5th Health Care Engineering Systems Symposium
and
Interactive Medical Exposition

Monday, September 17, 2018
I Hotel and Conference Center
1900 South 1st Street
Champaign, IL 61820

healthengsymp.illinois.edu

AGENDA

8:30 – 9:00 AM

Breakfast and Registration

Lobby

9:00 – 9:15 AM

Welcome and Opening Remarks

Tamer Başar
Interim Dean, College of Engineering, UIUC

9:15 – 9:35 AM

Jump ARCHES Review

Kesh Kesavadas
Director, Health Care Engineering Systems Center, UIUC
John Vozenilek
Vice President & Chief Medical Officer for Simulation
Jump Simulation and Education Center, OSF HealthCare

9:35 – 10:45AM

Presentations of Jump ARCHES Funded Projects

Moderator: William Bond

Stephen Boppart
Beckman/ECE/BioE, UIUC
Development of a Smartphone-based Skin Simulation Model for Medical Education

Scott Barrows
Jump Simulation, OSF HealthCare/UICOMP
Heart Failure & Behavior Change: Patient/Provider Interactive Clinical Education App for Mobile Devices

Mariana Kersh
Mechanical Science and Engineering, UIUC
kneeVIEW: A VIrtual Education Window for Knee Orthopedics

Manuel Hernandez
Kinesiology and Community Health, UIUC
Simulation of Postural Dysfunction in Parkinson's Disease

Daniel Morrow
Educational Psychology, UIUC
Interactive Technology Support for Patient Medication Self-Management

Kesh Kesavadas
Health Care Engineering Systems Center, UIUC
360 Mixed Reality Authoring Tool

Pavithra Rajeswaran
Health Care Engineering Systems Center, UIUC
AirwayVR: Learning Endotracheal Intubation in Virtual Reality

Ramavarapu "RS" Sreenivas
Industrial and Enterprise Systems Engineering, UIUC
A Natural Language Powered Platform for Post-Operative Care

Brad Sutton
Bioengineering, UIUC
Deep Learning for Fully Automated Segmentation of Pediatric Cardiac Hearts from MRI

Citlali Lopez-Ortiz
Kinesiology and Community Health, UIUC
Characterization of Muscle Activity in Isometric Force Efforts Using a Haptic Robotic Interface

10:45-11:15 AM **Invited Talks -Innovative Research in Healthcare**
Moderator: Brad Sutton

Viktor Gruev
Electrical and Computer Engineering, UIUC
Bioinspired Sensors for Intraoperative Detection of Sentinel Lymph Node

Kevin Lowe
Cancer Center, Carle Foundation Hospital
Technology Integration in Multidisciplinary Cancer Care

Lyndsie Koon
Kinesiology and Community Health, UIUC
Exploring the Potential of Voice-Activated Digital Assistants for Older Adults' Health Management

Jaime Thissen
Agricultural & Biological Engineering, UIUC
Health and Safety Indicator Subsets for Selected Greenhouse Production Facilities in North America

Lui Sha
Computer Science, UIUC
Medical "GPS" Systems

Girish Krishnan
Industrial and Enterprise Systems Engineering, UIUC
Soft Technologies for Human Assistive Devices

11:15 – 11:30 AM **Break**

11:30 AM – 11:35 AM **Jump ARCHES Funding Announcement**

Kesh Kesavadas
John Vozenilek

11:35 AM – 12:30 PM **2 Minute Pitches of Research Ideas**

Moderator: Kesh Kesavadas

Idoia Ochoa
Electrical & Computer Engineering, UIUC
MPEG-G Standard for Genomic Information Representation

Thomas Kim
Neuroradiology, Carle Physician Group

- *3D Virtual Reality Color Display of Complex Head and Neck Anatomy and Pathology*
- *3D Printing of Complex Spine Anatomy From Clinical Lumbar Spine CT's for Simulation Lab Use*

Ahmed Elbanna
Civil and Environmental Engineering, UIUC
Computational Modeling of Stress and Deformation in Networked Materials

Masooda Bashir
School of Information Sciences/College of Engineering, UIUC
Security and Privacy Vulnerabilities of Devices Used in Healthcare

Chris Zallek
UICOMP/OSF Healthcare
Engineering Challenges to Mitigate the Growing Neurological Care Crisis

Girish Krishnan
Industrial and Enterprise Systems Engineering, UIUC
Development of an Upper Body Force Jacket Using Pneumatic Soft Actuators

Amy Christison
UICOMP/OSF HealthCare
Food Quality Tracking

Priscilla Ferronato
Illinois Informatics Institute, UIUC
VR for Drug Session

Juan de la Rosa
Illinois Informatics, UIUC
Virtual Reality Simulation Tools for Emotional Training

Kesh Kesavadas
Health Care Engineering Systems Center, UIUC
BioGears Simulation

12:30 – 2:00 PM **Lunch**
Quad Room and Lobby

2:00 – 4:30 PM **Interactive Medical Simulation Exposition**

Lincoln Room

Naveen Sankaran
Health Care Engineering Systems Center, UIUC
- *Mixed Reality-based Sepsis Training for Medical Students*
- *Mixed Reality Food Safety Curriculum for Public Education*

Manuel Hernandez
Kinesiology and Community Health, UIUC
Simulation of Postural Dysfunction in Parkinson's Disease

Fanxin Wang
Mechanical Science and Engineering, UIUC
Single Port Minimally Invasive Robotic Surgical Platform

Kevin Gu
Electrical and Computer Engineering, UIUC
Dr. Babel Fish: A Machine Translator to Simplify Providers' Language about Medication

Pavithra Rajeswaran
Health Care Engineering Systems Center, UIUC
- *AirwayVR: Virtual Reality Trainer for Endotracheal Intubation*
- *CadaVR: Interactive 3D Anatomy Visualization Tool*

Roberto Galvez
Carle Illinois College of Medicine, Jump Simulation Center, UIUC
Patient Simulator and Ultrasound

Interactive Medical Simulation Exposition

Technology Room

Brian Dennen
Ankura
ArcGIS and Ambulatory Planning

Xiao Li
Health Care Engineering Systems Center, UIUC
Surgical Robot with Environment Reconstruction and Force Feedback

Pramod Chembrammel
Health Care Engineering Systems Center, UIUC
Simulator for Training Extracorporeal Membrane Oxygenation

Stan Ruecker
School of Art and Design, UIUC
Redesigning the List as a Sculpture

Citlali Lopez-Ortiz
Kinesiology and Community Health, UIUC
Health Care Engineering Systems Center, UIUC
Movement Impairment Characterization and Rehabilitation for Dystonic Cerebral Palsy Using Robotic Haptic Feedback in Virtual Reality

Lui Sha
Computer Science, UIUC
Medical "GPS" Systems

Shrey Pareek
Health Care Engineering Systems Center, UIUC
Haptics-based Rehabilitation of ADL skills

POSTERS

Lobby

Kenneth Blocker
Educational Psychology, UIUC
Designing an Antihypertensive Medication Management Application: User Insights from Older Adults

Holly Rosencranz, Diane Corsaro, Debbie Deedrich, Ramkumar Japhia
University of Illinois College of Medicine at Urbana-Champaign
A Quality Improvement Process for a Medical School Simulation Program

Roshan Dsouza
Beckman Institute for Advanced Science and Technology, UIUC
Development of a Smartphone-based Skin Simulation Model for Medical Education

Ruopeng Sun, Jacob Sosnoff
Kinesiology and Community Health, UIUC
Fall Risk Prediction in Multiple Sclerosis Using Postural Sway Measures, a Machine Learning Approach

Abigail Wooldridge
Industrial & Enterprise Systems Engineering, UIUC
A Macroergonomic Framework to Understand Team Cognition in Care Transitions

Idoia Ochoa
Electrical & Computer Engineering, UIUC
The MPEG-G Standard for Genomic Information Representation

Brian M. Pastor
Human Factors & Aging Laboratory, CHART, UIUC
CHART: Collaborations in Health, Aging, Research, and Technology Program

Nicole Holtzclaw-Stone
Kinesiology & Community Health, UIUC
Overview of Health Technology Graduate and Continuing Education Program

Symposium Co-Chairs

John Vozenilek
Vice President & Chief Medical Officer for Simulation
Jump Simulation and Education Center, OSF HealthCare
Duane and Mary Cullinan Professor in Simulation Outcomes
Professor of Medicine, University of Illinois College of Medicine at Peoria
Professor of Bioengineering and Co-Director of Jump Simulation Center
College of Engineering, University of Illinois at Urbana-Champaign

Thenkurussi "Kesh" Kesavadas
Director, Health Care Engineering Systems Center
Co-Director, Jump Simulation Center
Professor, Industrial and Enterprise Systems Engineering
Professor, Computer Science and Electrical and Computer Engineering
University of Illinois at Urbana-Champaign
College of Engineering
Professor, Carle Illinois College of Medicine

Opening Remarks

Tamer Başar
Interim Dean, College of Engineering
Swanlund Endowed Chair and Professor of Electrical and Computer Engineering
Director of the Center for Advance Study
Professor of ITI, CSL, MechEng
University of Illinois at Urbana-Champaign
College of Engineering

Presentations of Jump ARCHES Funded Projects

Stephen Boppart
Abel Bliss Professor of Engineering
Director, Center for Optical Molecular Imaging
Head, Biophotonics Imaging Laboratory
University of Illinois at Urbana-Champaign
Departments of Electrical and Computer Engineering, and Bioengineering
Carle-Illinois College of Medicine
Beckman Institute for Advanced Science and Technology
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Development of a Smartphone-Based Skin Simulation Model for Medical Education

Teaching dermatology to medical students entails a series of lectures, photographs and diagrams, and hands-on skin examinations to convey a sense of skin lesions, their appearance, and their relationship to dermatopathology. Simulated skin models are often available at significant cost, are often difficult for a mobile physician to carry, and often still lack accurate visual and tactile reproductions of skin lesions. Hence, the development of a new skin simulation model that accurately portrays the color, texture, and biomechanical properties of a lesion would be a useful teaching device. We report the development of a smartphone-based skin simulation model which is intended to provide a truer visual and tactile sense of a lesion, and utilizes the ubiquitous availability of smartphone-based mobile platforms. Polydimethylsiloxane (PDMS) was used as a configurable elastomer material to model the stiffness and texture of skin. A novel custom smartphone-based app was developed to capture images of various skin lesions (or digital images can be accessed from an image database) which are subsequently displayed on a tablet or second smartphone, and over which the PDMS model skin elastomer is placed. Using the local Bluetooth connection between mobile devices, an iterative feedback algorithm corrects the visual distortion caused by the scattering of the elastomer to enable better virtual visualization of the skin lesion, while also providing a textured, biomechanically-appropriate tactile representation of the skin and lesion. Future versions of the PDMS material will include programmable texture and stiffness capabilities via electro-activatable elastomer materials. This technology and methodology has the potential to enable a new mobile and configurable dermatology teaching platform for medical students and physicians.

Stephen Boppart is an Abel Bliss Professor of Engineering. He is Director of the GSK Center for Optical Molecular Imaging, and has been a strong supporter for the integration of engineering and medicine in our new engineering-based College of Medicine at the University of Illinois at Urbana-Champaign to advance human health and healthcare systems. His Biophotonics Imaging Lab is focused on developing novel optical biomedical diagnostic and imaging technologies and translating them into clinical applications. Prof. Boppart received his Ph.D. in Medical and Electrical Engineering from MIT, his M.D. from Harvard Medical School, and completed residency training at the University of Illinois in Internal Medicine. He was recognized by MIT's Technology Review Magazine as one of the Top 100 Young Innovators in the World for his development of medical technology, and received the Paul F. Forman Engineering Excellence Award from the Optical Society of America for dedication and advancement in undergraduate research education. More recently, he received the international Hans Sigrist Prize in the field of Diagnostic Laser Medicine. He was Founding Director of the Mills Breast Cancer Institute at Carle Foundation Hospital and has worked to establish and strengthen partnership ties between the University of Illinois and local medical institutions.

Scott Barrows
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Heart Failure & Behavior Change: Patient/Provider Interactive Clinical Education App for Mobile Devices

After the initial diagnosis of heart failure, the 5-year mortality is 50%. The one-year mortality after an admission primarily for heart failure is 30% and worsens with each hospitalization. The financial burden imposed by HF is high around the world. Recent work has demonstrated, however, that even simplified interventions can lead to improved adherence with a therapeutic regimen which reduces disease severity, mortality, and readmission rates.

It is known that clear and effective communication between the provider, the patient, and their caregivers is imperative for improving patient outcomes and decreasing the human and financial burden of HF. An interactive mobile app may provide a robust tool to support this, while also providing the benefits of additional information and education presented at varying depths for patients and caregivers.

Scott Barrows is the director of medical visualization at Jump Simulation and Education Center at the OSF Saint Francis in Peoria, IL. He was previously vice president of marketing, clinical engagement and strategic development at a biotechnology laboratory in Virginia, and vice president of creative development at a medical software “think tank” in Nevada. He has also worked with eHuman, a Stanford-based medical-dental software company and served as an advisor to Apple.

Barrows is a clinical assistant professor of emergency medicine at University of Illinois College of Medicine Peoria and retains the role of clinical assistant professor in biomedical visualization at the University of Illinois at Chicago. He was also an assistant professor at the University of Texas Southwestern Medical Center in Dallas and was the former director of the biomedical visualization graduate program at UIC.

Barrows has been the recipient of numerous awards, including recognition from two U.S. Presidents, the Smithsonian Institution and the University of Illinois. His work has been presented at Nobel presentations and is included in the archives of the National Library of Medicine.

Mariana E. Kersh
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kneeVIEW: A VIrtual Education Window for Knee Orthopedics

Improving the musculoskeletal training of both novice and expert clinicians is necessary to improve clinical outcomes and patient satisfaction during the treatment of musculoskeletal disorders. The objective of this work is to provide a systematic and structured environment for consistent clinical training of knee anatomy, function, and clinical procedures performed on the knee. Our approach is to develop augmented reality simulations designed to create a learning environment coupled with a physical model that mechanically reflects knee stiffness and laxity.

Using previously collected in vitro data, load-displacement data for each knee ligament were extracted. The results generated from the cadaver tests were used as a baseline to compare various synthetic ligament materials and form an optimization protocol from which a configuration of artificial ligaments could be achieved. Current work includes identifying methods for attachment and integration with the augmented reality components, and development of a complete model of the knee with synthetic tissues. By damaging, tearing, and removing various ligaments in the simulator, medical students will be able to feel the difference between an array of injuries.

Mariana Kersh is an Assistant Professor in the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign and is Director of the Tissue Biomechanics Laboratory. Dr. Kersh first received a BA in English from The University of Texas-Austin, followed by a BS and MS in Mechanical Engineering, and PhD in the Materials Science Program from the University of Wisconsin-Madison as a National Science Foundation Pre-Doctoral Fellow. She was a post-doctoral research fellow in the Department of Mechanical Engineering at the University of Melbourne as a McKenzie fellow and the awardee of the 2013 ANZORS Early Career Researcher Award. Her research uses experimental methods to evaluate mechanical and structural properties of bone, cartilage, and connective tissues. This data is also used in finite element simulations to evaluate intervention techniques and develop novel hypotheses of tissue structure-function relationships. Current work in the Tissue Biomechanics Laboratory includes experimental measurements of bone strain under physiological loading conditions and identifying the compositional and structural determinants of bone strength during growth. In collaboration with local orthopedic surgeons, Prof. Kersh is also investigating the sensitivity of shoulder function to rotator cuff tears using robotic-actuated motion control to simulate functional tasks as well as using time-lapsed techniques to identify determinants of bone strength.

Manuel Hernandez
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Simulation of Postural Dysfunction in Parkinson's Disease

Postural instability is a cardinal feature of Parkinson's disease (PD), which marks the onset of severe disability due to its unresponsiveness to dopaminergic therapy and increased risk of injury and falls. Abnormal neural oscillations and synchronization within numerous basal ganglia-cortical circuits due to the loss of dopamine-producing cells is a hallmark of PD. However, the cortical impairments underlying postural control deficits due to PD and the role of anxiety in mediating these alterations have not been well studied. This project proposes to investigate the role of anxiety in underlying postural dysfunction due to PD and further examine the effects of dopamine-replacement therapy. In addition to providing a greater understanding of the coordinated activity of the body and brain, the disruption of this coupling that results from PD, this work will provide a new computational method for the characterization and classification of neural and motor dysfunction relevant to a wide range of motor disorders, a new tool for use in long-term monitoring to disease progression and drug treatment efficacy, and a platform for simulation of the impact of altered sensorimotor function in postural control.

Manuel Hernandez received the B.S. degree in Mechanical Engineering from Cornell University, Ithaca, NY, USA, in 2003, and M.S. and Ph.D. degrees in biomedical engineering from the University of Michigan, Ann Arbor, MI, USA, in 2005 and 2012, respectively. He completed his post-doctoral training in neuro-science at the Institute for Neural Computation at the University of California-San Diego, La Jolla, CA, USA, in 2014. He joined the faculty of the Department of Kinesiology and Community Health Champaign in 2014 and is currently the Director of the Mobility and Fall Prevention Research Laboratory. His research interests include biomechanics, motor control, and neuroscience in older adults. Dr. Hernandez's research has focused on the use of experimental and theoretical models of risk factors for injury or disability during the performance of goal-directed movements in older adults with and without neurological disorders, particularly Parkinson's disease. Dr. Hernandez is interested in the behavioral and neural mechanisms underlying postural dysfunction in older adults and particularly in the development of behavioral and neural biomarkers for early detection of neurological disorders.

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Interactive Technology Support for Patient Medication Self-Management

Our team is developing technology-based support for patient self-management of chronic illness, focusing on older adults with diverse cognitive/literacy abilities. Specifically, we are developing a Natural Language Processing-based tool that takes as input nonstandard and technical medication information from Electronic Health Record (EHR) systems and generates language that is easy for patients to understand. This patient-centered language is integrated into a Computer Assistant (CA)-based system that supports patient self-care by emulating best practices for face-to-face communication in distributed contexts, such as patient portals. I will describe progress in developing and evaluating the NLP tool and the CA-based system, including age differences in NLP translation benefits and in responding to CA delivery of medication information.

Dan Morrow is professor and chair of the Department of Educational Psychology at the University of Illinois at Urbana-Champaign, with appointments in the Beckman Institute, the Carle-Illinois College of Medicine, Illinois Informatics Institute, and the Departments of Psychology and Industrial & Enterprise Systems Engineering. He received a PhD in cognitive psychology from the University of California Berkeley. His research on the impact of aging on cognition, communication and decision making in the health care and aviation domains has been funded by NIH and NASA-Ames. He is current editor of the *Journal of Experimental Psychology: Applied*, past president of American Psychological Association Division 21 (Applied Experimental and Engineering Psychology), and fellow of APA and the Human Factors and Ergonomics Society. He has served on advisory committees for the Food & Drug Administration and US Pharmacopeial Convention.

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Professor, Carle Illinois College of Medicine

360 Mixed Reality Authoring Tool

The authoring tool software helps in creating mixed reality and 360 degree video training along with serious games, to help instructors develop interactive and immersive training contents. The software potentials for developing complex medical and healthcare scenarios are demonstrated with a sepsis prevention training module for medical education and a food safety module for public health developed in partnership with the Champaign county health department.

Kesh Kesavadas is Professor at the Department of Industrial and Enterprise Systems Engineering, Director of Health Care Engineering Systems Center and Co-Director of Jump Simulation Center at the University of Illinois at Urbana-Champaign.

Before coming to Illinois, Kesavadas was a professor in the Department of Mechanical and Aerospace Engineering at the University at Buffalo (NY), where he founded the University at Buffalo Virtual Reality Laboratory. He received his doctoral degree from the Pennsylvania State University in 1995. Kesavadas has been in the forefront of Virtual Reality and its application to medicine since 1993, when this field was still in its infancy. In 2004, Dr. Kesavadas was honored as the "Inventor of the Year" Western New York. He has also won numerous awards including SUNY Chancellor's award for Innovation in 2004 and UB Visionary of the year award in 2010. He developed the world's first stand-alone virtual reality Robotic Surgical Simulator RoSS and also co-founded two start-up companies. His own research interests are in the areas of medical robotics and simulation, virtual reality in design.

Pavithra Rajeswaran
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AirwayVR: Learning Endotracheal Intubation in Virtual Reality

Endotracheal intubation is a complex psychomotor skill and a potentially lifesaving procedure used in many clinical situations. AirwayVR is a Virtual reality based simulation trainer to learn and practice endotracheal intubation. The aim is to develop self-guided curriculum for intubation procedure. In this process, we are also developing an innovative VR controller for task training using a 3D printed laryngoscope to make this training experience translate seamlessly to real world. It is a low cost and high impact VR simulation trainer that brings a safe self-learning training environment to medical students, nurses and other professionals at an early stage with the flexibility of practicing as many times as they want to master the skill.

Pavithra Rajeswaran is a Simulation Engineer at Health Care Engineering Systems Center, UIUC. She received her Bachelor of Engineering degree in Biomedical Engineering from the College of Engineering Guindy, Anna University, India in 2013. She received her Master of Engineering degree in Bioinstrumentation from U of I in 2016. Her research interests include Medical Instrumentation, Physiological modelling and Virtual Reality simulation. Prior to her masters, she worked with IBM, India Pvt. Ltd. as a software application developer. During her Master's program, she interned with Jump Simulation center in which she developed a tablet based patient education application for prostate tumor visualization. Passionate about the healthcare simulation space and using technology to create innovative medical education applications, she joined HCESC where she is working on utilizing advanced technologies like 3D modelling, virtual reality, and virtual physiology engine to create innovative healthcare simulations.

At HCESC, She is involved in a variety of projects from developing virtual physiology based curriculum for medical students, to developing virtual reality trainers for skill training, to using IoT based sensors for monitoring patient's health status at-home.

Ramavarapu "RS" Sreenivas
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Arthur Davis Faculty Scholar
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A Natural Language Powered Platform for Post-Operative Care

This talk will review the on-going work involving Amazon's Echo Dot, which is interfaced to a development platform that is connected to a range of sensors. The patient interacts with the platform using natural language commands, and receives relevant verbal-feedback from the platform, which in turn records the vitals to vitiate any compliance-related risks involving patients recuperating at home.

RS Sreenivas is an Associate Professor with the Industrial and Enterprise Systems Engineering Department and the Associate Head of Graduate Studies. He holds research appointments at the Coordinated Science Laboratory (CSL) and the Information Trust Institute (ITI). He is also an affiliate of the Electrical and Computer Engineering Department. He is an Arthur Davis Faculty Scholar at the University of Illinois.

Professor Sreenivas received a B.Tech. in Electrical Engineering from the Indian Institute of Technology, (IIT) Madras, India in 1985. I was at the IIT, Madras from 1980-1985. I have an M.S. and a Ph.D. in Electrical and Computer Engineering from Carnegie Mellon University in Pittsburgh, PA. He completed his studies as a Post-Doctoral Fellow in Decision and Control, Division of Applied Sciences of Harvard University before his move the University of Illinois at Urbana-Champaign.

Brad Sutton
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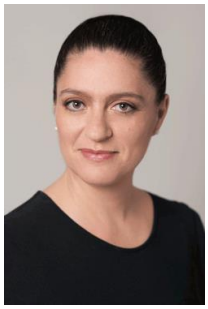
Deep Learning for Fully Automated Segmentation of Pediatric Cardiac Hearts from MRI

Children with congenital heart disease (CHD) pose significant challenges in planning surgical interventions. Creating patient specific 3D models of their complex anatomy can be helpful to visualize defects and plan interventions. However, such models have required manual segmentation from medical images by a trained expert, a timely and costly procedure that severely limits application. In this work, we developed a fully automated segmentation pipeline using data preparation steps and deep learning and applied it to a set of MRI images from CHD patients to automate the model creation process. We demonstrate excellent accuracy of the fully automated method when compared to expert manual segmentation.

Brad Sutton is a Professor of Bioengineering and Technical Director of the Biomedical Imaging Center at Beckman Institute. He is also affiliated with the Department of Electrical and Computer Engineering, the Neuroscience Program, and the Carle-Illinois College of Medicine. He received his undergraduate education from the University of Illinois at Urbana-Champaign in General Engineering (1998). Along with MS degrees in Biomedical Engineering and Electrical Engineering, he received his Ph.D. in Biomedical Engineering from the University of Michigan in 2003. He then returned to the University of Illinois to serve as a research scientist at the Biomedical Imaging Center. He joined the Department of Bioengineering at the University of Illinois at Urbana-Champaign in 2006. Dr. Sutton's research is in development of magnetic resonance imaging acquisition and reconstruction methods to improve the accuracy, speed, and information content of neuroimaging and dynamic imaging methods.



Citlali López-Ortiz
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Characterization of Muscle Activity in Isometric Force Efforts Using a Haptic Robotic Interface

Determination of the degree to which muscles interact with one another during a given action provides insight into how the central nervous system controls movement. In this experiment, the interactions among 16 muscles were examined in 10 adults with no known neurological disorders that applied isometric forces on a six-degrees-of-freedom force/torque transducer rigidly mounted the end effector of a robotic arm. The force was applied in 14 different directions at each of five configurations assumed by the robot while surface electromyography (EMG) signals were collected from each muscle. Two different analysis methods, principal component analysis (PCA) and non-negative matrix factorization (NNMF) subject to a generalized Akaike information criterion cutoff, were applied to the 16 EMG signals of the muscles examined and the six-degrees-of-freedom force/torque data to determine the muscle groups that play the largest role for a given isometric force effort. The two methods were compared to one another. NNMF tended to isolate muscles or group them in pairs. PCA tended to identified muscle groupings with more muscles than NNMF. The EMG activity of muscle groups identified by PCA were plotted against the PCA of the forces generated resulting in multivalued functional relationships. The activity of the muscle groups and forces in PCA space was characterized by Fourier fits using time as a parameter variable. These results provide a quantitative and analytical characterization of the reduction of degrees of freedom in the motor control system for upper limb isometric force tasks and allows for a standard against which disorders of motor control may be quantitatively compared to aid in medical diagnosis.

Dr. Citlali López-Ortiz is an Assistant Professor at the Department of Kinesiology and Community Health in the College of Applied Health Sciences at the University of Illinois at Urbana-Champaign. She also holds affiliations with the Neuroscience Program, the Illinois Informatics Institute and the Department of Dance. at the University of Illinois at Urbana-Champaign and with the Joffrey Ballet Chicago. She directs the Neuroscience of Dance in Health and Rehabilitation Laboratory where she is developing the scientific basis for dance as therapy for rehabilitation of movement disorders and augmented motor learning.

Innovative Research in Healthcare

Victor Gruev
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Bioinspired Sensors for Intraoperative Detection of Sentinel Lymph Node

Surgery remains the primary curative options for patients with cancer. Sentinel lymph node (SLN) mapping is critical in determining the staging of the diseases. To improve the detection of SLN during intraoperative procedures, we have designed a sensor based on the visual system of the mantis shrimp. This sensor is enabling physicians to determine multiple fluorescent markers in the near infrared spectrum which are targeting SLN. Clinical data will be presented in this talk.

Viktor Gruev is an associate professor in the department of Electrical Engineering at University of Illinois at Urban Campaign. Prior to joining UIUC, he was an associate professor in the Department of Computer Science and Engineering at Washington University in St. Louis. Prof. Gruev received his B.S. in Electrical Engineering with distinction from Southern Illinois University in Carbondale in 1998. He completed his M.S. and PhD. in electrical engineering from Johns Hopkins University in 2000 and 2004 respectively. Dr. Gruev was a post-doctoral researcher at the University of Pennsylvania before joining Washington University in St. Louis in 2008 as an Assistant Professor. He has received numerous awards for his research on imaging sensors and their application in the medical field, including the 2016 IEEE Donald G. Fink Award for an outstanding scientific contribution in the IEEE society. His current research focuses on bringing medical imaging technology to resources limited hospitals and to the developing world.

Kevin Lowe
Surgical Oncologist
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Technology Integration in Multidisciplinary Cancer Care

The increasing complexity of cancer treatment and supporting technology deemphasizes distinctions between clinical subspecialties. Providing high value care requires that systems based approaches to cancer care are applied to individual patients. This is particularly important when high cost, high risk technologies are offered as part of treatment. This abstract provides examples in video supported discussion of this paradigm shift in cancer care. The value of the clinical integration of high resolution cholangioscopy, robotic surgery and percutaneous approaches to treatment of foregut cancers are discussed with surgical video and cross sectional imaging examples.

Kevin Lowe is a Surgical Oncologist at the Carle Foundation Hospital, Urbana, IL. He received MD from the Chicago Medical School at Rosalind Franklin University of Medicine and Science, Chicago, IL. He was awarded his PhD in Physiology from the University of South Alabama, Mobile, AL. He completed his residency in General Surgery at the University of South Alabama, Mobile, AL and a Fellowship in Foregut and Hepatopancreatobiliary Surgery at the Methodist Dallas Medical Center, Dallas, TX.

Dr Lowe's medical and research interests are cancer and complex benign diseases of the liver, pancreas, esophagus, stomach, small intestine, as well as Intra-abdominal and retroperitoneal sarcomas.

Lyndsie Koon
Post-Doctoral Research Associate
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Exploring the Potential of Voice-Activated Digital Assistants for Older Adults' Health Management

Voice-activated digital assistants have the potential to enable users to control their home environment, access information, provide support for healthcare management, and social engagement. However, these devices have not been designed with consideration of older adult users' unique capabilities and needs. We are investigating the perceived ease of use and usability of digital home assistants (Amazon Echo products) among adults and older adults who are current and novice users. Participants (50+) who currently own a digital assistant reported high levels of ease of use and usefulness, however, they also expressed a desire to perform more tasks (e.g., learn a new language, contact others), but were unaware of how to successfully engage in these tasks. Novice users (65+) interacting with the digital assistants (Amazon Echo, Echo Show) experience challenges with commands, regardless of being provided an initial demonstration and then guidance from a researcher. Despite those challenges, participants report high levels of perceived usefulness, and thoroughly enjoyed learning about, and interacting with, the digital assistants. These findings indicate a need for design changes to these devices to be utilized successfully, as well as appropriate instructional protocol and continued support for adult and older adult users.

Lyndsie Koon is a Post-Doctoral Research Associate (2017---) at the University of Illinois Urbana-Champaign in the Human Factors and Aging Laboratory (Dr. Wendy Rogers, Director). She received her undergraduate education from Arkansas State University in 2005, and her graduate education from the University of Memphis in 2007, both in Sport and Exercise Science. She completed her Ph.D. in Social Psychology of Sport and Physical Activity from the University of Northern Colorado in 2016. Her research interests include exercise and physical activity, cognitive function, motivation, technology, and older adults. Her current research focus examines the challenges and solution strategies adults aging with sensory and mobility impairments experience with everyday activities and specifically, exercise needs. She also is exploring the potential of various technologies to support physical activity participation and social engagement for adults aging with and without mobility impairments; and understanding motivational factors for older adults associated with physical activity technologies.

Jaime Thissen
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Health and Safety Indicator Subsets for Selected Greenhouse Production Facilities in North America

Greenhouse crop production is increasing as consumer demand increases, specifically in areas where the natural climate is more hostile to the desired production. However, no holistic assessment of the sustainability (notably health and safety) of existing facilities currently exist, and there is sufficient consumer demand for assessing this from seed to shelf. The purpose of this study was to evaluate the sustainability of current systems in North America. Sustainability assessment was accomplished through the development of various sustainability or S-score equations. Approximately 20 hoophouse and greenhouse facilities in both the public and private sector volunteered to provide data for these equations. Each facility was assigned a region: Florida, Northeast, Midwest, Northwest and Southwest. Key parameters were organized according to four general categories based on health and safety aspects. The final value was an "S-score" for each facility. The facilities ranged in size from seasonal, single-house hoophouse to large facilities ranking in the top 10 for indoor agricultural production. Additionally, facilities with either or both vegetable and ornamental production participated in this study. Overall, greenhouse facilities were found to have a range of S-scores. There was also some variation in the development and application of health and safety procedures.

Jaime Thissen is pursuing doctoral work in Agricultural and Biological Engineering, with an anticipated graduation date of December 2018. He hopes to secure an extension specialist position at a university. His research focuses on the sustainability of indoor environmental control systems, specifically greenhouses, as measured by such factors as economic value, environmental effects as well as health & safety.

Lui Sha
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Medical "GPS" Systems

In 2013 Journal of Patient Safety reported that more than 400,000 people die every year because of preventable medical errors. The negative economic impact was estimated at a colossal $1 trillion per year in a US Senate hearing in 2014.

Preventable medical errors are not a medical knowledge problem. It is a medical cyber-physical system challenge in the form of medical information and workflow management challenge, where the medical devices, doctors, nurses, and technicians have to work together flawlessly in real-time. Like how GPS revolutionized navigation, Medical Best Practice System will revolutionize clinical practices.

Currently, we are working with Carle Foundation Hospital and with OSF Illinois Children's Hospital in the development and clinical evaluation of medical best practice systems. The Cardiac Arrest Resuscitation Guidance System has entered Phase II evaluation at Carle ICU.

Lui Sha graduated with Ph.D. from CMU in 1985. He worked at the Software Engineering Institute from 1986 to 1998. He joined UIUC in 1998. Currently, he is Donald B. Gillies Chair Professor of Computer Science, the University of Illinois at Urbana-Champaign. He was named Tau Beta Pi Daniel C. Drucker Eminent Faculty in 2017. He is a Fellow of ACM and IEEE, and a recipient of IEEE's Simon Ramo medal, which honors exceptional achievement in systems engineering and systems science. IEEE Medals are the highest distinctions that the IEEE presents.

Sha works on safety critical Cyber physical Systems such as avionics and medical device systems. He served as a member of the National Academy of Science's committee on Certifiably Dependable Software, of the NASA Advisory Council, and of the NSF's Planning Committee on High Assurance Medical Devices.

Girish Krishnan
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Soft Technologies for Human Assistive Devices

While robots and engineering artifacts are becoming increasingly intelligent, innovations in their structural design have not kept pace. Most robots still consist of myriad bulky rigid parts connected by interfaces or joints leading to non-optimal performance. In contrast, around 90% of nature's species (invertebrates) are designed seamlessly using soft and compliant materials and use material elasticity to undergo spatial continuum deformation. This talk presents a bioinspired paradigm of realizing soft and compliant robotic building blocks using fabrics, pressurized fluids and stretchable elastomeric skins. Design and analysis of fiber reinforced soft robots is complicated because of the coupling of the local microstructure with large global deformations. This talk will present unique modeling techniques to analyze their pressure induced deformation behavior and accompanying insights on how soft robots can be designed by combining different fiber reinforced building blocks. Furthermore, the efficacy of this method will be demonstrated through two examples: an upper extremity exoskeleton, and a soft continuum manipulator for use in agricultural applications.

Girish Krishnan received his BS degree in Mechanical Engineering from R. V. College of Engineering, Bangalore, India, in 2004, his MS in Engineering from the Indian Institute of Science, Bangalore, India, in 2006 and his PhD in Mechanical Engineering from the University of Michigan, Ann Arbor, United States of America, in 2011. He is an Assistant Professor at the Department of Industrial and Enterprise Systems Engineering

Professor Krishnan's expertise is in the design of compliant mechanisms, soft robots and in material design. He is currently working on soft robotics for locomotion, manipulation and wearable devices such as exoskeletons. He is currently working on soft robotic solutions for human assist applications including orthotics for crutches, wearable exoskeletons for industrial and hazardous material workers. He is the recipient of several awards such as 2015 NSF CAREER award, 2016 Dean's award for excellence in advising, and 2017 ASME Freudenstien Young Investigator Award.

Jump Applied Research for Community Health through Engineering and Simulation (Jump ARCHES) is a partnership of clinicians and engineers working together for the advancement of healthcare.

An endowed fund supports these collaborative efforts between engineers at the College of Engineering at Illinois and healthcare providers at OSF HealthCare and University of Illinois College of Medicine at Peoria as they work to solve healthcare challenges through innovative solutions.

Jump ARCHES provides direct access and grants for engineers and clinicians of every discipline to work together, tackling problems in the real world of healthcare. Further, through international partnerships, Jump ARCHES is also developing simulation-based educational tools to meet global healthcare challenges. Further, through the new Jump Simulation Center at UIUC, Jump ARCHES also provides a comprehensive simulation testbed for testing and validating diverse healthcare innovation for academia and industry.

In collaboration with the Health Care Engineering Systems Center in the College of Engineering at Illinois and the Jump Simulation and Education Center at OSF Healthcare in Peoria, Illinois, Jump ARCHES focuses on creating simulation and educational tools through imaging, health information technology, novel sensors and devices, and human factors engineering.

These teams work together and use the unique environment of Jump to hypothesize, test and redesign tools, techniques and processes being used by caregivers every day.

Through Jump ARCHES, our studies are intended to demonstrate improved clinical outcomes, reductions of cost and higher quality practices through simulation.

Jump ARCHES Request for Proposals
Fall 2018

Opportunity Information

The Jump Applied Research for Community Health through Engineering and Simulation [Jump ARCHES] Endowment offers this Request for Proposals to members of faculty of the University of Illinois, College of Engineering at Urbana-Champaign, members of faculty of the University of Illinois College of Medicine at Peoria, and/or OSF HealthCare System clinicians.

The goal of this select competitive grant is to improve healthcare quality and patient safety through the combined efforts of engineers and clinicians.

UIUC investigators please contact Antonios Michalos, M.D., M.S., Associate Director, Health Care Engineering Systems Center, University of Illinois at Urbana-Champaign, telephone: (217) 244-4563 e-mail: michalos@illinois.edu, for questions regarding preparation of a responsive application.

OSF investigators please contact Jessica Svendsen, BA, CCRC, Jump Research Manager, OSF HealthCare, telephone: (309) 308-9536 email: jessica.d.svendsen@osfhealthcare.org

The goal of this program is to use our combined expertise in the broad areas of Sensing Devices, Materials and Mechanics, Health Information Technologies, Simulation, Human Factors/Industrial Ergonomics and Design for executing collaborative projects which could be used for and directed to simulation in training of the healthcare practitioners of tomorrow. During the current cycle we encourage proposals in the following areas:

- The training and evaluation of undergraduate medical students.
- The training and evaluation of graduate medical education learners ("interns" and "residents").
- Inter-professional education incorporating the above.
- Distance learning solutions.

The proposed research should address the needs of clinical simulations and training, and be amenable to translational activities, which lend themselves to full deployment and commercialization of the outcomes for use in medical training. Proposals will be specifically evaluated for their respective alignment to program goals [Relevance], the potential impact on patient and learner outcomes [Impact], and the proposed plan and quality of the team proposed [Approach]. Proposals must identify two Co-Investigators: one from the University of Illinois at Urbana-Champaign, College of Engineering and one from among the clinicians providing care within OSF Healthcare System.

Opportunity Manager: Jessica Svendsen
Posted Date: 7/31/2018
Public Link: https://www.gotomygrants.com/Public/opportunities/details/b8733554-0079-4541-9e22-bf8560eb4d1f

Award Information

Submission Information

Submission Open Date: 8/1/2018, 10:00 AM Central Standard Time

Submission Close Date: 11/1/2018, 5:00 PM Central Standard Time

Submission Timeline Type: One-Time

Submission Timeline Additional Information: Proposals will be reviewed swiftly with an announcement of awards by first week of January, 2019. Review Process The steering panel for Jump ARCHES will prioritize:

- Applied research programs that evaluate the improvement of patient outcomes through clinical simulation.
- The creation of equipment and facilities to evaluate and improve health care through clinical simulation.
- Contributions to scholarship and support for advanced degrees to prepare new generations of experts in the field.
- Proposals which are competitive for additional external funding to advance the broader use of clinical simulation in healthcare.

Suitable space will be assigned to Jump ARCHES within the new 3rd and 4th floor of the Jump Sim Center building above the simulation center and adjacent to the landmark Milestone building of OSF Saint Francis Medical Center and at Health Care Engineering Systems Center if required. This location will provide access to a wide spectrum of clinical professionals and their existing health care technologies, and illuminate the challenges they face in the transformation of health care. Continued Funding for the current ARCHES grantees, we invite you to submit a proposal for funding to continue the project, if excellent progress has been made during the initial phase(s) of the project. Will require a final report before continued funding request is reviewed. The proposal must show potential for translational research or external funding opportunity. Extended proposal deadlines are the same as described earlier. Information will be captured in the form intake process.

Multiple Applications Allowed

Eligibility Information

Additional Eligibility Information: Proposals must identify two Co-Investigators: one from the University of Illinois at Urbana-Champaign, College of Engineering and one from among the clinicians providing care within OSF Healthcare System.

Additional Information

Additional Information URL: http://jumpsimulation.org/research-innovation/research/jump-arches