Apart from theoretical analysis and/or experiments, we conduct dynamic modeling and perform the simulation with the iFogSim simulator. Our results show that in STLS application fog does save energy when compared to the cloud in omnidirectional considerations.

A 6. SOLID STATE AUTO-TRANSFORMER CONCEPT FOR MULTI-PULSE RECTIFIERS

Srikanth Yerra and Harish S. Krishnamoorthy , Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Typical non-isolated multi-pulse rectifier configurations in applications such as aircrafts, ships, etc. consist of a low frequency (LF) auto-transformer, followed by 3-phase diode bridges at the interface of the AC power source. This paper proposes a higher frequency (HF) solid state auto-transformer (SSAT) based interface that can serve as a retrofit replacement to existing bulky LF auto-transformers in such applications and reduce the system weight/volume. In the proposed approach, the LF AC voltages are converted to HF AC voltages that are applied to the primary windings of higher frequency auto-transformers. Overall, the SSAT approach improves power density of the front-end auto-transformer, while maintaining similar source current quality and efficiency as in conventional LF auto-transformer based multi-pulse rectifiers.

A 7. COUPLED INDUCTOR HYBRID CIRCUIT BREAKER FOR HVDC GRID APPLICATION

Anindya Ray, Satish Naik, and Kaushik Rajashekara, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Reliability of DC grid depends on fast fault interruption capability of the switchgear. Faster fault interruption is achieved by using solid state circuit breakers (SSCB) at the expense of high conduction power loss. Hybrid circuit breakers combining the features of mechanical breakers and SSCB show better performance in terms of efficiency. This paper presents a hybrid couple inductor DC circuit breaker topology. The coupled inductor and a commutation capacitor forms a resonant circuit during fault to force zero crossing of fault current in the mechanical switch. Proposed topology do not require pre-charging of commutation capacitor and also eliminate the requirement of surge arrester used for suppressing stored energy present in the network inductance. Analysis and design of the proposed circuit breaker topologies are presented and validated through simulation.

A 8. A MATRIX CONVERTER BASED SINGLE STAGE DC-AC CONVERTER WITH REDUCED DEVICE COUNT

Parthasarathy Nayak, Sumit Pramanick and Kaushik Rajashekara, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

This paper proposes a matrix converter based single stage single phase isolated DC-AC converter topology with reduced switch count. The isolation is provided by a center-tapped transformer. The DC side is a full bridge (FB) inverter, and the AC side consists of a matrix converter based cycloconverter. The converter is operated by a soft-switched unipolar SPWM scheme with synchronous rectification (SR). This modulation technique provides zero voltage switching (ZVS) for FB side devices and zero current switching (ZCS) for cycloconverter side devices. It addition, it also provides natural commutation for grid current and transformer leakage inductor current during unity power factor (UPF) operation. A regenerative flyback snubber circuit is also presented for non-unity power factor operation. A SiC MOSFET based 1.2 kW prototype is built based on the proposed topology to evaluate performance of the proposed modulation scheme. The improvements in the converter performance are discussed in this paper.

A 9. MODELING THE STRUCTURE OF SODIUM SOLID STATE ELECTROLYTES

Haotian Zheng[1] and Yan Yao[1,2], [1]Department of Electrical and Computer Engineering and, Materials Science and Engineering Program, [2]Texas Center for Superconductivity, University of Houston, Houston, Texas 77204, USA.

The interfacial stability between sodium and the solid-state electrolyte is crucial for the cycle life and rate performance of the all-solid-state sodium batteries. Despite the high ionic conductivities of sulfide-based solid state electrolytes, most of them will react with metallic sodium anode and lead to a large interfacial resistance. By doping oxygen into the Na_3PS_4 glass, the $Na_3PS_{4-x}O_x$ (x=1) glassy electrolyte shows an improved electrochemical stability against Na metal.

We use Reverse Monte Carlo method to simulate pair distribution function(PDF) of $Na_3PS_{4-x}O_x$ (x=1) glassy electrolyte. It can help us have better understanding of glass electrolyte structure and reveal the mechanism of stability improvement.

A 10. AQUEOUS RECHARGEABLE BATTERIES UTILIZING VERSATILE ORGANIC REDOX ELECTRODES

Michael de la Torre[1,2], Saman Gheytani[1,2], and Yan Yao[1,2], [1] Department of Electrical and Computer Engineering, [2] Materials Science and Engineering Program, University of Houston, Houston, TX 77204-4005

Aqueous rechargeable batteries alleviate safety concerns of Li-ion batteries by using water as the electrolyte solvent. However, this comes with the cost of limiting the amount of energy and power that we can store in our battery as well as limiting material options for battery electrodes.

With recent advances of "water-in-salt" electrolytes, higher energy densities can be achieved in aqueous batteries. Our lab has developed organic electrodes with the ability to be chemically tuned to operate within a range of battery chemistries and perform over long lifetimes. Combining these ideas, we hope to enable aqueous rechargeable batteries as a viable option for safe and long-lasting energy storage devices.

A 11. DEVELOPING PLASMONIC IMAGING FOR IN-SITU UNDERSTANDING OF SOLID ELECTROLYTE INTERPHASE FORMATION

Chaojie Yang and Xiaonan Shan, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

We develop a novel Plasmonic imaging technique to image localized SEI formation and evolving as well as how does it relate with lithium dendrites formation during initial charge-discharge cycles for lithium metal battery. This novel technique is mentioned by us as Surface Plasmonics-based electrocheical microscope (SP-ECM).

B 1. A WATER DROPLET SMARTPHONE MICROSCOPE

Yulung Sung, Zhenyu Hu, and Wei-Chuan Shih, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Water has been used as a lensing material for millennia, but have been largely ignored academically due to usability and stability issues. We demonstrate that using a single water droplet as a lens is a remarkably simple method of transforming a smartphone into a microscope. We also introduce methods of enhancing observation by spiking water with selected liquids to improve magnification and incorporate wavelength filtration.

B 2. PB^{2+} DETECTION IN DRINKING WATER USING DARK FIELD SMARTPHONE MICROSCOPE

Hoang Nguyen and Wei-Chuan Shih, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Lead contamination has always been a great concern due to its potential of causing serious illness and health problem to human. To detect trace level of lead contamination in water, bulky and costly analytical instruments are required which also are not readily available for resource-limited areas and field testing. In this report, we introduce a new method to visually detect lead ions in water using smartphone nano-colorimetry (SNC). Specifically, a sedimentation approach was done by spiking with a control quantity of chromate ions (CrO_4^{2-}) into Pb^{2+} solution to produce highly insoluble lead chromate ($PbCrO_4$) as yellow precipitates, followed by microscopic color detection and intensity quantification using SNC. The sum of the intensity of yellow pixels bears a highly reproducible relationship with Pb^{2+} concentration between 1.37-175 ppb in deionized water, and 5-175 ppb in city tap water. SNC is rapid, affordable, and can enable Pb^{2+} detection in any environment setting.

B 3. SUPPRESSION OF HYDRATE FORMATION DURING PALLADIUM DEPOSITION USING LEAD

M. Yarali, K. Ahmadi, W. Yang, and S. R. Brankovic Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Electrochemical deposition is an easy and more cost-effective way to grow thin film or a single monolayer on conductive substrate at room temperature. Palladium has attracted much attention recently due to being more costly efficient than platinum and more electro-catalytic activity in alkaline media. Palladium hydrate formation is a main obstacle during palladium deposition on gold substrate when we approach to hydrogen evolution region. Incorporation of hydrate can generate huge compression on the film. This work

investigates the effect of introduction of lead to palladium depositing solution. In-situ stress measurement has shown that presence of lead can significantly reduce the compressive stress of the deposit.

B 4. DO-IT-YOURSELF VEIN-MAPPING WITH A SECURITY CAMERA AND INFRARED LEDS

Mohsen Rakhshanderoo, Yulung Sung, and Wei-Chuan Shih, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Near infrared light is widely used for non-invasive biomedical imaging due to its transparency to body matter such as cell and bone. However, hemoglobin in red blood cells do have an absorption in this region. Here, we introduce a do-it-yourself vein-mapping technique using a high-definition security camera with an IR filter, and external 950 nm near-infrared LEDs. The LEDs do not emit in the visible spectra and the images enable accurate mapping of vein location in the body extremities.

B 5. DESIGNING SYNTHETIC MICROVASCULAR MODELS WITH REALISTIC STRUCTURE AND FLOW

Jiaming Guo, Paul Ruchhoeft, and David Mayerich, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Microvascular networks play a crucial role in tissue dynamics and disease progression. Realistic *in vitro* tissue models should therefore incorporate microvascular components with similar structure and flow properties to their *in vivo* counterparts. Recent research shows that realistic microvascular structures can be replicated in microfluidic devices. However, limitations in fabrication approaches often prevent these networks from exhibiting realistic flow. In this paper, we describe a method for inducing realistic flow by augmenting synthetic networks with connections that enforce the appropriate boundary conditions. These augmented networks are amenable to existing fabrication techniques and result in biomimetic, microvascular networks containing a single inlet and outlet port for use in traditional microfluidic setups. We demonstrate that fabricated models exhibit the expected flow properties based on *in vitro* tracking of microspheres.

B 6. MAGNETIC MANIPULATION OF UNTETHERED MINIATURE ROBOTS FOR SURGICAL APPLICATION

Julien Leclerc and Aaron T. Becker, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Untethered navigation of millirobots within a human body is a promising technology to perform minimally invasive surgery. Electromagnets arranged around a patient can be used to apply a force on magnetic robots placed inside the patient's body. The force produced by magnetic manipulators is often too weak to make robots penetrate body tissue. A millirobot was designed to solve this issue. It has a tubular structure in which a magnetic sphere moves back and forth. On the anterior side, a hard rod creates a surface for the sphere to impact. Repeated impacts produce large pulsed forces that enable tissue penetration.

B 7. FABRICATION OF ULTRA-SENSITIVE GOLD NANOPARTICLES WITH FAR FIELD COUPLING AND UNDERCUTTING

Ibrahim Misbah[1] and Wei Chuan Shih[1,2], [1]Department of Electrical and Computer Engineering, [2] Department of Biomedical Engineering,, [3] Department of Chemistry,, University of Houston, Houston, TX 77204-4005

Combining the effects of far-field coupling and undercutting with HF, substrate bound gold nanodisks with extreme sensitivity have been fabricated using nanosphere lithography. Substrate undercutting have resulted into the blue shifted LSPR peak at 926 nm and showed a sensitivity of 764nm/RIU which is very close to the theoretical limit of single disk sensing for the 350nm gold disk. Using both undercutting and far-field plasmonic coupling the Figure of Merit of nanodisks were increased from 0.35 to 2.36. The sensitivity of the substrates reported here are far superior to any of the previously reported substrates in the given wavelength range. The effects of far field plasmonic coupling and undercutting for tuning the sensitivity of the nanodisks are explored and it's established that both the effects can be fine-tuned for achieving desired sensitivity performance.

B 8. STUDY OF CAVITATION DYNAMICS OF MICROBUBBLES THROUGH PHOTOTHERMAL EFFECT ON NANOPOROUS GOLD DISC (NPGD)

Abu Farzan Mitul[1] and Wei-Chuan Shih[1, 2, 3, 4], [1]Department of Electrical and Computer Engineering, [2]Department of Biomedical Engineering, [3]Department of Chemistry, [4]Program of Materials Science and Engineering, University of Houston, 4800 Calhoun Road, Houston, Texas 77204, USA

Generation of microbubble has wide range of applications in the fields of pharmacology, medicine, food industry and material science. Recent researches show that, microbubble can be utilized for controlled drug delivery system in the affected cells and tissues. Cavitation process of microbubble can help in transportation of external substances across biological barriers by orders of magnitude over diffusive transport which can eventually create a platform for effective drug delivery into the targeted cells. Here, we are working on the generation of cavitation process of microbubble through photothermal effect on nanoporous gold disc (NPGD).

B 9. HYDROGEN ADSORPTION AND HYDROGEN EVOLUTION REACTION ON SINGLE CRYSTAL Au(111), Ru(0001),Pd(111) and Pt(111) ELECTRODES STUDIED BY IN-SITU ELECTROCHEMICAL INFRARED SPECROSCOPY

Mehrnaz Shirazi[1] and Stanko Brankovic[2,] [1] Materials Engineering Program, [2] Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Hydrogen evolution reaction (HER) on single crystal metal electrodes was investigated. Pd_{ML}/Ru(0001), Pd_{ML}/Au(111), Pd(111)-single crystal and Pt(111)-single crystal electrodes have been studied in 0.05 M sulfuric acid aqueous solution by in-situ electrochemical infrared spectroscopy. A vibrational mode characteristic of H_2 adsorption at atop sites was observed at 1900-2150 cm^{-1} for Pd_{ML}/Au(111), 2000-2080 cm^{-1} for Pd_{ML}/Ru(0001), 2090-2175 cm^{-1} for Pd(111)-single crystal and 1910-2060 for Pt(111)-single crystal. This band appears at -0.56 V vs. MSE reference electrode and grows at more negative potentials in parallel to the increase in hydrogen evolution current.

B 10. STUDY OF ELECTROLESS DEPOSITION OF PB MONOLAYER ON GOLD BY EQCM

W. Yang[1], S.R.R. Brankovic[1], and F. C. Robles Hernández[2], [1] Department of Electrical and Computer Engineering, [2] Department of Mechanical Engineering Technology, University of Houston, Houston, TX 77204-4005

Pb monolayer is a widely used sacrificial layer in metal deposition via SLRR (Surface Limited Redox Replacement) and ALD (Atomic Layer Deposition) of noble metal deposition. In the past, so many studies focused on depositing Pb monolayer by applying under potential of Pb (UPD). Here we found an easy and efficient way to do electroless deposition of Pb monolayer, in which V^{2+} is served as reducing agent. EQCM (Electrochemical Quartz Crystal Microbalance) was employed to check the mass change of Pb through the process. The mass of deposited Pb indicates V^{2+} as reducing agent successfully deposits a monolayer of Pb on the gold surface.

B 11. A UAV FOR DESTRUCTIVE SURVEYS OF MOSQUITO POPULATION

An Nguyen, Dominik Krupke, Mary Burbage, Shriya Bhatnagar, S´andor P. Fekete, and Aaron T. Beckerm [1] Department of Electrical and Computer Engineering, [2] Department of Mechanical Engineering, University of Houston, Houston, TX 77204-4005

This paper shows the new techniques for mosquito population surveys, using electrified screens, (ie. Bug zappers) mounted to an UAV. The instrumentation on the UAV logs the path, GPS location, attitude and the time of each mosquito zapped. When the UAV changes paths, it also changes the number of mosquitos it encountered. This paper poses this as a new problem in robotic coverage. The paper provides a simulator for mosquitos in flight and a UAV with an electrified screen. In addition, four baseline algorithms are compared to establish a benchmark. The hardware experiments with a UAV equipped with an electrified screen provide real-time measurements of previous mosquito locations and mosquito-free volumes.

C 1. A STATE-SPACE APPROACH FOR DETECTING STRESS FROM ELECTRODERMAL ACTIVITY

Dilranjan S. Wickramasuriya, Chaoxian Qi, and Rose T. Faghih, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

The human body responds to stress in multiple ways through its autonomic nervous system and a pertinent issue is to quantify this state of neurocognitive stress. State-space models have previously been applied to uncover an unobserved neural state from physiological signals and behavioral data. We relate stress to the probability that a phasic driver impulse occurs in a skin conductance signal, and apply state-space modeling to extracted binary measures in order to continuously track a stress level across episodes of relaxation, cognitive and emotional stress. Results demonstrate a promising approach for tracking stress through wearable devices.

C 2. SYSTEM IDENTIFICATION OF ELECTRODERMAL ACTIVITY Via HARTLEY MODULATING FUNCTION

Md. Rafiul Amin and Rose T. Faghih, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Electrodermal Activity (EDA) indicates eccrine sweat gland activity which is partly caused by physiological events including different emotions. To understand emotions, recovery of underlying neural stimuli and the corresponding rise and fall times is a challenging problem. Previously proposed

deconvolution schemes for EDA data include a non-convex optimization step for system parameter estimation. We use the Hartley modulating function to formulate a convex optimization formulation. We illustrate that our algorithm outperforms previous algorithms.

C 3. HIGH RANGE PORTABLE BIOIMPEDANCE SPECTROMETER WITH FOUR ELECTRODE ANALOG FRONT END FOR CHARACTERIZATION OF MITOCHONDRIA BIOENERGETICS

Uday Kiran Karlapudi, Joe Charlson, Jarek Wosik, Jinghong Chen and Wanda Wosik, Department of Electrical and Computer Engineering,, University of Houston, Houston, TX 77204-4005

Design of a high range portable bioimpedance spectrometer with four electrode analog front end for characterization of mitochondria bioenergetics. Mitochondrial dysfunction has been linked to many diseases including diabetes, obesity, heart failure and aging. The synthesis of Adenosine Tri Phosphate (ATP) is determined by the electrical potential across the inner mitochondrial membrane and by the pH difference due to proton flux across it. This circuit helps study the influence of frequency over mitochondria. The proposed bio impedance spectroscopy uses four-point analog front-end setup, i.e., two electrodes induce current while the other two electrodes pick up the voltage. This reduces the Maxwell-Wagner and counter ion polarization effects. This circuit has wide bandwidth of 2MHz, and high range for impedance measurement form 50 Ω to 50 MΩ. The probes used for measuring impedance of mitochondria are also custom designed to fit into Oroboros Oxygraph 2K machine which measure the oxygen consumption of mitochondria, so that we can measure both impedance and oxygen consumption simultaneously.

C 4. A WIDEBAND COMPLEMENTARY NOISE AND DISTORTION CANCELING LNA FOR HIGH-FREQUENCY ULTRASOUND IMAGING APPLICATIONS

Yuxuan Tang, Yulang Feng, Qingjun Fan and Jinghong Chen
Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

This paper presents a simultaneous noise and distortion canceling low noise amplifier (LNA) for highfrequency ultrasound imaging applications. A feedforward noise canceling (NC) technique is developed to achieve both low noise figure (NF) and good input impedance matching (S11). The LNA also exploits the complementary characteristics of NMOS and PMOS transistors to cancel the second-order harmonic for linearity enhancement. The proposed LNA is designed in a 0.18 μm CMOS technology and exhibits a 6 dB NF and a 10 dB total harmonic distortion (THD) improvements. The LNA is specifically designed for 30-120 MHz high-frequency ultrasound transducers. At 30 MHz, the LNA achieves a NF of 2.1 dB, a voltage gain of 19 dB, and a THD of 60 dB under 1 mV peak-to-peak input. The core circuit draws 10 mA current from a 1.8 V supply.

C 5. OBSERVATION AND STATISTICS OF THE MECHANICS OF MEMBRANE VIBRATIONS IN HELA CELLS USING SPR IMAGING

Suraj Khochare and Xiaonan Shan, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Surface Plasmon Resonance Imaging is a label-free non-invasive technique for observation of cancer cells. We are interested in studying the mechanics of cell membrane vibrations of HELA cells. SPR provides good lateral resolution and enough longitudinal resolution for this purpose. This enables us to monitor the activity of cell features like membrane proteins which are responsible for communication and transport of

materials in and out of the cell. We may use this technique to monitor cell response to different drugs used for treatment of cancer.

C 6. COMPUTATIONAL METHODS FOR PROFILING CELLULAR HETEROGENEITY & SPATIAL PATTERN DISCOVERY IN WHOLE BRAIN RAT SLICES AFTER TRAUMATIC BRAIN INJURY

Jahandar Jahanipour and Badri Roysam, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Development of novel image analysis methods and pattern recognition techniques can provide powerful new tools to investigate large image datasets efficiently and accurately. Deep learning has been widely used in analysis of large imaging datasets. In this study, we define the machine learning task of extracting and clustering abstract representations of the samples using the deep hierarchical clustering method. We demonstrate comprehensive results on profiling cellular heterogeneity with biologically plausible interpretations. We report deep profiling of astrocyte activation status in brain tissue and recapitulation of the layered cytoarchitecure of cortical layers.

C 7. PREDICTING HAND GRIP FORCES FROM NONINVASIVE ELECTROENCEPHALOGRAPHY

Andrew Y. Paek[1], Alycia Gailey[2], Pranav Parikh[3], Marco Santello[4], and Jose Contreras-Vidal[1],
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Robotic devices show promise in restoring motor abilities to individuals with paresis or amputations. We propose that these robotic devices can be controlled through scalp electroencephalography (EEG), a neuroimaging technique that can capture motor commands through brain rhythms. In this work, we studied the extent to which EEG can be used to predict an individual's grip forces produced by the hand. Brain rhythms and grip forces were recorded from able-bodied human subjects while they performed an isometric force production task and a grasp-and-lift task. Trajectory reconstruction models were trained and tested through 10-fold cross validation.

C 8. PREDICTION OF JOINT ANGLES DURING TREADMILL WALKING USING EEG AND LSTM

Sho Nakagome, Trieu Phat Luu, Yongtian He, and Jose L. Contreras-Vidal, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Neural decoding is a crucial part in Brain Computer Interface as a fundamental node that connects intentions from the brain to the output (e.g. Joint angles). Here, we used Long-Short Term Memory (LSTM), a type of recurrent neural network (RNN) based approach in decoding joint angles of the lower limb using electroencephalography (EEG) signals while subjects are walking on a treadmill. The performance was compared against Unscented Kalman Filter (UKF) algorithm which was used in the same dataset for other publications. LSTM outperformed UKF in a preliminary research improving the Pearson's correlation values of more than 0.2 in average.

C 9. DEVELOPMENT OF A PEDIATRIC LOWER-EXTREMITY GAIT SYSTEM

David Eguren, Atilla Kilicarslan, Trieu Phat Luu, Samuel Akinwande, Marianna Zanovello, Anirudh Arunkumar, and Jose L. Contreras-Vidal, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

This project reports the ongoing development of a powered, lower-body exoskeleton prototype for over-ground walking, suitable for children with gait limiting conditions. The system is designed to allow for automated multimodal gait intent detection, including EMG and EEG, and includes innovative structural design based on 3D printing for improved fit and functionality. The system includes six actuated degrees of freedom in the sagittal plane about the hip, knee and ankle joints. Robotic assisted gait trainers are currently available for adults, however the tools for children are limited to clinical settings due to their large size. Thus, this project seeks to develop a custom, pediatric powered exoskeleton for young children.

C 10. TOWARDS AUTOMATIC FEATURE EXTRACTION IN ARTISTIC MOBILE BRAIN BODY IMAGING

Jesus G. Cruz-Garza[1, 2] and Jose Luis Contreras-Vidal[1], [1] Department of Electrical and Computer Engineering, [2] Center for Advanced Computational and Data Science, University of Houston, Houston, TX 77204-4005

Skilled visual artists were instrumented with wireless EEG, inertial units, and video recording devices, performed in a public setting. A classical machine learning approach with a predefined set of features is compared to a deep learning approach with automatic feature extraction. The electro-cortical data shows differences in frontal (1-4Hz, 8-12Hz), central (8-12Hz, 30-50Hz), and posterior (8-50Hz) brain networks as the artists engage in the improvisational tasks, both in classical and automatic feature extraction methods. Automatic feature extraction and visualization has the potential to uncover distinct neural features associated with varied tasks in human cognitive output.

C 11. TOWARDS AUTOMATIC FEATURE EXTRACTION IN ARTISTIC MOBILE BRAIN BODY IMAGING

Saikiran Ambati and Bhavin R. Sheth, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Visual images affect humans on an emotional level, being able to reliably and automatically estimate the degree and kind of emotion aroused in a typical observer has widespread significance in social media, business analytics, etc., Attempts to automate emotion detection in images have been largely unsuccessful due to lack of images independently evaluated for emotional content, limited generality of approach, etc., Here, we overcome these limitations by using a hybrid, integrated approach that automatically extract the level of arousal and valence in images from standardized data sets of IAPS, NAPS evaluated for emotional content. Our approach broadly consists of two components: the front end consists of several classifiers to identify different semantic content in the image from images not found in the image base; the back-end component takes output from front end and weights the contribution of each semantic category to generate a discrete output of image valence (+/-) and arousal (low/medium/high). System performance is evaluated by comparing its prediction with ground truth data.

D 1. DIGITAL STAINING OF FTIR SPECTROSCOPIC IMAGES

Mahsa Lotfollahi, Sebastian Berisha, Davar Daeinejad, and David Mayerich, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Current methods for cancer detection rely on tissue biopsy, chemical labeling/staining, and examination of the tissue by a pathologist. Though these methods continue to remain the gold standard, they are susceptible to human error and non-quantitative. Fourier Transform Infrared (FTIR) spectroscopic imaging provides quantitative chemical and spatial information that allows the non-destructive extraction of both biochemical composition and morphology. In this work, we show that convolutional neural networks (CNNs) can efficiently classify biomedical IR spectroscopic imaging data. Our CNN-based method outperforms standard classifiers, such as a random forest classifier, that operate only on the spectral data.

D 2. MITIGATING FRINGING IN DISCRETE FREQUENCY INFRARED IMAGING USING TIME-DELAYED INTEGRATION

Shihao Ran, Sebastian Berisha, Rupali Mankar, Wei-Chuan Shih, and David Mayerich, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Infrared (IR) microscopes provide label-free non-destructive imaging of tissue samples. While most IR imaging systems rely on Fourier transform infrared (FTIR) spectroscopy, these instruments use a low-power broadband source that limits throughput. Recent coherent illumination techniques using tunable quantum cascade laser (QCL) sources can provide significantly increased throughput. However, coherent light source also induce fringing artifacts in the final image due to sample scattering. We describe an IR spectroscopic imaging system that combines a QCL-based imaging system with an MCT detector and time-delayed integration. This system can significantly mitigate fringing artifacts by simulating a coherent source in one dimension.

D 3. SECOND-GENERATION GPU-BASED SEGMENTATION FOR HIGH-THROUGHPUT TIME-LAPSE IMAGING MICROSCOPY IN NANOWELL GRIDS (TIMING 2)

Jiabing Li[1], Leila Saadatifard[1], Navin Varadarajan[2], Badri Roysam[1] and David Mayerich[1],
[1]Department of Electrical and Computer Engineering, [2]Department of Chemical Engineering, University of Houston, Houston, TX 77204-4005

Automated profiling of individual cell-cell interactions from high-throughput Time-lapse Imaging Microscopy In Nanowell Grids (TIMING) provides a method for studying variations in the effectiveness of engineered immune calls. However, current algorithms used to perform segmentation and tracking are slow and computationally expensive. This is primarily due to reliance on eigen decomposition of a large sparse matrix. In this paper, describe a revised algorithm that is able to achieve a 17% improvement in accuracy with a 70X speedup using GPU computing. This allows real-time data processing without the need of high-performance clusters and time-consuming data transfers.

D 4. ACTIVE LEARNING FOR EFFICIENTLY TRAINING CONVOLUTIONAL NEURAL NETWORKS

Aditi Singh, Hien Nguyen, and Badri Roysam, Department of Electrical and Computer Engineering University of Houston, Houston, TX 77204-4005

Classification of brain cells, is significant for in-depth study of Traumatic Brain Injuries. Convolutional

Neural Networks(CNNs) are known to handle classification problems with high intra-class variability, but they need large annotated training data, difficult to obtain in biomedical domain.
We propose a framework to train CNN, using limited training data. It iteratively selects best images to annotate for training. We use a statistical approach and a reinforcement learning based approach, for image selection. We perform a comparative study of our framework with baseline methods, for classifying rat brain cell images, to show that our framework outperforms others.

D 5. A FULLY-AUTOMATED DEEP LEARNING TECHNIQUE FOR DETECTING AND CLASSIFYING CELLS IN PHASE-CONTRAST TIME-LAPSE IMAGES

Leila Saadatifard[1], Melisa Martinez[2], Navin Varadarajan[2], and David Mayerich[1], [1] Department of Electrical and Computer Engineering, [2] Department of Chemical and Biomolecular Engineering University of Houston, Houston, TX 77204-4005

Human T cells and tumor cells are co-incubated on polydimethylsiloxane arrays of nanowells and different markers are used to fluorescently label the cells. A multi-channel time-lapse microscopy is used to image the nanowells, T cells, and tumor cells. In this work we trained a machine learning method to detect and classify different cell types and that would remove the fluorescent labeling and multi-channel imaging steps. In order to accurately predict types and locations of the cells, a big training dataset is a necessity. We used a fully automated method called ivote to generate the training set, and used that to train an object detection API.

D 6. STUDIES ON A TRANSMISSION MECHANISM OF CONDUITS FILLED WITH RIGID MEDIA

Haoran Zhao[1], Aaron T. Becker[1], and Nikolaos V. Tsekos[2], [1] Department of Electrical and Computer Engineering, [2] Department of Computer Science, University of Houston, Houston, TX 77204-4005

Fluidic transmission mechanisms use fluids to transmit force through conduits. In this paper, we present a transmission mechanism called solid-media transmission (SMT), which uses conduits filled with spheres and spacers for push-only bidirectional transmission. We report experimental studies with an SMT-actuated, one-degree-of-freedom (DoF) positioning manipulator to assess the impact of different conduit lengths, curvatures, and componentry material. The SMT mechanism may have applications in specialized domains, such as in the high magnetic field of imaging scanners, by selecting nonmagnetic, non-conductive material, and for applications with extreme temperatures or pressures.

D 7. EXPLOITING NON-SLIP WALL CONTACTS TO POSITION TWO PARTICLES USING A SHARED INPUT

Shiva Shahrokhi, Jingang Shi, Benedict Isichei and Aaron T. Becker, Department of Electrical and Computer Engineering, University of Houston, Houston, TX 77204-4005

Steered particles offer a method for targeted therapy, interventions, and drug delivery in regions inaccessible by large robots. Magnetic actuation is able to operate from a distance and allows imaging for feedback (e.g. MRI). Having more than one particle to steer makes the system underactuated because there are more states than control inputs. In previous works, we showed that the individual 2D position of two particles is controllable in a square workspace with non-slip wall contact. This work extends previous work to convex workspaces and 3D positioning. This paper also implements the algorithms using a hardware setup inspired by intestine anatomy.

D 8. ASSEMBLY AND SORTING OF POLYOMINOES UNDER UNIFORM CONTROL INPUTS

Sheryl Manzoor[1], Li Huang[1], Arne Schmidt[2], Phillip Keldenich[2], Dominik Krupke[2], , Sándor P. Fekete[2], and Aaron T. Becker[1], [1] Department of Electrical and Computer Engineering University of Houston, Houston, TX 77204-4005, [2] Department of Computer Science, Braunschweig University of Technology, Braunschweig, Germany

This work presents algorithmic results for the parallel "staged" assembly of micro-scale objects from tiny particles, which has been proposed in the context of programmable matter and self-assembly for building high yield micro-factories. The underlying model has particles moving under the influence of uniform external forces until they hit an obstacle; particles bond when forced together with a compatible particle. We have also studied the problem of sorting polyominoes using two dimensional, static and dynamic workspaces. We present hardware results for both assembly and sorting using gravity and magnetically actuated systems.

D 9. ROBOT MOTION PLANNING USING GLOBAL INPUTS AND OBSTACLE INTERACTION

Parth Joshi and Aaron Becker, Department of Electrical and Computer Engineering University of Houston, Houston, TX 77204-4005

Milli-Robots have great potential to bring transformation in the field of Medical applications, defense system, security and many other areas. One of the main challenges is to steer the Robots and Motion planning of many Milli-robots to reach the desired goal. Milli-Iron robots can be steered using magnetic field generated by MRI machine but all the robots will steer in the same direction as the magnetic effect is global and not local. In my Thesis project, I have solved instances of motion planning problem for more than one milli robots when steered using a magnetic field.

D 10. MAPPING AN UNKNOWN REGION USING HOMOGENEOUS AND HETEROGENEOUS PARTICLES

Arun V. Mahadev, Daniel Bao, and Aaron T. Becker, Department of Electrical and Computer Engineering University of Houston, Houston, TX 77204-4005

Under the Influence of a common control Input, a swarm of homogenous particles all move in the same direction, like iron particles moving towards a magnet. But particles such as 'Janus' particles have two or more types of surface properties since they are spheres split into two parts and each part is made of a different material. This property allows for a swarm of Janus particles to disperse more than homogenous particles when subjected to a magnetic field. In this work we compare homogenous and heterogenous swarms perform mapping based on parameters such as initial configuration, Map complexity and Path widths. We also study how to optimize movement in 3D maps and continuous maps.

D 11. AUTOMATED LABEL-FREE MEASUREMENT OF TRABECULAR BONE IN BONE MARROW

Rupali Manakr[1], Mustafa Kansiz[2], Carlos Bueso-Ramos[3] and David Mayerich[1], [1]Department of Electrical and Computer Engineering, University of Houston, [2]Agilent Technologies (Australia), Melbourne, Vic., Australia, [3]Department of Hematopathology, University of Texas MD Anderson Cancer Center, Houston, TX, USA

Measurements of trabecular bone marrow area (TBA) are used to evaluate progression in several diseases, including osteosclerosis and fibrosis and leukemia. Recent studies have shown that measurement of TBA can be done digitally by imaging tissue stained with hematoxylin and eosin. Mid-Infrared spectral pathology has been proved as good technique to augment current histopathology. We propose use of Fourier transform infrared (FTIR) spectroscopic imaging to provide quantitative, label-free analysis of trabecular bone. We can also take advantage of discrete frequency IR imaging to provide high throughput imaging and computational analysis by imaging tissue only at optimal bands needed for the analysis.

Plenary Speaker: Mauro Ferrari, Ph.D.

"Lost in Translation: A Tragedy of our Times"

ABSTRACT: The time required for translation into clinical use of a medical discovery or invention (say, a new drug or device)is estimated to be between 10-17 years, at a cost of $ 2-3 Billion. Thus, the vast majority of discoveries that could potentially benefit patients never makes it to the clinic. These are not scientific failures, in most cases, they are process failures. The measure of the tragedy associated with these process failures is evident upon considering, for instance, that the average life expectancy of a cancer patient from the time of discovery of metastases is about 18-24 months. The cost and timelines associated with clinical translation drive the price of the newest generation drugs and devices to unsustainable levels, even for the small fraction of the world population that lives in countries that can afford them now. Failures in medical translation are a true tragedy of our times.

In this talk, I will report of our experience at Houston Methodist, aimed at improving the process of clinical translation of leading-edge medical discoveries. We found that it is essential to establish core GMP/GLP facilities, competitively allocate funds for the cost of preclinical and early-stage clinical trials, and develop new professional education degree programs for clinical translation. I will illustrate with examples drawn from our portfolio: Novel contrast agents for the early detection of neurodegenerative diseases; Neurorehabilitation devices; Injectable nano-particle generators for metastatic cancer; Nanofluidics implants for long-term delivery of drugs and cell transplantation; T-Cell clonality diagnostics for the selection of transplant recipients; Novel cardiovascular intervention devices, among others.

Mauro Ferrari, Ph.D.

President and CEO
Ernest Cockrell, Jr. Presidential
Distinguished Chair
Houston Methodist Research Institute

Director, Institute for Academic Medicine
Executive Vice President
Houston Methodist Hospital System

Senior Associate Dean & Professor of Medicine
Weill Cornell Medical College, New York

Mauro Ferrari, Ph.D. is President and CEO of Houston Methodist Research Institute, where he directs more than 2,300 employees and credentialed clinicians engaged in basic science and over 1,000 clinical research protocols in cancer, cardiovascular diseases, neurology, and many others domains of medicine. He also serves as Executive Vice President of the Houston Methodist Hospital System, recently recognized by U.S. News and World Report as one of the top twenty hospitals in the USA. Concurrently, Dr. Ferrari serves as Senior Associate Dean and Professor of Medicine at Weill Cornell Medical School in Manhattan, New York. His laboratory develops new drugs for cancer.

He is recognized as the pioneer of nanomedicine and transport oncophysics. He was the principal architect of the Cancer Nanotechnology Plan at the National Cancer Institute of the USA (2003-2005), which is the largest nanomedicine research program to date, worldwide. He has published over 500 scientific articles, 7 books, and is inventor of over 50 patents issued in the USA and internationally. Dr. Ferrari is a Fellow of AIMBE, AAAS (Biological Sciences), and ASME. He has won numerous scientific awards and recognitions, including the Founders' Award from the Controlled Release Society, the Blaise Pascal Medal from the European Academy of Sciences, the Aurel Stodola Medal from ETH Zurich. Dr. Ferrari is a Foreign Member of the Italian National Academy of Sciences (Accademia dei Quaranta), a Member of the European Academy of Sciences, and a Corresponding Member of the Pontifical Academy for Life, by appointment of Pope Francis. Born in Italy, Dr. Ferrari holds a degree in Mathematics from the Universita' di Padova, Masters and Ph.D. degrees in Mechanical Engineering from the University of California, Berkeley, and attended medical school at the Ohio State University. Dr. Ferrari holds honorary faculty positions at several universities in the USA and internationally. He has received honorary doctorates in biotechnology, electrical engineering, and letters (theology). His prior employment includes tenured faculty positions in Engineering at the University of California, Berkeley, in Engineering and Medicine at the Ohio State University, and the University of Texas M.D. Anderson Cancer Center and Health Sciences Center in Houston, Texas.