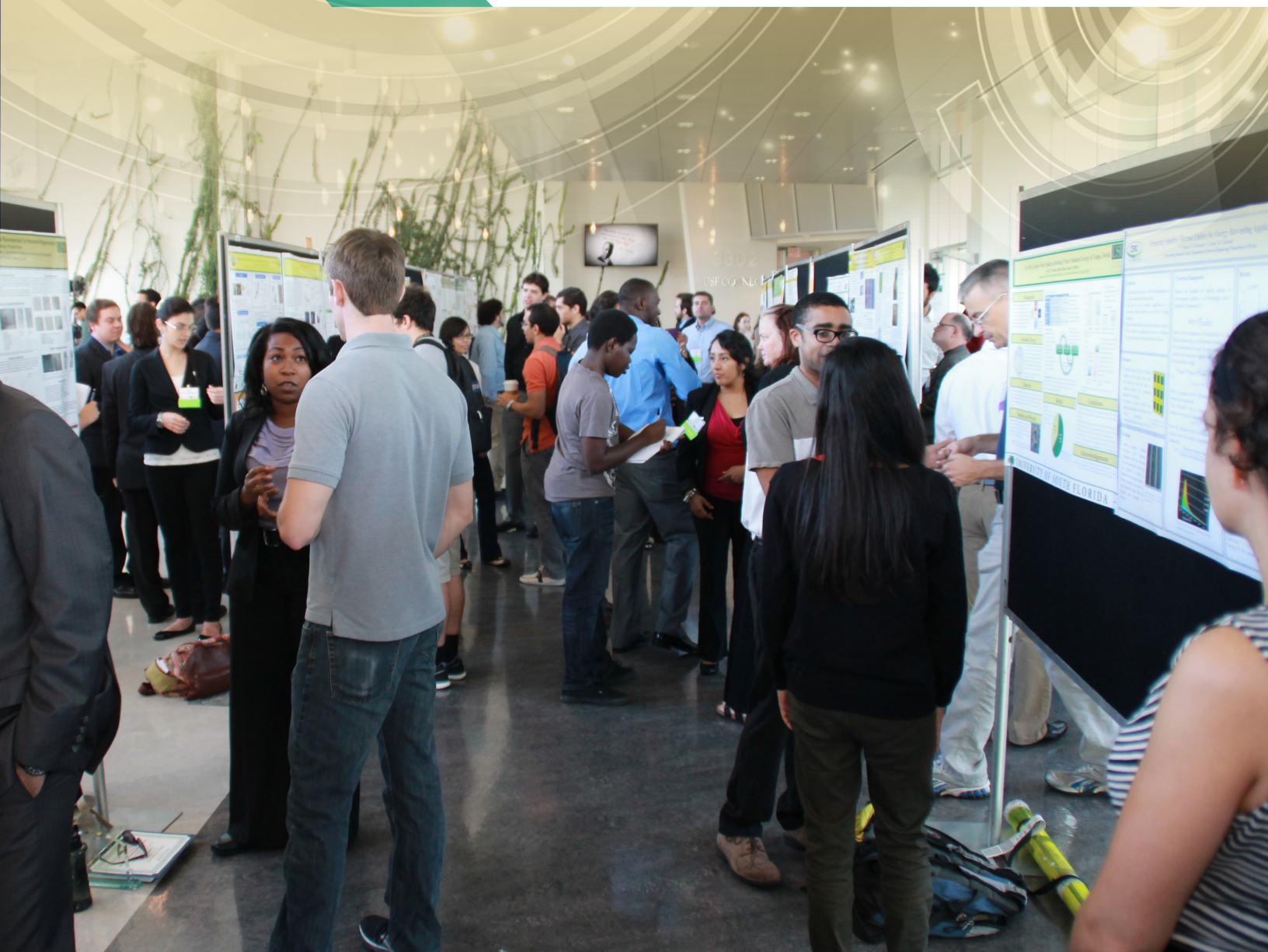
Program and Book of Abstracts

Research Day

University of South Florida's 6th Annual College of Engineering Research Day

Interdisciplinary Research Building (IDRB)

Wednesday, November 6, 2013



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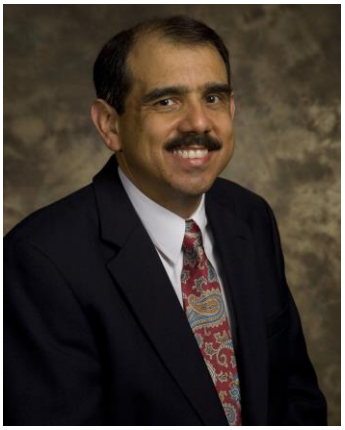
Alfred P. Sloan Foundation
Minority PhD Program

College of Engineering Leadership Team

Rafael Perez, Ph.D.
Professor, Interim Dean
& Associate Dean for Academic Affairs



Jose Zayas-Castro, Ph.D., FIIE
Professor & Associate Dean of Research

CHEMICAL & BIOMEDICAL ENGINEERING

Venkat Bhethanabotla, Ph.D.
Professor & Chair
Biosensors, Plasmonics, Computational Catalysis, Cardiac Electrophysiology Modeling.

Norma Alcantar, Ph.D.
Associate Professor
Surface Forces and Chemical Characterization, Micellar Surfactants, Nanoparticles, and Organic/Inorganic Thin Films, Material Science, Drug Delivery Systems.

J. Carlos Busot, Ph.D.
Professor Emeritus
Reactor design and simulation, Irreversible thermodynamics, and Engineering education.

Scott W. Campbell, Ph.D.
Professor
Solution Thermodynamics, Phase Equilibria, Environmental Monitoring and Modeling, Semiconductor Processing, Engineering Education.

David Eddins, Ph.D.
Interdisciplinary Professor
Correlates of Auditory Perception, Auditory Perception of the Pathological Voice, Models of Auditory Processes.

Robert Frisina, Ph.D.
Professor , Associate Chair, & Director of the Biomedical Engineering Program
Development of Bio-therapeutic Systems, Devices and Compounds for Treating Sensory Deficits, Emphasis on Bench-to-Bedside Investigations of the Auditory System, Translation Research on Deafness and other Neuroengineering Applications.

Richard Gilbert, Ph.D.
Professor
Biomedical systems, Electrochemotherapy, Instrumentation, Engineering education, and Drug delivery.

Yogi Goswami, Ph.D.
Distinguished University Professor
Energy conversion, Solar energy, Hydrogen energy and Fuels cells, Thermodynamics and Heat transfer, and HVAC.

Vinay K. Gupta, Ph.D.
Professor and Graduate Program Director
Interfacial Phenomena, Polymeric Materials, Self – Assembled Systems, Molecular Recognition, Nanoscale/Smart Materials.

Mark Jaroszeski, Ph.D.
Associate Professor
Drug and gene delivery, Electrofusion, Biomedical Instrumentation, and Electrophoresis.

Babu Joseph, Ph.D.
Professor
Modeling and simulation applied to a wide variety of problems ranging from the production of liquid fuels from biomass to the capture of solar energy using novel photocatalytic systems

Piyush Koria, Ph.D.
Assistant Professor
Tissue engineering, Biomaterials, Drug delivery, Nanomedicine, Protein engineering, and BioMicroelectromechanical systems (BioMEMs).

John Kuhn, Ph.D.
Assistant Professor
Heterogeneous catalysis, Structure and properties of metal and metal oxide nanoparticles, and Electrochemistry.

William E. Lee III, Ph.D., PE
Professor
Biomechanics, Human sensory perception, Biorheology, and Environmental biotechnology.

Christopher Passagila, Ph.D.
Associate Professor
Vision Systems, Neural Signal Processing, Computational Modeling, Retinal Physiology, and Disease.

George P. Philippidis, Ph.D.
Associate Professor
Advanced biofuels, biochemical conversion of cellulosic biomass, algae technologies, biorefinery processes, enzymatic reactions, fermentations, biomass-to-power.

Anna Pyayt, Ph.D.
Assistant Professor
Nano-photonic chips for biomedicine, Nano-instruments and bio-sensors applied to advanced diagnostics, imaging and treatment.

Carlos A. Smith, Ph.D., PE
Professor Emeritus
Automatic process control, Dynamic process modeling, and Process engineering.

Aydin K. Sunol, Ph.D., PE
Professor
System engineering, Supercritical fluid technology, Green engineering, and Product and process design.

Ryan Toomey, Ph.D.
Associate Professor
Material science, Polymer thin films, Hydrogels, Molecularly imprinted materials, and Holographic Polymerization.

Joseph Walton, Ph.D.
Interdisciplinary Professor
Neural bases of age-related hearing loss, brain plasticity following injury, neural coding of complex sounds.

CIVIL & ENVIRONMENTAL ENGINEERING

Manjriker Gunaratne, Ph.D., PE
Professor & Chair
Pavement management systems, Pavement design, and Probabilistic methods and reliability.

Nicholas Albergo, PE, DEE, MSCE
Professor of Practice
Domestic and international experience in contamination assessment, degradation and migration analysis, water/wastewater treatment and permitting, and soil & groundwater remedial strategy.

William Carpenter, Ph.D., PE
Professor Emeritus
Structural engineering, Optimization, Viscoelasticity, Fracture mechanics, and Adhesive bonding.

Jeffrey A. Cunningham, Ph.D.
Associate Professor
Contaminant fate and transport in the environment, Physical, chemical and biological processes for water treatment, Water resources and water re-use, and Remediation of contaminated soil and groundwater.

Sarina J. Ergas, Ph.D.
Professor and Graduate Program Director
Environmental biotechnology-bioremediation, Biological air pollution control, Membrane bioreactor systems, Nutrient removal, and Water scarcity.

Stanley C. Kranc, Ph.D., PE
Professor Emeritus
Experimental and theoretical fluid mechanics, Numerical analysis, Corrosion of reinforcing steel in concrete, Magnetofluidmechanics and electrohydrodynamics, Transport processes, Multiphase flow and heat transfer, Chemically reacting flow and combustion, and Physics of high temperature gases.

Jian J. Lu, Ph.D., PE
Professor
Traffic operations, Intelligent transportation systems, Systems design, Safety, Data acquisition, and Pavement performance modeling.

Qing Lu, Ph.D.
Assistant Professor
Pavement Design, including analysis and preservation, asphalt and asphalt mixes, transportation infrastructure system management and surface technologies for orthotropic steel deck bridges.

James R. Mihelcic, Ph.D.
Professor, State of Florida 21st Century World Class Scholar
Sustainable development, Green engineering, Global water and sanitation, and Engineering education reform.

Gray Mullins, Ph. D., PE
Professor
Large scale testing, Field instrumentation, Subsurface sensing and characterization, Structural and geotechnical engineering, Instrumentation, Full scale testing of bridges and foundations, Post Grouted Drilled Shaft Design and Construction, Quality Assurance of Drilled Shafts.

Mahmood H. Nachabe, Ph.D., PE
Professor
Subsurface hydrology, fate and transport of chemicals in the vadose zone, Stochastic hydrology, and Uncertainty in distributed models.

Karim Nohra, M.S.
Instructor
Statics, Dynamics, Mechanics of materials, and Engineering education.

Abdul Pinjari, Ph.D.
Assistant Professor
Transportation Planning and Travel Demand Modeling, Econometric Modeling of Travel Behavior, Integrated Land-use Travel Demand Modeling, Sustainable Transportation, Freight Transportation, Travel Data Collection, Safety

Steve E. Polzin, Ph.D., PE
Transit Research Director, Center for Urban and Transportation Research (CUTR)
Public transportation planning and design, Mobility and accessibility, Policy analysis

Mark Ross, Ph.D., PE
Professor
Water resources, Hydrologic hydraulic, and water quality modeling, Surface and groundwater interaction, GIS applications in hydrology, lake and estuary water quality management, and Estuary sediment dynamics.

Michael J. Stokes, Ph.D., PE
Instructor
Foundation load testing, non-destructive foundation integrity testing, FRP (fiber-reinforced polymer) repair of corroding piles, engineering education.

Amy Stuart, Ph.D.
Associate Professor
Transport and transformation of pollutants in the atmospheric environment, environmental computational modeling, human exposures to air pollutants.

Alberto A. Sagues, Ph.D., PE
Distinguished University Professor
Materials engineering, Corrosion performance of materials for construction and energy applications, Failure analysis and prevention, and Physical metallurgy.

Rajan Sen, Ph.D., PE
Professor
Structural engineering, Bridge design, Dynamics response of structures, Dynamic behavior of piles, and Pre-stressed concrete.

Daniel Simkins, Ph.D.
Associate Professor
Nanomechanics and computational nanomechanics, Computational biomechanics and computational biology, Computational solid and fluid mechanics, Inverse problems in structural dynamics.

Michael Stokes, Ph.D., PE
Instructor
Foundation load testing, non-destructive foundation integrity testing, FRP (fiber-reinforced polymer) repair of corroding piles, engineering education.

Andrés E. Tejada-Martinez, Ph.D.
Associate Professor
Finite element methods for fluids, Subgrid-scale parameterizations for large-eddy simulation (LES) of turbulent flows, Novel LES methodologies, and Numerical simulations of turbulence in the ocean and integration with field observations.

Maya A. Trotz, Ph.D.
Associate Professor
Application of chemical principles to the study and manipulation of pollutant behavior (e.g. arsenic) in natural aquatic systems and in engineered processes.

Kalanithy Vairavamoorthy, Ph.D.
Professor & Dean, Patel College of Global Sustainability
Membrane and biological processes for water purification and wastewater reclamation, Industrial wastes minimization, and the Remediation of contaminated soils and sediments, Sustainable energy sources and processes, and Ecological engineering.

Daniel H. Yeh, Ph.D., PE
Associate Professor
Membrane and biological processes for water purification and wastewater reclamation, Industrial wastes minimization, and the Remediation of contaminated soils and sediments, Sustainable energy sources and processes, and Ecological engineering.

Abla M. Zayed, Ph.D.
Associate Professor
Materials engineering and mechanical performance of concrete, metals and composites.

Qiong Jane Zhang, Ph.D.
Assistant Professor
Green engineering and sustainable, life cycle assessment water-energy nexus, environmental fate and transport modeling, and water supply and treatment.

Yu Zhang, Ph.D.
Assistant Professor
Air transportation, Transportation network modeling and operations, Transportation economics and planning, Freight transportation, and Transportation Sustainability.

COMPUTER SCIENCE & ENGINEERING

Larry Hall, Ph.D.
Distinguished University Professor & Chair
Intelligent systems, Machine learning/data mining, Fuzzy logic in intelligent systems, and Artificial intelligent in visual pattern recognition.

Ken Christensen, Ph.D.
Professor & Undergraduate Program Director
Performance evaluation of computer networks and High –speed packet switch architectures.

Swaroop Ghosh, Ph.D.
Assistant Professor
Low-power, energy-efficient and robust circuit/system design, Emerging high density memory design, Hybrid integrated systems, Ultra low-power non-silicon nano-electronics and applications.

Harvey Glass, Ph.D.
Professor Emeritus
Operating systems, Programming languages, and Embedded systems design.

Dmitry Goldof, Ph.D.
Professor and Associate Chair
Motion analysis, Computer Vision, Image Processing & Biomedical Applications, Pattern Recognition

Adriana Iamnitchi, Ph.D.
Associate Professor
Large-scale distributed systems, Grid computing, and Peer – to –peer networks.

Henrick Jeanty, Ph.D.
Instructor
Handwriting & pattern recognition, Image & face recognition, Optical character recognition, and Automatic document handling systems.

Abraham Kandel, Ph.D.
Endowed Eminent Scholar, Distinguished University Professor, Professor Emeritus
Applied fuzzy logic and computational intelligence, Software testing and productivity, Decision-making in uncertain environments, and Data mining.

Rangachar Kasturi, Ph.D.
Douglas W. Hood Professor
Computer vision and pattern recognition, and Document image analysis.

Srinivas Katkoori, Ph.D.
Associate Professor
High level synthesis, Low power synthesis, Radiation VLSI design, and CAD.

Valentina Korzhova, Ph.D.
Visiting Instructor
Computer Vision, Imaging Processing, and Pattern Recognition.

Tina Kouri, Ph.D.
Instructor and Undergraduate Advisor
Applied Algorithms, Cheminformatics.

Miguel Labrador, Ph.D.
Professor & Graduate Program Director
Design and evaluation of transport layer protocols, Wireless Ad hoc and sensor networks, Bandwidth estimation techniques, Location-Based Sensing Systems.

Jay Ligatti, Ph.D.
Associate Professor
Software security and programming languages.

Yao Liu, Ph.D.
Assistant Professor
Network Security, Wireless Technologies.

Luther Palmer, Ph.D.
Assistant Professor
Biomorphic Robotics

Nathaniel Paul, Ph.D.
Assistant Professor
System security, Malaware detection, Medical device systems, Trustworthy systems.

Rafael Perez, Ph.D.
Professor, Interim Dean, & Associate Dean of Academics Affairs
Artificial intelligence, Neutral networks, and Genetic algorithms.

Matthew Peterson, Ph.D.
Bioengineering, Patient safety, Mobile Health, Rehabilitation

Les Piegl, Ph.D.
Professor
Computer-aided design, Geometric modeling, Computer graphics and analysis, and Design of geometric algorithms.

Nagarajan Ranganathan, Ph.D.
Distinguished University Professor
VLSI system design, VLSI design automation power estimation and optimization computer architecture, and Heterogeneous computing bioinformatics.

Dewey Rundus, Ph.D.
Professor Emeritus
Human-computer interaction.

Sudeep Sarkar, Ph.D.
Professor & Associate Vice President for Research & Innovation
Perceptual organization in single images and multiple image sequences, Biometrics, Gait recognition, Color- texture analysis, and Performance evaluation of vision systems.

Yu Sun, Ph.D.
Assistant Professor
Robotics, Haptics, Computer vision, Human computer interaction (HCI), and Medical robotics.

Ralph Tindell, Ph.D.
Instructor and Undergraduate Advisor
Computer Science Curriculum.

Yicheng Tu, Ph.D.
Associate Professor
Data management, Power-efficient data management systems, and automatic databasetuning, Data stream processing, Peer-to peer networks, and Multimedia databases.

Murali Varanasi, Ph.D.
Emeritus Professor
Coding theory and Computer arithmetic.

Jing Wang, Ph.D.
Instructor
Computer animation, Motion capture, and Empirical evaluation.

Alfredo Weitzenfeld, Ph.D.
Courtesy Professor
Biologically-inspired Robotics, Cognitive Robotics, Humanoid Robotics, Multi-Robot Systems.

Hao Zheng, Ph.D.
Associate Professor
Developing methods to describe digital systems at high abstraction level, and synthesis algorithms mapping those digital systems into the implementation with high performance, low power consumption, robustness, and adaptivity.

ELECTRICAL ENGINEERING

Thomas M. Weller, Ph.D.
Professor and Chair
Planar and electrically-small 3D antennas, development and application of novel microwave materials, additive manufacturing for RF/microwave design, and electromagnetic sensors.

Huseyin Arslan, Ph.D.
Associate Professor
Advanced signal processing techniques at the physical layer, with cross-layer design for networking adaptivity and Quality of Service (QoS) control. UWB, OFDM based wireless technologies with emphasis on WIMAX and IMT-Advanced, and cognitive and software defined radio.

Sanjukta Bhanja, Ph.D.
Associate Professor
Analysis of reliability and its trade-off with performance and power, Development of quantum-aware probabilistic belief model for Quantum cellular automata, Magnetic and Molecular cellular automata, and unconventional non-Boolean computing paradigm using inherent properties of the nano-structures.

Kenneth Buckle, Ph.D.
Retired Professor
Analysis, understanding, and modeling of electromagnetic phenomena from direct current magnetic field configurations through high frequency electromagnetic problems, direct conversion of solar radiation to DC power using an antenna/rectifier assembly called a rectenna.

Larry Dunleavy, Ph.D.
Professor
Microwave and millimeter-wave device, circuit and system design, characterization and modeling.

Lingling Fan, Ph.D.
Associate Professor
Renewable energy source grid integration, modeling and control of energy systems, large-scale power system planning and operation.

Ralph Fehr, Ph.D.
Assistant Professor
Power system planning methods and reliability enhancement techniques, infrastructure design improvements, high-power semiconductor applications at medium voltages, and engineering education reform.

Christos Ferekides, Ph.D.
Professor
Study and development of electronic materials and devices for opto-electronic applications such as solar cells, light emitting diodes, and x-ray detectors.

Nasir Ghani, Ph.D.
Professor
Cyberinfrastructure design, networking, disaster recovery, cloud computing, and cyber-physical systems (integrated power grids).

Richard Gitlin, Sc.D.
State of Florida 21st Century World Class Scholar, Agere Systems Chair, Distinguished University Professor
Wireless signal processing, communications, and networking (4G, cognitive systems, heterogeneous systems, ad-hoc systems, and cross-layer design), broadband networking (quality of service, restoration and reliability, Terabit networks), communications and networking for biomedical applications, bioengineering, Miniature and Anchored Remote Videoscope for Expedited Laparoscopy (MARVEL).

Andrew Hoff, Ph.D.
Professor & Graduate Program Director
Afterglow chemical processing of materials for electronics, sensor, and MEMS applications, Oxide formation on Si & SiC, Diamond processing, Surface Conditioning, Noncontact Corona Kelvin Metrology of electronic materials, Dielectrics, SiC, Corona Ion-Assisted delivery of drugs and DNA to Skin and Tissue, Noncontact voltage and corona characterization of cells and tissue, Contamination monitoring and control in IC Manufacturing, Microsystem and MEMS fabrication, and Integrated Circuit manufacturing and in-line testing.

Vijay Jain, Ph.D.
Distinguished University Professor
Biomedical systems, biomedical imaging and biomedical image processing, Communication systems and networks, Digital image and video processing, VLSI implementations, system on a chip (bio-sensing, DNA microarrays, opto-electronics, MEMS, digital, analog), and 3-D SOCs.

Chung Seop Jeong, Ph.D.
Instructor
Control systems with specialty in designing resilient, robust, optimal, and adaptive observers and controllers for linear, nonlinear, stochastic, and chaotic systems.

Selcuk Kose, Ph.D.
Assistant Professor
Analysis and design of high performance integrated circuits, monolithic DC-DC converters, and interconnect related issues with specific emphasis on the design and analysis of power and clock distribution networks, 3-D integration, heterogeneous integrated circuits, and emerging circuit technologies such as resistive memories.

Zhixin Miao, Ph.D.
Assistant Professor
Smart grid automation, electrical power system modeling and simulation, microgrid technologies to integrate renewable energy and energy storage, and power markets.

Don Morel, Ph.D.
Professor
Renewable energy, Photovoltaic solar energy with particular emphasis on the development of thin film solar cells of CuInGaSe2, CdTe and CdSe, amorphous Si, and organic materials, Transparent conductors including ZnO, SnO2, ITO, High efficiency thin film tandem solar cells, Photovoltaic device modeling and simulation, Photodetectors, thin film transistors and memory devices, LED's, and x-ray and gamma ray detectors, I-III-VI2 and II-VI materials and devices, Physical vapor deposition including sputtering, evaporation, close space sublimation and scale up to pre-manufacturing.

Wilfredo Moreno, Ph.D.
Professor
System integration by providing "off-the-shelf" hardware/software solutions to industrial application in the areas of Digital Signal Processing, Communications, Industrial Controls, Microelectronics, and Biomedical Engineering and Multimedia Solutions including Voice and Video over IP applied to Distance Learning Solutions.

Salvatore Morgera, Ph.D.
Professor
Wireless networks, biometrics for identity management, and the intersections between communications and information theory and medicine.

Gokhan Mumcu, Ph.D.
Assistant Professor
Electromagnetic theory, computational electromagnetics, THz imaging systems, metamaterials and their applications to small directive radiators and printed miniature antennas.

Andrew Raij, Ph.D.
Assistant Professor
Intersection of Personal Sensing, Computer Graphics, and Human-Computer Interaction, including how wearable sensors, mobile smartphones, virtual reality, and information visualization can enable people to gain insight into and improve aspects of everyday life.

Stephen Saddow, Ph.D.
Professor
Wide-bandgap semiconductor materials for high-field and high-power device applications, specifically SiC for Bio, Nano and MEMS applications.

Ravi Sankar, Ph.D.
Professor
Wireless communications, networking, and signal processing and its applications, Resource and mobility managements of wireless cellular, Ad-hoc, and sensor networks, Energy-efficient design and cross-layer optimization, processing, coding, and recognition applications to speech, image, biomedical and other signals and in integrating intelligent techniques including the use of neural networks and fuzzy logic in the simulation, modeling, and design of high performance and robust systems.

Rudy Schlaf, Ph.D.
Professor & Director of Undergraduate Research, College of Engineering
Spray based deposition of macro-molecular thin films and interfaces, Photoemission spectroscopy on organic semiconductor/bio-materials interfaces, Work function measurements, Directed assembly of macromolecular materials, Biosensors, Thin film photovoltaics, and New substrate materials for Matrix Assisted Laser Desorption Ionization Mass spectrometry (MALDI-MS).

David Snider, Ph.D.
Professor Emeritus
Mathematical modeling in physics and engineering, numerical analysis, signal processing, differential equations, optimization, and random processes.

Lee (Elias) Stefanakos, Ph.D.
Professor & Co-Director of Clean Energy Research Center
Solar Energy Conversion (Photovoltaics, Rectennas, etc.), Fuel Cells, Hydrogen Production and Storage, Energy Systems, Electric/Hybrid Vehicles - Alternative Fuels.

Arash Takshi, Ph.D.
Assistant Professor
Bio and Organic electronic devices, particularly in photovoltaic devices.

Sylvia Thomas, Ph.D.
Assistant Professor
Advanced materials for alternative energy sources, sustainable environments, aerospace, and bio-applications from the micro to the nano scale, characterizing, modeling, and integrating materials that demonstrate high levels of biocompatibility, thermal reflectivity, mechanical robustness, and environmental sustainability, such as carbides, sol-gel coatings, high temperature oxides, and mucilage.

Ismail Uysal, Ph.D.
Assistant Professor
Applications of wireless and radio frequency identification (RFID) technologies to supply chain for food and pharmaceuticals, remote environmental modeling, adaptive algorithms for smart sensory data processing and other auto-ID systems..

Thomas Wade, Ph.D.
Professor Emeritus
Solid state microelectronics, VLSI multilevel inter-connection systems, test structure development, fluctuation phenomena in solid state devices, and solid state material characterization.

Jing Wang, Ph.D.
Associate Professor
Nano/microfabrication, Nanomaterials, RF MEMS devices, On-chip power generation, Microfluidics, MEMS transducers, RF integrated circuit, Wide bandgap materials, Polymer nanocomposite, and Responsive polymers.

Paris Wiley, Ph.D.
Associate Professor & Associate Chair
Energy Systems, Electric/Hybrid Vehicles, and Alternative Fuels.

INDUSTRIAL AND MANAGEMENT SYSTEMS ENGINEERING

Tapas K. Das, Ph.D.
Professor and Chair
Modeling of decision making problems in interdisciplinary fields including restructured electric power markets with emissions restrictions, large-scale pandemic outbreak impact mitigation, and cancer diagnosis and prevention.

Patricia Anzalone, Ph.D.
Instructor & Engineering Management Program Coordinator
Manufacturing and services systems, Application in medical devices and pharmaceutical industries, Multivariate quality control, and Statistical analysis.

Griselle Centeno, Ph.D.
Associate Professor
Applied operations research, Scheduling, Decision making, Capacity planning modeling for transportation, Manufacturing, and Healthcare Systems.

Shuai Huang, Ph.D.
Assistant Professor
Big Data Analytics, Statistical Learning & Data Mining, motivated by the statistical challenges in Health Care, Biomedical Informatics and Statistical Quality Control.

Susana Lai-Yuen, Ph.D.
Associate Professor
Computer-aided design (CAD), Computer-aided molecular design (CAMD), Nanotechnology, Human-computer haptic interfaces, and Computational geometry for design and manufacturing.

Geoffrey Okogbaa, Ph.D.
Professor
Reliability, Maintainability, Engineering design, Automated manufacturing systems, and Quality Control.

Kingsley Reeves, Ph.D.
Associate Professor
Supply chain management, Organizational structure, Collaborative networks, and Managerial decision making in outsourcing.

Alex Savachkin, Ph.D.
Associate Professor
Analytical support of enterprise risk management, Health care engineering, Public health disaster mitigation, and Cancer care engineering.

Paul Schnitzler, Ph.D.
Instructor
Management of technological change motivation, and the development of individual creativity for the benefit of organizations.

Michael Weng, Ph.D.
Associate Professor
Computer numeric methods, Production control, Operations research, and Material resource planning.

Ali Yalcin, Ph.D.
Associate Professor
Discrete event systems modeling, Analysis and control, and Manufacturing information systems.

Hui Yang, Ph.D.
Assistant Professor
Healthcare informatics, Nonlinear dynamics, Sensor based modeling and analysis, Reliability, and Statistical quality control.

Jose Zayas-Castro, Ph.D.
Professor & Associate Dean for Research
Enterprise change reengineering, Engineering the service sector, Productivity improvement applied to service and manufacturing enterprises, Entrepreneurship, Applied statistical analysis, Economic/cost analysis and systems dynamics student learning curricular development and assessment.

Bo Zeng, Ph.D.
Assistant Professor
Discrete and combinatorial optimization, and Data mining and their applications in medical decision making and healthcare systems.

MECHANICAL ENGINEERING

Rajiv Dubey, Ph.D.
Professor & Chair
Design, simulation and testing of haptic interfaces and assistive devices for persons with disabilities, Rehabilitation engineering, Smart prosthetics and orthotics, Robotic/telerobotic applications in healthcare, space, undersea, and nuclear waste management, and Dynamic systems and controls.

Glenn Besterfield, Ph.D.
Assoicate Professor & Executive Director, INTO USF
Finite Element Analysis, Computational Mechanics, Mechanical Design, Bascule bridges.

Stephanie Carey, Ph.D.
Assistant Research Professor
Motion analysis, Rehabilitation engineering, Biomechanics, Prosthetic design.

Wenjun Cai, Ph.D.
Assistant Professor
Metallurgy, Mechanical behavior, Nanomaterials, Materials Characterization, Tribology.

Nathan Crane, Ph.D.
Associate Professor
Micro and Nanoscale assembly, Additive manufacturing/rapid prototyping processes, Manufacturing, Machine design, and Thermal protection systems for hypersonic flight.

Don Dekker, Ph.D.
Adjunct Professor
Engineering design processes, and Engineering education.

Don Dekker, Ph.D.
Adjunct Professor
Engineering design processes, and Engineering education.

Delcie Durham, Ph.D.
Professor
Sustainable manufacturing, Predictive product realization, Fundamental methods for complex systems, and Interdisciplinary research organizational models.

Jonathan Gaines, Ph.D.
Instructor
Human-Robot Collaborative Systems, Co-Robotics Technology for Non-Traditional Populations, STEM Education, Sensor Perception.

Nathan Gallant, Ph.D.
Assistant Professor
Biomechanics, Cell adhesion, Biomaterials, Tissue engineering, Surface functionalization, and Micropatterning.

Rasim Guldiken, Ph.D.
Assistant Professor
Bio-MEMS sensor design and fabrication, Micro-fluidics, Ultrasonic imaging, Micromachined ultrasonic transducer design, Ultrasonic cleaning and Non-destructive testing.

Daniel Hess, Ph.D.
Professor
Dynamics of mechanical & structural systems with friction, Machinery dynamics & diagnosis, and Mechanical design.

Autar K. Kaw, Ph.D.
Professor
Engineering education research, Mechanics of composite materials, Elasticity, Fracture, Thermal stresses, Graphic user interfaces for engineering problems, and Web based course development.

Ashok Kumar, Ph.D.
Professor
Thin film technology for multifunctional applications, Processing, characterization, and applications of nanomaterials, Reliability issues in microelectronics and MEMS devices, Sensor technology, Novel materials for energy applications, Analytical techniques of thin films and surfaces.

John Dixon, Ph.D.
Instructor
Porous Media, Heat Transfer, Fluid Mechanics, Engineering Education.

Craig Lusk, Ph.D.
Associate Professor
Compliant mechanisms, MEMS design, Biomechanics, and Theoretical kinematics.

Ajit Mujumdar, Ph.D.
Instructor
Engineered and functionalized active pharmaceutical ingredients (APIs) by dry coating technique, Magnetically assisted impaction mixing of nano-size particles, Discrete element model based numerical simulation of agitator.

Jose Porteiro, Ph.D.
Professor
Fluid dynamics, Heat transfer, Separated flows, and Experimental techniques.

Frank Pyrtle III, Ph.D.
Instructor
Two-phase heat transfer, Droplet and spray cooling, Micro/nano scale heat transfer, and Microelectronic device thermal management.

Muhammad Rahman, Ph.D.
Professor & Graduate Program Director
Modeling and simulating of thermal systems, Hydrogen liquefaction and storage, Aircraft and spacecraft thermal management, Heat transfer and air quality in buildings, Electronics packaging, Magnetic refrigeration, and Jet and spray impingement.

Kyle Reed, Ph.D.
Assistant Professor
Rehabilitation engineering, Haptics, Human-machine interaction, Medical robotics, and Engineering education.

Alex Volinsky, Ph.D.
Associate Professor
Thin films processing, Mechanical properties and characterization, Adhesion and fracture of thin films, Nanoindentation, Irradiated materials properties and X-Ray diffraction.

Stuart Wilkinson, Ph.D.
Associate Professor
Advanced interdisciplinary systems design.

Shuh Jing Benjamin Ying, Ph.D.
Professor Emeritus and Adjunct Professor
Electro-Mechanical Design

College of Engineering Research Centers

1	***Center for Assistive and Rehabilitation Robotics Technologies (CARRT)***	*This Center incorporates innovative theory and state-of-the-art facilities to develop rehabilitation robotics technologies.* *URL: http://carrt.eng.usf.edu/*
2	***Center for Communications and Signal Processing (CCSP)***	*This Center promotes research and development in the transport of information on electronic photonic media; networking of intelligent systems; and processing of signals, images and video.* *URL: http://ccsp.eng.usf.edu/*
3	***Center for Digital and Computational Video (CDCV)***	*This Center provides a focal point for multidisciplinary research and education in a broad spectrum of digital and computational video.* *URL: http://cdcv.eng.usf.edu/*
4	***Center for Urban Transportation Research (CUTR)***	*CUTR is a nationally recognized center of excellence in transportation issues.* *URL: http://www.cutr.usf.edu/*
5	***Center for Wireless and Microwave Information Systems (WAMI)***	*Research done here is advancing the state of knowledge in the wireless and microwave field.* *URL: http://wami.eng.usf.edu/*
6	***Clean Energy Research Center (CERC)***	*This Center investigates Florida's abundance of solar and biomass resources for use as environmentally clean sources of power.* *URL: http://cerc.eng.usf.edu/*

7	***Nanotechnology Research and Education Center (NREC)***	*Research at the NREC deals with diverse fields of nanoscience such as new materials, molecular and nano-electronics, nano-electroptics, nano-medicine and nano-biology.* *URL: http://www.nrec.usf.edu/*

8	***Global Center for Hearing and Speech Research (GCHSR)***	*Research at GCHSR focuses on developing novel interventions and treatments for different types of sensory deficits.* *URL: http://www.gchsr.usf.edu/*
9	***Center for Modeling Hydrologic and Aquatic Systems***	*Assists in the solution of water resource problems for local, state and federal governmental agencies, often working closely with or directly for private consulting firms with particularly challenging or specialized investigations.* *URL: http://cmhas.eng.usf.edu/*
10	***National Bus Rapid Transit Institute***	*Facilitating the sharing of knowledge and innovation for increasing speed, efficiency, and reliability of high-capacity bus service through the implementation of BRT systems in the United States.* *URL: http://www.nbrti.org/*
11	***Center for Applied Research in Medical Devices (CareMed)***	*The mission of CareMed is to improve the overall effectiveness of the medical devices and equipment (MDE) industry across its entire value chain.* *URL: http://caremed.eng.usf.edu/*
12	***USF Center for Entrepreneurship***	*The USF Center for Entrepreneurship is a nationally-ranked, multidisciplinary, campus-wide center focusing on entrepreneurial education, training, and research.* *URL: http://entrepreneurship.usf.edu/*

13	***National Center For Transit Research***	*NCTR's goal is to make public transportation and alternative forms of transportation, including managed lanes, safe, effective, efficient, desirable, and secure.* *URL: http://www.nctr.usf.edu/*

College of Engineering Graduate Fellowship Recipients

NSF Graduate Research Fellowship Program (GRFP)
Frank Alexander, Jr.
Suzanne Boxman (Honorable Mention)
Shamara Collins
Joel Cooper
Pablo Cornejo-Warner (Honorable Mention)
Joseph Register
Matt Verbyla

NSF East Asian Pacific Summer Institute Fellowship
Adrian Johnson

NSF/ASEE Engineering Innovation Fellowship Program (EIFP)
Frank Alexander, Jr.

NASA Space Technology Research Fellowship(NSTRF)
Drew Burgett

NASA Harriett Jenkins Predoctoral Fellowship Program
Innocent Udom

UNCF Merck Graduate Dissertation Fellowship
Olukemi Akintewe

UNCF Gates Millennium Scholarship (GMS)
Dagmara Monfort

National Institutes of Health/National Institute of Aging Research Supplement to Promote Diversity in Health Related Research Award
Jeanine Mansour
Tanika Williamson

IEEE Microwave Theory, Techniques, Society (IEEE-MTTS) Fellowship Programs
Evelyn Benabe
Ibrahim Nassar

USF Presidential Fellowship
Jayita Das

ARFTG Microwave Measurement Student Fellowship Program
Evelyn Benabe

National Consortium for Graduate Degrees for Minorities in Science and Engineering (GEM) Fellowship
Michael Grady
Alisha Peterson

Florida Education Fund's McKnight Doctoral Fellowship Program
Olukemi Akintewe (declined)

College of Engineering Graduate Fellowship Recipients

Veronica Aponte-Morales
Evelyn Benabe
Dagmara Monfort
Pablo Cornejo-Warner
Michael Grady
Maritza Muniz-Maisonet
Alisha Peterson
Issa Ramirez
Christopher Slater

USF Dissertation Completion Fellowship
Henry Cabra
Debosruti Dutta

USF Graduate Student Success Fellowship
Henry Cabra
Vinicio Carias
Yolanda Daza
Tamina Johnson
Sandro Paz
Monica Puertas
Laura Rodriguez
Innocent Udom

USF Signature Research Fellowship
Pacia Hernandez
Sandra Pettitt

Mayor's Hispanic Advisory Council Fellowship
Jose Leon

Society of Hispanic Professional Engineers (SHE) Dissertation Fellowship
Andrea Sanchez

American Society of Mechanical Engineers (ASME) Graduate Teaching Fellowship
Jamie Trahan

Alfred P. Sloan Minority Ph.D. Fellowship Program
Olukemi Akintewe
Veronica Aponte-Morales
Edikan Archibong
Evelyn Benabe
Nellie Bonilla
Pablo Cornejo-Warner
Mutasim El-Sheikh
Nicole Febles
Jose Fernandez
Michael Grady

College of Engineering Graduate Fellowship Recipients

Amine Hafsi
Pacia Hernandez
Tamina Johnson
Maritza Muniz-Maisonet
Samuel Perez
Alisha Peterson
Issa Ramirez
Mandek Richardson
Laura Rodriguez
Rafael Rodriguez
Mark Santana
John Shelton
Eric Tridas
Innocent Udom
Ramiro Vega

NSF Louis Stokes Florida-Georgia LSAMP (FGLSAMP) Bridge to the Doctorate Fellowship Program
Olukemi Akintewe
Frank Alexander, Jr.
Edikan Archibong
Vinicio Carias
Shamara Collins
Pablo Cornejo-Warner
Nicole Febles
Tamina Johnson
Raul Iglesias
Sandro Paz
Alisha Peterson
Monica Puertas
Issa Ramirez

U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN) Fellowship
Brian Bell
Ivy Cormier
Matthew Earle
Trina Halfhide
Ryan Locicero
Mark Santana
Jamie Trahan
Carlos Wilfrong

U.S. Student Fulbright Research Grant Scholarship
Vinicio Carias
Trina Halfhide

WEF Canham Graduate Studies Scholarship
Ryan Locicero

College of Engineering Graduate Fellowship Recipients

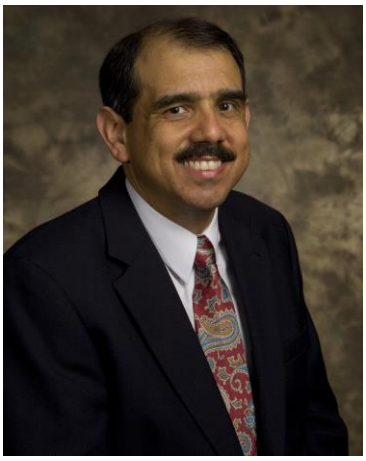
NSF Scholarships in Science, Technology, and Engineering, and Mathematics (S-STEM)

Bertho Augustin
Robert Bair
Sarah Burns
Cherise Burton
Suzanne Boxman
Jorge Calabria
George Dick
Joshua Donegan
Ronald Greenwade
Weishen Hong
Michelle James
Ryan Locicero
Nathan Manser
Katherine Marshall
Jacob Mirabella
Collen Naughton
Robert Panczer
Christine Prouty
Laura Rankin
Benjamin Yoakum

6th Annual USF College of Engineering Research Day
USF Research Park, Galleria (Interdisciplinary Research Park – IDRB)
Wednesday, November 6, 2013
AGENDA

8:00 a.m. to 8:45 a.m.	**Poster Setup (USF Research Park, Galleria - IDRB)**
9:00 a.m.	**Opening Remarks** *Dr. Jose Zayas-Castro* *Professor & Associate Dean for Research* *College of Engineering*
	Welcome *Dr. Paul Sanberg* *Senior Vice President, Office of Research & Innovation* *Distinguished University Professor*
	Presentation of Student Awards *Dr. Jose Zayas-Castro, Professor & Associate Dean*
9:30 a.m. to Noon	**Poster Viewing/Judging**
Noon to 1:00 p.m.	**Lunch (USF Research Park, Galleria - IDRB)**
1:00 p.m. to 2:30 p.m.	**Lab Tours (CARRT, GCHSR, NREC, CUTR)** *Dr. Jose Zayas-Castro* *Professor & Associate Dean for Research*
2:00 p.m.	**Poster Breakdown (USF Research Park, Galleria - IDRB)**

Opening Remarks



Jose Zayas-Castro, Ph.D., is a Professor and Associate Dean for Research in the College of Engineering at the University of South Florida. In 2002, he joined USF as a Professor and Chair of the Department of Industrial & Management Systems Engineering (IMSE). He received his Bachelor of Science degree in Industrial Engineering in 1978 from the University of Puerto Rico – Mayaguez. In 1979 he received a Masters of Science degree in Industrial and Management Engineering from the Rensselaer Polytechnic Institute (RPI) and an MBA in 1981 from RPI. He received his Doctorate in Management from RPI in 1981. His research interests are in Healthcare Systems Engineering, Economic and Cost Systems, Manufacturing and R&D strategy. Dr. Zayas-Castro also serves as a Research Associate with the James A. Haley VA Hospital and as a Member at the H. Lee Moffitt Research Institute and Cancer Center, both in Tampa, FL.

During his career, Dr. Zayas-Castro has advised/mentored almost a dozen PhDs, 30 MS, and over 25 undergraduate research students. More than 80% of them underrepresented students. In addition he has been an active committee member of 36 MS students and 16 doctoral students, including one in Chile, S.A.; more than 50% of them being underrepresented students. He has been an invited speaker to several universities, professional and national forums and workshops on aspects related to increasing the participation of underrepresented students in STEM, mentoring potential faculty among underrepresented doctoral students and increasing the participation of undergraduate underrepresented students in REU programs. In his tenure at the University of Puerto Rico-Mayagüez (UPRM) he worked very actively with undergraduate students to help them pursue Ph.D.s in outstanding programs in the continental US. While Department Head at IE (1987-90) he initiated efforts to systematically mentor and advice undergraduates to pursue graduate degrees and help them to seek opportunities for fellowships and scholarships. While Department Head at IE (1987-90) he initiated efforts to systematically mentor and advice undergraduates to pursue graduate degrees and help them to seek opportunities for national fellowships and scholarships. Dr. Zayas-Castro established the Learning Factory at UPRM and has adapted Learning Factory concepts to other U.S. universities. In 1999, he implemented the Entrepreneurial Manufacturing Innovation Learning Experience Program at the University of Missouri-Columbia, and at USF, he has redesigned the capstone project to include elements of the Learning Factory.

Dr. Zayas-Castro has been awarded 2009 INFORMS Moving Spirit Award, the 2006 USF Hispanic Pathways Award, the 2006 HENAAC Education Award – University, and the 2005 UPS- IIE Minority Advancement Award. He is a member of NSBE and SHPE, and has been advisor of NSBE and SHPE student Chapters.

Welcome

Paul Sandberg Ph.D., D.Sc. is Senior Vice President for Research & Innovation, Distinguished University Professor. Dr. Sanberg trained at York University, the University of British Columbia, the Australian National University and Johns Hopkins University School of Medicine, among others. Before coming to USF, Dr. Sanberg held academic positions at Ohio University, the University of Cincinnati, and Brown University.

Prior to his current position, Dr. Sanberg served as Associate Dean in Morsani College of Medicine, Associate Vice President in USF Health, Senior Associate Vice President for the Office of Research & Innovation and Special Assistant to the President all at USF.

Dr. Sanberg is a member of the Board of Scientific Counselors for the National Institute of Drug Abuse at the National Institutes of Health, and has served on numerous scientific advisory boards for health-related foundations and companies. He has significant industry experience with biotech companies involved in cell therapy for degenerative disorders and biopharmaceutical development. He is the Editor-in-chief of *Technology and Innovation*, and serves on editorial boards for more than 30 scientific journals. Dr. Sanberg is the President of the National Academy of Inventors and has also served as president of a number of professional societies including the American Society for Neural Transplantation and Repair, the Cell Transplant Society, and the International Behavioral Neuroscience Society. He is the author of more than 600 scientific articles, including thirteen books, with over 20,000 scientific citations (Google scholar).

As an inventor on approximately 100 health-related U.S. and foreign patents, his early work was pioneering in understanding why brain cells die in neurological disorders and in drug abuse research. His recent research has focused on discovering innovative ways to repair the damaged brain, and has helped lead the team that demonstrated that bone marrow and umbilical cord blood derived stem cells can be transformed to neural cells that may be useful in stroke, spinal cord injury and ALS. Dr. Sanberg's work has been instrumental in translating new pharmaceutical and cellular therapeutics to clinical trials for Tourette syndrome, depression, stroke, Huntington's disease and Parkinson's disease. He is a Fellow of the AAAS, a Charter Fellow of the National Academy of Inventors, and serves on the evaluation committee of the National Medal of Technology and Innovation.

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Research Category # 4
OTHER

Research Category # 1: Energy, Sustainability, Water and Infrastructures/Transportation

Encapsulation of Phase Change Material: Application in Thermal Energy Storage System for Concentrating Solar Power Plants

Tanvir E Alam[1,3], Jaspreet Dahu[2], D. Y. Goswami[2,3]

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Keywords: polymers, Phase change materials, encapsulation, latent heat, electroplating

Thermal energy storage (TES) is fast emerging as a key component of the concentrating solar thermal power plants as it provides a solution to the long standing issue of power generation during peak hours or the time when sun is not available. The commonly used approach for thermal energy storage involves the use of sensible heat storage systems. The low energy storage density of the sensible storage materials makes these systems very expensive. Since the phase change materials (PCMs) have larger specific storage capacity, it reduces the cost of the latent heat based TES system. However, large volume changes during phase transition and low thermal conductivity of PCMs makes the implementation of these systems quite challenging. One of the most promising ways to solve these problems is to encapsulate the PCM. Macro-encapsulation of the PCM increases the heat transfer rate by improving the surface area to volume ratio.

We have developed an innovative technique to encapsulate the PCMs that melts in the 120-4000C temperature range. The encapsulation procedure involves the coating of a non-reactive polymer over the PCM pellet followed by the deposition of a metal layer. A number of experiments were carried out in order to determine the thermal stability of the polymers in the presence and absence of molten PCMs. An innovative procedure was developed to deposit a thin layer of metal (nickel, zinc and copper) over the polymer. Sodium nitrate and its eutectic with potassium nitrate and or lithium nitrate were encapsulated by this approach and subjected to thermal testing. The tested capsules have survived more than 1800 thermal cycles which is equivalent to more than 6 years of working environment. The thermophysical properties of the PCMs were investigated by DSC/DTA, IR and weight change analysis at various stages of thermal testing. No significant change in the thermophysical properties was noticed which establishes the suitability of the developed approach. We are currently in a process of testing these capsules in a packed bed set-up to test the storage capacity and charging-discharging time.

Modification of the Zeolite-Sequencing Batch Reactor (Zeo-SBR) for Ammonium Removal of Anaerobically Digested Swine Waste

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Keywords: Biological nitrogen removal, nitrification inhibition, zeolite bioregeneration, ammonium exchange, digested swine waste

Swine production represents 40% of the world's meat production. Wastes generated from this industry typically contain high concentrations of organic matter, nutrients, pathogens, trace metals, and salts, as well as pharmaceuticals and other compounds of concern. One technology capable of treating this waste is anaerobic digestion (AD). Since methane is produce during digestion, government agencies are endorsing the use of AD to provide an alternative energy source to farmers and offset operational cost. However, further treatment is required for residuals from AD treated swine waste because nutrients, such as nitrogen in the ammonium form, are not removed. Removal of ammonium (NH_4^+) can be accomplished by biological nitrification and denitrification; however, free ammonia (NH_3) at 10 to 150 mg/L causes nitrification inhibition. NH_3 concentration is dependent of NH_4^+ concentration and pH. NH_4^+ concentrations in digested swine waste have been reported in the range between 800 to 4,000 mg/L. In a biological nitrogen removal system operating at optimum pH, 7.5 – 8.5, NH_3 concentration will range between 20 to 600 mg/L, which are inhibitory to nitrifying bacteria. The goal of this study is to remove NH_4^+ from AD swine waste using a hybrid process that combines cation exchange and biological nitrification/denitrification in a sequencing batch reactor (SBR); also known as the Zeo-SBR. Chabazite, which is a natural zeolite with ion exchange properties, is added to the SBR as a biofilm carrier and to temporarily adsorb ammonium and prevent inhibition of the nitrification process. The objective of this study is to establish the chabazite dose to be used in the SBR that will reduce ammonia inhibition. Adsorption studies were performed in batches; for dose determination consisted of placing different masses of chabazite in contact with NH_4^+ solution (1,000 mg-N/L) at 22°C for 48 hr. For contact time determination was performed with a fixed mass of chabazite and the same conditions as the dose experiments. Chabazite (St. Cloud Mining, Winston, NM) was sieved and clean (particle free) before soaking in 3% NaCl and groundwater for 3 hr on a shaker table set at 200 rpm. Nitrification studies were performed in 0.6 L batch to determine the inhibitory concentration of ammonium to microbial population in seed sludge (2.5 gVSS/L). Seed sludge was spiked with NH_4^+ concentrations ranging from 50 to1,000 mg-N/L. Also, a chabazite dose was placed inside the batch containing 1,000 mg N/L NH_4^+ to examine if inhibition is reduced. In addition 2,000 mg/L Na^+ was added to the 50 and 100 mg-N/L NH_4^+ batches to examine if Na^+ that is exchange affects nitrification rate. Results indicated that chabazite pretreated with GW resulted in higher ammonium removal. Also, a chabazite dose of 150g/L and a contact time of 4 hr are necessary to reduce NH4+ concentration by 80%. This will keep the NH_4^+ concentration under the inhibitory NH_4^+ concentrations (< 350 mg-N/L). Acclimation of the microbial population to Na^+ will be necessary for the Zeo-SBR to improve the rate of nitrification.

Heat Transfer Improvement in Phase Change Materials for Thermal Energy Storage

Abhinav Bhardwaj[1,4], Jaspreet Dhau[4], Muhammad Rahman[2,4]
Elias Stefanakos[3,4], D. Y. Goswami[1,4]

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Keywords: Phase change material, Thermal energy storage, Heat transfer improvement

The advancement of solar energy is crucial towards the development of a sustainable energy future. The uncertain availability of sunshine makes thermal energy storage vital towards the development of solar power generation. Of the various options available for thermal energy storage, the use of latent heat thermal energy storage systems is particularly attractive on account of the high-energy storage density of the inorganic salt based phase change materials (PCMs). Furthermore, this energy is stored at a near constant temperature of the phase change process. While these PCMs must be cheap and abundantly available in order to make power generation feasible, they must also possess good thermal properties. Unfortunately, one major drawback is the low thermal conductivity of these PCMs.

This poster presents two approaches to resolve this problem. Firstly, the encapsulation of PCMs allows us to increase the area available for heat transfer between the PCMs and the heat transfer fluid thereby improving their performance. This approach was used for systems using nitrate salts as PCM. Secondly, additives may be employed to improve the radiative properties of these materials. While chloride salts such as NaCl are cheap and abundantly available, they are also transparent to infrared (IR) radiation. At high temperatures, heat transfer by radiation cannot be neglected. Hence, IR absorptive additives like cuprous chloride might be employed to improve the heat transfer rate of the PCM. With these enhancements, improved performance of PCMs is expected on account of faster charging/discharging rates.

The BioFertilizer Farm: Integrating Waste Stream Resource Recovery and Horticulture

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Keywords: Horticulture, Hydroponics, Anaerobic MBR centrate

As the world's population continues to grow, global demands for food production, freshwater, and fertilizer will continue to increase. Implications regarding increases in these demands include concerns of diminishing supplies of phosphorous and the potential rise in cost of freshwater as its supply diminishes as well. These trends serve as impetus to develop methods for resource recovery. Sanitation practices present unique opportunities to recover valuable resources such as water, energy, and nutrients.

This research investigates the performance of anaerobic membrane bioreactor (AnMBR) centrate as a nutrient solution for use in hydroponic applications. The nutrient rich centrate is derived from the anaerobic digestion of waste water coupled with membrane filtration. Tomato plants were grown in static hydroponic configurations using six different nutrient solutions. The performance of the AnMBR centrate was compared to that of a commercial hydroponic solution. The results show that the AnMBR effluent yielded viable plants that compare well to the reference plants grown with commercial fertilizer after slight alteration. The alterations include diluting the centrate to 50% or adjusting the pH with nitric acid to a pH of 6.5 which is ideal in hydroponic practice.

Synthesis and Characterization of Zeolite-Encapsulated $Ce_{0.6}$:$Zr_{0.4}$O - 8 %Ni:Mg Methane Steam Reforming Catalyst

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Keywords: H–β Zeolite Coating, Encapsulated catalyst, Core–shell structure, Steam reforming, Selectivity of Zeolite

Because of rising petroleum prices, greenhouse emissions and energy security, renewable energies play a key role in producing local and sustained energy to supply growing demand for electricity, heat, and transportation fuel. Gas to Liquid (GTL) and Biomass to Liquid (BTL) are very important technologies to produce synthetic fuels. Steam reforming of hydrocarbons used in producing and upgrading syngas is one of the main steps of GTL and BTL technologies. During the steam reforming of methane process, catalyst deactivation is a big problem because of the aromatic hydrocarbons. The development of active, selective and stable catalyst is a key point for steam reforming process.

This research concentrates on synthesis and characterization of zeolite-encapsulated steam reforming catalyst which is active, selective and stable. A tailor-made encapsulated catalyst with H-β zeolite directly is synthesized over $Ce_{0.6}$:$Zr_{0.4}$O - 8 %Ni:Mg pellets to form a core–shell structure without pinholes and cracks by a hydrothermal synthesis method. The structure of the encapsulated catalyst is characterized by X-ray Diffraction (XRD), Scanning Electron Microscope (SEM), and N_2 Physisorption Analysis.

From XRD pattern, H–β zeolite was synthesized using a hydrothermal synthesis method successfully. From the N_2 physisorption analysis, the surface areas of $Ce_{0.6}$:$Zr_{0.4}$ catalyst and zeolite H-β zeolite were found as 636 and 39 m^2/g , respectively. The pore size distribution of H-β zeolite was obtained between 0.40-0.56 nm using Horvath Kawazoe Method. Further characterization efforts by temperature-programmed studies are underway. In future work, the catalytic activity and selectivity for methane and toluene steam reforming will be performed to validate the enhanced catalytic properties associated to the zeolite shell.

Estimating Greenhouse Gas Emissions for Water Reuse and Desalination Facilities

Pablo K. Cornejo[1], Mark V. Santana[1], David R. Hokanson[2], James R. Mihelcic[1], Qiong Zhang[1]

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[2]*Trussel Technologies Inc., Pasadena, CA*

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Keywords: carbon footprint, model development, life cycle assessment, water reclamation, drinking water, wastewater, reverse osmosis, climate change, sustainability

As population and water demand increase, there is a growing need for alternative water supplies from water reuse and desalination utilities. These supplies will be beneficial for the provision and augmentation of water; however, there are concerns related to the energy consumption and associated carbon footprint of water reuse and desalination. This study compiled greenhouse gas (GHG) emissions of water reuse and desalination systems from existing literature to identify major challenges and trends associated with comparing GHG emissions. Furthermore, available tools to estimate GHG emissions from water reuse and desalination facilities are reviewed to identify limitations, challenges, knowledge gaps, and recommendations for the development of a robust and accurate GHG estimation method for water reuse and desalination. Major challenges in comparing existing studies are associated with variability in location, electricity mix, technologies, life cycle stages, parameters considered and GHG estimation methods. For desalination, reverse osmosis (RO) technologies have lower CO_2 emissions than thermal technologies (e.g., multi-effect distillation (MED), multi-stage flash (MSF)) for an equivalent volume of water produced under similar electricity mixes. The estimated carbon footprint of RO seawater desalination (0.4 to 6.7 kg CO_2eq/m^3) is generally larger than RO brackish water desalination (0.4 to 2.5 kg CO_2eq/m^3) and water reuse (0.1 to 2.4 kg CO_2eq/m^3). Comparison of two models with quite different levels of input requirements showed that the estimated carbon footprint results for seawater desalination, brackish groundwater desalination, and water reuse facility (capacity of 26.1 mgd) were within reported ranges. However, the less data intensive model accounted for only 52-74% of the more complex model's estimate because it underestimates the lifecycle impacts. GHG estimation tools for water reuse and desalination could be improved by incorporating the separate output GHG emissions by unit process, separate output of direct and indirect emissions, accurate model calibration, user-friendly interface, and regional transferability. This study also determined there is a need for a consistent framework to estimate GHG emissions for different levels of sophistication related to input parameters required.

A comprehensive fuel supply chain model for Tampa Electric Company (TECO)

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Keywords: Power System, Fuel Supply Chain, Logistics, Large-scale Optimization, Mixed Integer Programming, Robust Optimization

TECO, a major electricity provider in Tampa Bay area, depends on coal-fired generators to satisfy the majority of their electricity demand. Although coal is a cost-effective fuel source, it has a complex supply chain and its combustion results in emission of harmful gases like CO_2 and SO_2. To handle these challenges, we collaborated with TECO to develop and implement an elaborate design and management system for coal supply chains through a National Science Foundation GOALI grant (Grant Opportunities for Academic Liaison with Industry).

Some of the challenges addressed in our system are the following: (1) Environmental regulations on harmful pollutant emissions should be observed; (2) Different sources of coal have heterogeneous coal quality including heat, sulfur and chlorine content; (3) Coals of different type might be blended together to match generator requirements; (4) Feasible blending recipes are generator-dependent; (5) Transportation costs, including credits and dead-freight charges, are nonlinear; (6) Transportation availability differs from one source to another; (7) Long-term supplier and transportation contracts must be coordinated.

The Mixed Integer Programming model is developed in GAMS and is linked to a user-friendly Excel interface. The model has been reviewed and tested under various scenarios by TECO experts. This system helps TECO reduce the fuel cost by tens of millions of dollars, while reducing the risk of shortage and single-supplier dependency as well as having better boiler performance and lower pollutant emissions. Implementing this system benefits the community by considerably reducing their electricity bill, and assuring a better air quality. Demonstrations will be presented to illustrate the effectiveness of this system.

Carbon dioxide reduction by oxygen absorption on strontium doped lanthanum cobalt perovskite-type oxides

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Keywords: Carbon dioxide reduction, perovskite-type oxides.

In 2010, the world estimate carbon dioxide emissions were 30.6 Gt, which constitutes an all time high. From this number, US is responsible for around 5Gt of carbon dioxide emissions. To prevent this continuous increase, new techniques need to be developed. Perovskites materials have been used in the past as electrodes in fuel cells and and conductors. These types of materials with molecular formula ABO_3 have oxygen deficiencies in its structure. In the present work, strontium doped lanthanum cobalt perovskite in different proportions was synthesized to evaluate its properties as carbon dioxide reductor with temperature programmed techniques. In order for the reduction reaction to take place, an unfavorable Gibbs energy must be overcome. Results showed that $La_{0.75}Sr_{0.25}CoO_{3-\sigma}$ was the most active catalyst in the reduction of carbon dioxide. Further studies are currently being performed to improve the carbon dioxide conversion using these materials.

Design of a Highly Portable Data Logging Embedded System for Naturalistic Motorcycle Study

N.Elmehraz[1], S.Katkoori[1], A.Kourtellis[2], P. Lin [2]

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Keywords: Transportation, Arduino, DAS, SPI, I2C

According to Motorcycle Industrial Council (MIC), in USA the number of owned motorcycle increased during last few years and most likely will keep increasing. However, the number of the deadly crash accidents associated with motorcycles is on the rise. Although MIC doesn't explain why the accident rate has increased, the unprotected motorcyclist gear can be one of the reasons. The most recent National Highway Traffic Safety Administration (NHTSA) annual report stated that its data analyses are based on their experiences and the best judgment is not based on solid scientific experiment [3]. Thus, building a framework for the data acquisition about the motorcyclist environment is a first step towards decreasing motorcyclist crashes.

There are a few naturalistic motorcycle studies reported in the literature. The naturalistic motorcycle study also identifies the behaviors and environmental crash hazards. The primary objective of this work is to design a highly portable data logging embedded system for naturalistic motorcycle study with capability of collecting many types of data such as images, speed, acceleration, time, location, distance approximation, etc. This work is the first phase (of three phases) of a naturalistic motorcycle study project. The second phase is to optimize system area, form factor, and power consumption. The third phase will be concerned with aggressive low power design and energy harvesting. The proposed embedded system design is based on an Arduino microcontroller. A whole suite of Arduino based prototype boards, sensor boards, support software, and user forum is available. The system is high portable with capability to store up to eight (8) hours of text/image data during a one month study period. We have successfully designed and implemented the system and performed three trial runs. The data acquired has been validated and found to be accurate.

Hydrogen Purification by Catalytic Tar Reforming of Biomass-derived Syngas

Nada H. Elsayed[1], Yolanda. A. Daza[1], Matthew. M. Yung[2], John N. Kuhn[1]

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[2]National Renewable Energy Laboratory.

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Keywords: Tar, Syngas, Catalytic Conversion, Thermodynamics

In this study, tar reforming of oak-derived syngas was studied over a mixture of Ni/Mg/K supported on commercial α-Alumina at 900°C. Almost complete conversion of benzene and heavy tars was achieved, but the catalyst deactivated quickly presumably due to impurities in the raw syngas. The thermodynamics of the process were modeled using ChemCad® in a temperature range of 400°C to 900°C at 1 bar. Production of hydrogen began at 600°C and it reached a stable maximum at 900°C where a H_2/CO ratio of ~1.3 was attained. An economic analysis on hydrogen production from biomass obtained from the gasification of the residue from a paper pulping plant was performed. Results showed potential for profitability during the long run however, a more in depth study is still necessary to optimize profitability.

Modeling the Stormwater Runoff Reduction Capabilities of Low Impact Development Practices (LIDs) in an Urban Watershed

M. Esteban[1,2], S. Lovelace[2], A. Blair[2], L. Vandiver[2]

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Keywords: Stormwater Runoff, Low Impact Development, Urban Watershed, Stormwater Retrofit

Urban stormwater runoff is a major environmental concern for coastal ecosystems. As urban development increases so will the impervious cover. Research has found once a watershed exceeds 10% impervious cover, there is a significant increase in the volume and rate of runoff. Increases in stormwater runoff volume contribute more of a pollutant load, which leads to greater environmental degradation. Traditional stormwater management has focused on conveying the rainwater offsite to address concerns of flooding and maintaining pre-development runoff rates. Low Impact Development (LID) is a more comprehensive watershed management approach which utilizes strategies that focus on reducing runoff rate and promoting infiltration of stormwater volumes to retain natural hydrologic regimes.

The objective of this project is to model the volume of runoff from an urban watershed and determine the feasibility of restoring hydrologic regimes to below 10% impervious cover conditions using LID practices. The watershed used for this project was the Noisette Watershed in North Charleston, SC. The SWARM runoff model used in this project is a simple model based on the USDA's Curve Number method of calculating runoff volume. SWARM was used to calculate runoff volume for the watershed at current land cover conditions and at an idealized condition below the threshold at 9% impervious cover. The calculated runoff volumes were then used to approximate the volume of retention from LIDs needed to restore the current watershed to the equivalent runoff volume of the 9% scenario. The retention volume was then used to evaluate the feasibility of installing bioretention cells and other LID practices to restore hydrologic regimes.

Upon finishing the feasibility evaluation, I concluded that it would not be possible to accomplish the restoration on city land using bioretention cells as the only LID practice. Implementing other LID practices on city land such as green roofs, pervious pavers and rainwater harvesting would make restoration using only city lands more practical, but still unlikely. The most feasible solution would be to disperse the LID's throughout the full range of the city, focusing the larger LID practices on city owned land and then dispersing smaller practices throughout privately owned land. Inclusion of privately owned land would require an education component and a community program or incentive to get residents and business owners to participate in protecting their watershed resources.

* Blair, A., D. Sanger, D. White, A.F. Holland, L. Vandiver, C. Bowker, S. White. 2012. Quantifying and Simulating Stormwater Runoff in Watersheds. Hydrological Processes. doi: 10.1002/hyp.9616.

An energy management system model for micro-grids in deregulated electricity networks: A bi-level model approach.

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Keywords: Power markets, MPEC, smart grids, emissions reduction, renewable energy.

Smart energy systems, known as Smart Grids, are becoming more and more popular worldwide. Micro-grids are expected to be the main key component of Smart Grids. Micro-grids are advance small-scale versions of the electricity system. They attempt, among others, to increase system reliability, carbon emission reduction, diversification of energy sources, and cost reduction. Micro-grids are able to work in both connected and isolated mode. In connected mode, micro-grids can be either a source of electricity or a standard load. These new sources and loads will impact the current deregulated markets and therefore its economic and operational planning. Three main objectives are addressed in this research: First, develop an operational model (cost minimization) for micro-grids in order to obtain the optimal operation for the each micro-grid. Second, develop an operational model (cost minimization) integrating the micro-grids and main grid. Third, assess the impact of smart grids in deregulated electricity markets (via emissions reduction, social cost, electricity prices among others). We propose a bi-level optimization model to study the interaction between the micro-grid and the main electricity grid. The upper level optimization model seeks to minimize the operational and emissions cost in the micro-grid while ensuring that the load demand is satisfied. The lower level problem models the interaction of the market participant (GENCOS, micro-grids and consumers) via a DC-OPF model. The bi-level model is reformulated as a mixed integer programming model which can be solve optimally. Different sources of electricity (renewable, non-renewable, and PHEVs), and energy storage are considered.

Exploring Pedestrian Behavior and Perceptions of Road Safety on University Campus

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Keywords: pedestrian safety; observational survey; questionnaire survey; behavioral study

Florida is the state with the highest pedestrian fatality rate per unit population in the U.S. In addition to engineering countermeasures, educational efforts directed to pedestrians and other road users are equally important for improving pedestrian safety. To explore educational formats and identify effective educational methods, the Florida Department of Transportation (FDOT) have sponsored a program called “Bulls Walk and Bike Week Campaign” on the Tampa campus of the University of South Florida (USF). A before-and-after comparison study was designed to evaluate the effectiveness of this campaign. In the study, observational surveys and a questionnaire survey were conducted to compare the surrogate measures of safety performance of the campus before and after the campaign. Seven sites with high volumes of vehicle, pedestrian, and bicyclist traffic on or around the campus were selected for observational survey. The observational survey was conducted during three pedestrian peak-hours on five weekdays before and after the campaign. Pedestrian, bicyclist, and vehicle driver behaviors approaching and crossing intersections or crosswalks were observed and recorded. Observational survey outcomes show that roadway safety on campus improved after the campaign. The improvement is most significant for the site closest to the location where the majority of campaign activities took place. This suggests the necessity of seeking a spatial balance between concentrated and distributed campaign structures for optimal exposure to the campaign, especially when the budget of the campaign is limited and time is constrained.

The questionnaire survey was designed with the purpose of understanding the level of law awareness of road users and their opinions on different aspects of pedestrian safety on the USF campus. The analysis results of the questionnaire survey show that respondents as pedestrians, bicyclists, and drivers have different perceptions on driver yielding behaviors towards pedestrians and bicyclists. Contrasting points of view of different types of road users warrant careful and distinct designs of educational measures intended for different users. More respondents perceived that USF is a pedestrian/bicyclist-friendly campus after the campaign. It is suggested that a longitudinal survey should be conducted to follow up the effectiveness evaluation, and a cost-effective method should be further explored to continue the campaign efforts.

The Impact of Incentive Policies on a Renewable Energy Investment Decision

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Keywords: Smart Grid, Investment model, Incentive policies, electricity Regulation, Mixed Integer Programming, Distributed green generation and storage.

Higher level of green distributed energy generation and storage will lead to a significant reduction in carbon emission and also reduces cost of electricity in the grid, especially during peak times. Since the renewable green energy generation is still relatively expensive, there are federal, state and utility incentives to increase penetration of distributed green energy generation. In this study, we aim at developing a decision making model for the consumers to find the optimal level of investment in each technology for participation in smart grid. Then we will examine the impact of different incentive policies on the level of investment in green energy generation and storages for different regions in the country.

Based on existing incentives, consumer characteristics, price of technologies and the weather forecast, a Mixed Integer Programming (MIP) model has been developed and solved using Cplex in order to find optimal level of investment in renewable energy generators and storages corresponding to the minimum annual cost of energy. Four main categories of incentives are considered in this study: performance based incentive (PBIs), federal tax credit, rebates programs, and loan programs. PBI is production based compensation. Rebate programs, federal tax credit and loan programs are capacity based incentives.

Finally, we demonstrate a case study. An investment decision for a residential customer in Orlando-FL is shown. Based on this investment decision, a sensitivity analysis on several regulations and incentive policies has been done. Results coming out of this sensitivity analysis are surprising and very useful by the regulators. The green investment decision model can also be used for small businesses to decide the most profitable portfolio of renewable generators to invest in. This research aims at optimally exploiting the current incentives, and reducing share of current fossil fuels which produce huge volume of carbon dioxide emission. This can increase social welfare in the long term.

Stress Response of Retroreflective Pavement Markers to Dynamic Traffic Loads

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Keywords: Raised retroreflective pavement markers, finite element model, traffic safety

Raised retroreflective pavement markers (RRPMs) are supplemental pavement marking devices that are used to enhance traffic safety during low-light and inclement weather conditions. In recent years, an increasingly poor performance of RRPMs, especially in terms of durability, has been observed in the state of Florida. Therefore, it was decided to investigate how RRPMs respond to dynamic loads from passing traffic. This information is expected to assist in the improvement of RRPM design for enhanced performance and durability.

There are several major modes of RRPM failure. These include retention failure, loss of retroreflectivity, sinking into the asphalt concrete, and structural failure. This research focuses specifically on structural failure of RRPMs, which is modeled numerically using the ANSYS finite element software package. Two finite element models are developed. The first model includes a standard locked-wheel tire used for pavement skid resistance tests with tire pressure of 220 kPa and a vertical tire load of 7 kN. The second model includes a 285/75R24.5H treaded truck tire with a tire pressure of 830 kPa and a vertical tire load of 22 kN. Additionally, each finite element model incorporates a rigid pavement surface, and a RRPM consisting of an outer polymer shell and resin filler. The direction of tire approach is set along the centerline of the RRPM in both models.

The first finite element model and two tests are used to calibrate both numerical models. First, the tire model is calibrated for its properties by adjusting the tire load-deflection characteristics obtained in the numerical analysis to fit data from a static tire load test. Second, to calibrate the RRPM properties, a field test will be conducted using a locked-wheel skid tester. In this test, four RRPMs will be instrumented with strain gages at pre-determined locations of critical stress and bonded to a pavement surface. Strain data from multiple passages of a rolling locked-wheel truck tire over the RRPMs, collected using a data acquisition system, will be compared with the corresponding FEM simulation results to identify material parameters that govern the RRPMs' dynamic response. Subsequently, the calibrated truck tire finite element model will be used to investigate the critical scenarios of tire-RRPM impact. The stress state generated in the RRPM will be examined with respect to the magnitudes of critical stresses in the RRPM and the corresponding locations.

Graphene –metal oxide (TiO_2, ZnO) nanocomposite for Organic Decontamination from Water

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Keywords: Synthesis, Characterization, Remediation, PhotoCatalysts, NanoComposites

The organics and heavy metals remediation from water are generally performed by combination of physical, chemical and biological techniques. However, the use of photocatalyst (i.e, titanium oxide (TiO_2)) shows the complete remediation of organics without generation of residues under UV-light. The previous studies from our group on graphene-TiO_2 and graphene-TiO_2-biosurfactant based photocatalysts have shown to remediate the organics in visible light. In the present work, G-zinc oxide (ZnO) and G-(ZnO+ TiO_2) nanocomposite photocatalysts were synthesized using chemical methods, and characterized by using FTIR, X-Ray Diffraction and SEM techniques. Attempts are made to remediate methyl orange (MO), naphthalene and organic oil using G-ZnO and G-(ZnO+ TiO_2) photocatalysts, and have been compared using graphene- TiO_2. The novel photocatalysts reveal that the complete remediation of organics from water could be made under sun light.

Water Supply Resilience in Coastal Communities: Framework Development for Climate Change Adaptation

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Keywords: AMR, climate change, coastal cities, critical infrastructure , Dunedin, DPSIR framework, Guardamar del Segura, groundwater, Integrated Urban Water Management (IUWM), reclaimed water, resilience, sustainability, urban water cycle, water reuse

Water supply is essential for communities to function and thrive. It is necessary not only for human consumption and well-being, but also for nearly every segment of urban life. Without reliable supplies, food production, waste management, power generation, air conditioning systems and a myriad of other necessary urban functions would come to a screeching halt. Although modern cities generally benefit from centralized treatment and distribution, aging infrastructure, along with changes in population and climate, are making it difficult to meet water supply demands. The anticipated societal and environmental effects due to current and imminent water issues are great. There is an urgent need to find sustainable solutions before the effects are irreversible (U.S. Water Alliance, 2012).

At this critical intersection in time where aging infrastructure, increasing urban pressures and the effects of climate change are threatening the ability of cities to persist, a new water management paradigm - which addresses our contemporary urban issues - must be formed. The Hurricane Sandy Rebuilding Task Force Report states, “More than ever, it is critical that when we build for the future, we do so in a way that makes communities more resilient to emerging challenges such as rising sea levels, extreme heat, and more frequent and intense storms” (Hurricane Sandy Rebuilding Task Force, 2013). Given the complex nature of water supply to urban areas, particularly in coastal settings, the proposed research project focuses on the development of a decision support system which assists the water sector in decision-making regarding:

- the future design, operation, and management of water infrastructure adapting to climate change,
- the development of a new water management paradigm, which addresses contemporary urban issues, and
- the development of policies, avoiding unintended impacts which jeopardize important connections between humans and the environment.

The proposed research includes: (1) a study site (Dunedin, FL) with a robust set of elements which closely exemplifies the effects of a highly-urbanized environment on the water cycle and the vulnerabilities of a coastal location, (2) a ‘systems thinking’ software (STELLA^{TM}) for creating a water/salt balance, modeling the urban water cycle and testing various stressor-response climate scenarios (sea level rise, drought and flooding), and (3) a ‘systems thinking’ framework, known as DPSIR (Driver-Pressure-State-Impact-Response), to determine appropriate adaptation responses by water utilities – evaluating sustainability with regards to water extraction/discharges to the environment and energy consumption - to the simulated climate-related scenarios.

Removal of bacteria from Stormwater using Biochar

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Keywords: stormwater, groundwater, bioinfiltration, biochar

Urbanization of natural landscape increases impervious surface coverage, which in turn reduces natural infiltration of stormwater into soil. This change causes several environmental problems including depletion in groundwater recharge, increased flooding, and increased erosion. Furthermore, stormwater contains a myriad of contaminants including suspended solids, nutrients, heavy metals, hydrocarbons, and pathogens, which lead to contamination of surface waters that receives overland flow of stormwater. Thus, there is an urgent need to improve management of urban stormwater. Bioinfiltration systems have been used to manage stormwater quantity, with limited attention to improving the water quality. To improve the removal of contaminants, bioinfiltration systems may be augmented with geomedia.

This research aims to examine efficiency of biochar; a charcoal-like engineered geomedia generated during the pyrolysis of biomass, to remove fecal indicator bacteria (*E. coli*) from stormwater with and without natural organic matter (NOM). Three types of biochar are used: a commercial biochar, and two biochars produced in a laboratory by pyrolyzing wood chips at 350°C, and 700°C. Batch experiments were conducted in triplicates by adding sand and biochar (5% by weight) in 20 mL of synthetic stormwater containing *E. coli* with or without NOM, and mixed for an hour before analyzing for aqueous concentration of *E. coli.* Sand removed 41± 9% of bacteria, whereas biochar addition improved the removal. The commercial biochar removed 66±5 %, the biochar pyrolyzed at 350°C removed 96 ±0%, and the biochar pyrolyzed at 700°C removed 95±3% of bacteria. The biochar pyrolyzed at 700°C seems to be more effective than other the biochars in removing bacteria from stormwater. The removal was not affected by presence of NOM. Overall, we demonstrated that augmenting bioinfiltration system with biochar can significantly improve the stormwater quality, thereby minimizing the contamination of surface water.

Design of an Advanced Lighting Measurement System for Roadway Safety

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Keywords: Embedded System Design, Light Sensors, Illumination Measurement, Highway Safety, Arduino.

Roadway illumination is a vital component of safety while driving during the night. There are regulations in place to ensure all publically maintained roads are properly lit, but the validation process is too time consuming, costly, and dangerous for adequate data collection studies. The work in this research is aimed toward remedying this problem by creating an Advanced Lighting Measurement System (ALMS) capable of recording illumination readings while traveling at normal driving speeds. This solution is based on the Arduino Uno development board, a cost effective yet powerful microcontroller.

This research involves collecting data along 100 centerline miles of Florida roadways and converting the resulting illumination readings into GIS format, allowing them to be included in the roadway database of the Department of Transportation. By including this data the DOT will be able to repair poorly lit corridors and will be aware of possible safety concerns. The illumination values recorded by the ALMS have been validated and verified as an accurate replacement for conventional lighting measurements.

Performance Testing of a Solar Air Conditioning System

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Keywords: carbon dioxide, sustainable energy source, power

CO_2 emissions are estimated to double by 2050 due to the current challenges in ensuring sustainable energy supplies and use. Solar energy if harnessed and deployed effectively, has been one of the oldest and most promising sustainable energy resource. Utilisation of solar energy in large commercial and industrial cooling and heating systems is receiving an increased focus and is also being tested for applications in residential homes. As a contribution to global energy sustainability, solar cooling is targeted to provide up to 17% of the global cooling requirement by 2050 [i].

This ongoing research aims to evaluate VaporGenics® solar thermal based vapour compression cycle for cooling. This cycle uses a proprietary VaporGenics engine that converts heat to linear motion thereby providing compression. A solar water heater is used to power this system. It is projected that the system will utilize 31 651 kJ of heat from hot water to produce cooling. The performance of the system will be measured based on ASHRAE standard 37. A laboratory test facility is set up with two chambers for producing controlled indoor and outdoor conditions. The heat supplied to the indoor chamber will be removed by the cooling unit which will be measured to ascertain the exact cooling capacity. COP of the unit will also be measured.

The success of this study is expected to encourage power utilities to promote the deployment of replicable systems in residential and commercial areas. With global projected space cooling growth of 42% from 2011 to 2040, this technology has the potential to penetrate into the residential and commercial sectors requiring smaller capacities.

Catalytic Conversion of Landfill Gas to Liquid Fuel

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Keywords: Landfill gas, catalytic conversion, synthetic fossil fuels

Landfill gas can be captured, converted, and used as an energy source. Approximately 234 MM tons/year of municipal solid waste is produced in United States, with the average landfill collecting 2800 ft^3/min of landfill gas (LFG). Most of this gas is wasted by flaring while landfills spend $8,000 per day on diesel fuel for its vehicle fleet. The process involves two specialized catalysts, Ni-Mg supported on $Ce_{0.6}Zr_{0.4}O_2$ for use in a Tri-reforming reactor, turning CO_2 and methane into hydrogen and carbon monoxide (syngas). This syngas is converted using a silica eggshell catalyst in the Fischer-Tropsch reactor (FTSR). Using both the tri-reforming and the FTS reactors in tandem enables conversion of the landfill gas directly into a tailored fuel cut of middle distillates (diesel and jet fuel) without creating heavier hydrocarbons. The catalysts combat current issues of coke formation and lowers the cost of synthetic fossil fuels. The downscaling of extremely large FTS reactors is important to the implementation of this system on a wider scale. Current efforts are aimed at integration of the reactors and scaling of the prototype system.

Graphene- MnO_2 Nanocomposite Materials for Supercapacitor Applications

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Keywords: graphene, supercapacitors, synthesis

We have done extensive work on ruthenium oxide 'RuO_2'–graphene composite materials for supercapacitor applications. However, the cost of RuO_2 has been an issue for use in large scale production of supercapacitors. This research project focuses on novel and cost effective graphene MnO_2-(G) novel composite materials. The MnO_2 and MnO_2-(G) and the corresponding nanomaterials were synthesized by the sol-gel technique, and characterized. The charging-discharging, cyclic voltammogram stability and the life cycle of the various MnO_2 and MnO_2 materials were studied in various supercapacitor configurations. The higher specific capacitance and stable number of charging–discharging cycles in MnO_2-(G) are analyzed to better understand the electrochemical properties of the graphene-metal oxide based supercapacitors. On the basis of our findings, the MnO_2-(G) material is very promising for use in supercapacitor applications.

Cactus Mucilage Biobeads and Absorption of Methylene Blue

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Keywords: Cactus mucilage, Calcium alginate, Composites, Biobeads

The cactus known as prickly pear distinctively produces of a sugar polymer known as mucilage, as extract has been empirically applied in contaminated water. The results have been promising and scholarly papers have reported the contribution that this extract has made to the field on cleaning samples containing bacteria, clay particles and metals. Despite the story of success on a research basis this plant's extract and its colloidal particles responsible of the mechanics of absorption of such contaminants currently demand elaborated research practices of membrane filtration to retire them from solution, limiting the application of these natural colloidal traps to the research depth. Thereby, the use of a substrate capable to entrap the cactus colloids, shape them into larger and tractable material clusters easier to be removed seems to be the right direction to follow towards the upscale level of application. Therefore, in this latter context, the study and application of a natural gelling agent known as calcium alginate interaction as substrate has been set in order to cap the cactus colloidal material into a more larger semisolid hydrogel spheroidal shapes (biobeads) to approach the water cleaning application combining two biomaterials. The first mucilage/alginate biobeads fabricated were assessed to assess their performance in the absorption in solutions made of an organic synthetic dye known as methylene blue.

Study of Bioretention Systems for Nitrogen Removal Under Field Conditions

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Keywords: Bioretention, nitrogen removal, stormwater, urban runoff, low impact development technologies, rain gardens

Urbanization in coastal cities has continued to increase over the several past decades, with Florida leading all states with a 75% coastal population growth. As urban development increases, more land is paved, reducing impervious surfaces, infiltration rates, and groundwater recharge; thereby, altering natural runoff pathways and increasing urban runoff. In the Tampa region, high levels of Nitrogen (N) and Phosphorus (P) found in the runoff overload Tampa Bay and its adjacent environments, degrading the quality of the water. The N in the water leads to excessive algal growth and eutrophication, which in turn causes a reduction to light penetration, sea grass mortality and decreased levels of dissolved oxygen. A study by the EPA and Florida DEP found that the largest contributor to N in the watershed was residential use. Part of a Best Management Practice (BMP) that can be applied to reduce N loads from urban runoff to Tampa Bay are the use of Low Impact Development (LID) technologies such as bioretention systems (a.k.a “rain gardens”). Bioretention systems are a shallow depression with a planting bed and a series of permeable layers where the water is filtered. Prior studies have shown how the use of an internal water storage zone containing an electron donor that supports denitrification has resulted in total N removal efficiencies greater than 88% under laboratory conditions. This research looks further at how denitrifying bioretention systems can be implemented in residential areas using locally available materials to reduce nitrogen loads from urban runoff to Tampa Bay.

The University of South Florida and the Corporation to Develop Communities of Tampa, Inc. (CDC) are collaborating to install bioretention systems on CDC properties to increase community awareness of the benefits of bioretention, evaluate N removal under field conditions and promote bioretention systems among the residents of the Tampa Bay watershed.

Modeling Pathogen Fate in Discretely-Fed Mesophilic Anaerobic Reactors

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Keywords: Ascaris Inactivation, Mesophilic Anaerobic Digestion

Global meat consumption has grown significantly over the past few decades, which has led to an increase in concentrated livestock waste streams. These waste streams contain pathogens but also resources that can provide energy and nutrients (i.e., phosphorus and nitrogen). Past research has shown that capture and treatment of the livestock waste by means of anaerobic digestion is an effective way to recover the energy associated with organic carbon and nutrients. However, when these anaerobic systems have been optimized for resource recovery there is little reported knowledge about how these conditions will accomplish pathogen inactivation.

This purpose of this study was two-fold, the first objective was experiment based and was designed to understand how the operating conditions of well-functioning anaerobic digestion systems affect the inactivation of resistant pathogens without sacrificing biogas and biosolids production. The second aspect applied a mathematical modeling approach to determine the sludge residence time distribution of the discretely-fed reactor utilized in the laboratory experiments.

We hypothesized that viable eggs of *Ascaris suum* will survive in a well-functioning discretely fed mesophilic (35°C) anaerobic reactor for 14 to 30 days as observed in similar studies at this temperature. The experiment included a 1.5 liter bench-scale reactor (SRT = 21 days) digesting swine manure. *Ascaris suum* eggs were used as the model microorganism and nylon mesh bags with 30-micron pore sizes were used to house the eggs while exposing them to the conditions inside the anaerobic reactor. Over the course of the experiment the reactor was monitored for biogas production, ammonia concentration and pH to ensure typical function. In triplicate, *Ascaris suum* viability was determined by microscopic examination of the eggs (n=200 minimum) to identify the current stage of development for each egg.

The experimental results showed that 99% inactivation was achieved in the reactor after 17 days of residence time, while the modeling work revealed that the reactor configuration was producing an effluent where 55% of it was less than 17 days old. This indicates that a majority of the sludge could still contain viable pathogens and that mesophilic anaerobic reactors that have been optimized to produce gas are not producing effluents that can be safely handled after the digestion process is complete. This result has large implications in tropical climates, especially in the developing world, because the prevalence of pathogens is much greater there and this technology is often applied in that setting as a means to provide multiple benefits like improved sanitation and energy.

Determination of the Optimum Binder Content of Open- Graded Friction Course (OGFC) Mixtures using Digital Image Processing

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Keywords: Open Graded Friction Course, Optimum Binder Content, Pie-plate visual method (FM 5-588), Image processing

Florida Department of Transportation (FDOT) has been using Open Graded Friction Course (OGFC) mixture since the early 1970's to improve skid resistance of asphalt pavements under wet weather. OGFC is a type of porous pavement that differs from traditional asphalt pavements in that the structure permits water to pass freely through it. Hence, OGFC mixes improve the surface drainage of asphalt pavements, reducing hydroplaning, splash and spray behind vehicles, and improving wet-pavement friction and surface reflectivity during wet-weather conditions. The OGFC mixture design strongly depends on the Optimum Binder Content (OBC) that represents if the sample has sufficient bonding between the aggregate of the mixture and asphalt binder. FDOT currently designs OGFC mixtures using a pie-plate visual method (FM 5-588). In this method, the OBC is determined solely based on visual assessment of binder draindown on three pie plates with trial binder contents. A drawback of this method is the subjectivity involved in the visual inspection performed to determine the OBC. Determination of the OBC is, therefore, of great interest for road and infrastructure engineers and it is appropriate to study it with recently developed images analysis method.

The purpose of this research was to finalize an effective analysis of pie plate's image for automatically measuring binder draindown without the need of a trained, experienced with the relationship between lab design and field construction, and knowledge of the materials technician to determine an accurate OBC with consistency. This research will prove that, thanks to the synergy use of different segmentations methods of the digital images taken on pie plates, it is possible to obtain a reliable determination of OBC of the mixture. The proposed methodology allows one to estimate the OBC that, otherwise, it would be necessary to establish via visual inspection, under taking subjectivity from the test that also imply error risks from the technicians. Subsequent implementation of FM 5-588 with image processing is expected to improve the consistency of determining OBCs for OGFCs and possibly result in a design procedure that could eventually be accomplished by Contractors, similar to Superpave mix design.

Development and characterization of novel high-temperature thermal energy storage media via advanced IR spectroscopic methods

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Keywords: thermal energy storage, PCM, radiation, molten salt, IR spectroscopy

Molten inorganic salts hold a great deal of promise as high-temperature heat transfer fluids and thermal storage media in renewable energy applications, and they have found use in nuclear and solar thermal power. As phase-change materials (PCMs) for thermal storage, chloride salts are especially promising—high latent heat of fusion and resistance to supercooling allow for high energy storage density and consistent energy delivery at design temperature. They are, however, hampered by relatively low thermal conductivity (less than 1 W/m-K in the molten state).

This study describes the development and characterization of novel high-temperature storage media, based on inclusion of transition metal chlorides in the potassium-sodium chloride eutectoid, (K-Na)Cl (melting temperature of 657°C, latent heat of 305 J/g). At the melting temperature of (K-Na)Cl, infrared (IR) radiation can play a major role in the overall heat transfer process— 90 percent of spectral blackbody radiation falls in the range of 2 to 13 µm. Inclusion of small amounts (0.5 wt %) of IR-active transition metal chlorides can greatly improve heat transfer rates.

Determining the degree of improvement requires measurement of the absorption coefficient in the spectral range of interest. Unfortunately, traditional spectroscopic methods are ill-suited for work with molten salts: direct transmittance measurements overestimate absorption if they do not capture backscattering, and window materials (e.g., quartz) are prone to corrosion by these molten salts. A new IR reflectance apparatus was constructed to allow for determination of the spectral absorption coefficient of the newly formulated PCMs in the molten state. The apparatus consisted of an alumina crucible coated at the bottom with a reflective platinum surface, a ceramic heating element housing the crucible, a weighted potassium bromide window to prevent evaporation of molten salt, and a zinc selenide window to seal the heating chamber, allowing for inert gas purge.

Upon characterization of the spectral absorption of these materials, it was possible to apply the measured absorption coefficients to numerical models simulating the charging of the thermal storage media. Two models were developed for this study: a simplified analytical model for heating the solid material to its melting point, and a more complex model for heating the liquid material above its melting point, the latter solved by finite element methods. Both show distinct improvement in heating times with the additive-enhanced PCMs relative to the pure salt.

Assessing Appropriate Technology Handwashing Stations in Mali, West Africa

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Keywords: hygiene, health, gender, seasonality, monitoring, Millennium Development Goals

Proper hand hygiene is the most effective and efficient method to prevent over 1.3 million deaths annually from diarrheal disease and Acute Respiratory Infections (ARIs). Hand hygiene is also indispensable in achieving the fourth Millennium Development Goal (MDG) to reduce the childhood mortality rate by 2/3rds between 1990 and 2015. Handwashing has been found in a systematic review of studies to reduce diarrhea by 47% and is, thus, capable of preventing a million deaths (Curtis et. al., 2003). Despite this evidence, hand washing rates remain seriously low in the developing world (Scott et al., 2008).

This study developed and implemented a comprehensive monitoring strategy of five usage variables (i.e., soap usage, functionality, presence of cleansing agent, ground wetness under station, and amount of water in the jug) for 42-64 appropriate technology handwashing stations. These stations were monitored throughout 2011-2013 in two communities in Mali, West Africa. Statistically significant results include: 1) a 29% decrease in soap usage from dry (October-June) to rainy seasons (July-September), 2) 35% decrease in stations with presence of cleansing agent between 2011 and 2012, 3) higher station usage for stations in households with higher scores on the Progress out of Poverty Index® , 4) a 27% difference in presence of cleansing agent, during the rainy season, between stations that were less than 35 meters and greater than or equal to 35 meters from a water source. Stations closer to a water source had higher station usage. Station usage also differed based on gender of the handwashing station owner in the two communities where stations built by women were used more in Zeala than those in Nci'bugu. In contrast to Zeala, handwashing stations built by men in Nci'bugu had higher soap usage and usage variable proportions than those built by women. Educational interventions resulted in 98% of households reporting that they wash their hands with soap in 2012 from 0% in 2011. Altogether, gender, education, water, seasonality, wealth, and monitoring were identified as major factors to promote sustainable handwashing behavior change that should be incorporated in future hygiene interventions.

Numerical Studies on Hydraulic Performance of the Waste Stabilization Pond in Bolivia using CFD

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Keywords: Sludge accumulation, waste stabilization ponds (WSPs), computational fluid dynamics (CFD) analysis

Sludge accumulation is an important factor that affects the performance of waste stabilization ponds (WSPs). However, there is an incomplete understanding of the relationship between sludge accumulation and hydraulic performance, the latter serving as an index of pathogens removal efficiency. In this study, computational fluid dynamics (CFD) analysis was applied to investigate the impact of sludge layer geometry on hydraulic performance of a WSP in rural Bolivia. The CFD model was first validated via comparisons with field measurements from a passive tracer experiment. Beyond this comparison, four WSP scenarios with different sludge volumes and distributions were investigated. It was found that sludge volume could either negatively impact or positively impact hydraulic performance of the pond, depending on the sludge distribution and sludge volume. In some cases the sludge distribution can act as a baffle inducing flow conditions closer to an ideal plug flow reactor, thus improving the hydraulic performance of the pond. However, a sufficiently large sludge volume reduces mean residence time in the pond, thus negatively impacting its hydraulic performance. In summary, sludge distribution was found to be a critical component for determining hydraulic performance of a WSP and deserves attention in future studies.

Study of Bioretention Systems for Nitrogen Removal Under Field Conditions

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Keywords: Bioretention, nitrogen removal, stormwater, urban runoff, low impact development technologies, rain gardens

Urbanization in coastal cities has continued to increase over the several past decades, with Florida leading all states with a 75% coastal population growth. As urban development increases, more land is paved, reducing impervious surfaces, infiltration rates, and groundwater recharge; thereby, altering natural runoff pathways and increasing urban runoff. In the Tampa region, high levels of Nitrogen (N) and Phosphorus (P) found in the runoff overload Tampa Bay and its adjacent environments, degrading the quality of the water. The N in the water leads to excessive algal growth and eutrophication, which in turn causes a reduction to light penetration, sea grass mortality and decreased levels of dissolved oxygen. A study by the EPA and Florida DEP found that the largest contributor to N in the watershed was residential use. Part of a Best Management Practice (BMP) that can be applied to reduce N loads from urban runoff to Tampa Bay are the use of Low Impact Development (LID) technologies such as bioretention systems (a.k.a “rain gardens”). Bioretention systems are a shallow depression with a planting bed and a series of permeable layers where the water is filtered. Prior studies have shown how the use of an internal water storage zone containing an electron donor that supports denitrification has resulted in total N removal efficiencies greater than 88% under laboratory conditions. This research looks further at how denitrifying bioretention systems can be implemented in residential areas using locally available materials to reduce nitrogen loads from urban runoff to Tampa Bay.

The University of South Florida and the Corporation to Develop Communities of Tampa, Inc. (CDC) are collaborating to install bioretention systems on CDC properties to increase community awareness of the benefits of bioretention, evaluate N removal under field conditions and promote bioretention systems among the residents of the Tampa Bay watershed.

Effect of Land Use on Surface Water Quality and the Associated Carbon Footprint and Embodied Energy of Water Treatment in the City of Tampa

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Keywords: Surface Water, Water Quality, Drinking Water Treatment, Chemical Use, Sustainability

The world is becoming more urbanized with most of the world's future population growth projected to occur in cities. Anthropogenic land use contributes to increased impervious areas and alterations of flow regimes. At the same time, issues of land use impact the release of particular water quality constituents into the surrounding surface and groundwater. For example, use of nitrogen and phosphorous fertilizers on agricultural and residential lands along with changes in local hydrology may transport these added nutrients to nearby water, thus changing the receiving water quality. If this water body is also a source of drinking water (as is the case in Tampa), the treatment plant may have to expend more energy, materials, and chemicals in treating the impacted water to an acceptable standard. Accordingly, this research will determine the carbon footprint and embodied energy associated with changes occurring at the water treatment plant that uses surface water as a source, in cases where that surface water's quality is impacted by changes in local land use.

The study site is the Hillsborough River watershed and the downstream reservoir that serves as the water source for the David L. Tippin water treatment facility, which serves the city of Tampa. Water quality data in the reservoir, land use changes in the watershed, and energy and chemical use at the treatment plant have been collected for the past decade. The data is being analyzed using a variety of statistical methods. First, a Pearson's correlation analysis was carried out to highlight the significant relationships between water quality and water treatment parameters over the period of 2000-2010. Second, a linear regression was used to quantify the effect of water quality on the amount of water treatment chemical usage using water treatment concentrations as the input variables and the chemical dosage as the output variable. Results highlight that two water treatment chemicals (used to aid in removal of turbidity via coagulation/flocculation), ferric sulfate ($FeSO_4$) and sulfuric acid (H_2SO_4), are significantly correlated to several water quality parameters. Linear regression equations, with R^2 values over 0.80, show that amounts of water quality constituents such as color, conductance, and turbidity, in addition to concentrations of total organic carbon (TOC) have a relatively significant influence on the $FeSO_4$ dosage at the drinking water treatment plant. Meanwhile, concentrations of alkalinity, hardness, and iron as well as measurements of conductance and temperature determine the dosage for H_2SO_4. Current research is quantifying the associated carbon footprint and embodied energy from these added requirements at the drinking water treatment plant that are influenced by the variations in the reservoir's water quality, which are associated with changes in land use.

Frequency Selective Thermal for Energy Harvesting Applications

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Keywords: Energy, Sustainability, Thermal Emission, Periodic Nanostructures, Surface Plasmons

A hybrid photonic crystal structure is designed to modify thermal emission spectrum tailored to suit applications in biosensors, detectors and thermophotovoltaic devices [1]. The hybrid photonic crystal structure uses the effect of surface morphology on the optical properties to introduce the selectivity in frequencies for the emission. The thermal emission in a certain set of frequencies can be suppressed while allowing the crystal to emit radiation limited in a narrow band of frequencies.

The emission spectrum tunability has been confirmed by using experimental setup as well as theoretical calculations. A metal-dielectric composite with the top metal surface etched into sub wavelength nanostructures is made the base case for the emitter design. From thereon, various periodic arrays of rectangular or circular holes as well as gratings were introduced in the base case [2-3]. While simulating the emission spectrum different metals including Silver, Gold, Tungsten, Nickel and Platinum were considered. Also, changing the dielectrics with varying indexes was also seen to impact the shape of the emission spectrum. Effect of etch depth in such periodic structures was also taken into account. Variations in period of the array and the dimensions of each hole were also noted to affect the narrowness of spectrum. Such frequency selectivity can be attributed to phenomena including Surface Plasmon Polariton (SPP) coupling as well as diffraction by the grating structure [4].

References:

1. M. U. Pralle, N. Moelders, M. P. McNeal, I. Puscasu, a. C. Greenwald, J. T. Daly, E. a. Johnson, et al. *Applied Physics Letters* 2002, 81 (25), 4685.
2. A. Heinzel, , V Boerner, A Gombert, B Bläsi, V Wittwer, and J Luther, 2000." *Journal of Modern Optics* 2000, 47 (13) 2399–2419.
3. H. Sai and Y. Kanamori, *Microscale Thermophysical Engineering* 7 2003, 101–115.
4. H. Sai, Y.I Kanamori, and H. Yugami. 2005. *"Journal of Micromechanices and Microengineering"*. 3003, 15 (9) S243-S24005.

Denitrification of surface runoff and tile drain effluent through use of anoxic wood-chip bioreactors in Salinas Valley of California

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Keywords: Denitrification, Bioreactor, Nitrate, Effluent

Nitrate is recognized as a leading non-point source contaminant in surface water and groundwater in the US. This has led to increased regulatory pressure to reduce discharges of nitrate-nitrogen (NO_3-N) from agricultural operations. Monitoring of surface waters in the Salinas Valley of California has recently shown that nutrient loads are commonly above acceptable range. The performance of pilot-scale denitrification bioreactors in reducing NO_3-N concentration in tile drain effluent and surface runoff was evaluated on 3 commercial farms in the Salinas Valley. The bioreactors treating tile drain effluent (sites 1 and 2) were built in spring, 2011 and are 12-13 m^3 in size, while the bioreactor treating surface runoff (site 3) was built in spring, 2012 and is 25 m^3 in size. Water was continuously cycled through the bioreactors at a rate that provided 2-3 days of residence time. Water samples were taken twice a week for 9 weeks during summer, 2013, as part of an ongoing, two-year study. Denitrification rates were determined by comparing NO_3-N concentrations of inlet and outlet flows using spectrophotometry.

Surface runoff influent NO_3-N concentration averaged 60 mg L^{-1} from May through July 2013. Tile drain influent averaged 116 and 214 mg NO_3-N L^{-1} at site 1 and 2, respectively, during the same period. Denitrification rates averaged 39.1 and 30.2 mg NO_3-N L^{-1} at sites 1 and 2 respectively, and 19.4 mg NO_3-N L^{-1} at site 3. When compared to historical data, influent NO_3-N concentrations were higher during the study period than in winter months due to increased agricultural production on the farms. In conclusion, denitrification bioreactors were effective at reducing nutrient loading from irrigated farms to surface water. However, this technology may be more practical for the remediation of surface runoff, due to its much lower inlet NO_3-N concentration compared to tile drain effluent.

CFD Analysis of Hydraulic and Disinfection Efficiencies of a Full-Scale Ozone Contactor

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Keywords: Computational Fluid Dynamics, Disinfection, Full-scale contactor

The capability of predicting hydraulic and disinfection efficiencies of ozone disinfection contactors is essential for evaluating existing contactors and improving future designs. Previous attempts based on ideal and non-ideal models for the hydraulics and simplified mechanisms for chemical reaction modeling have resulted in low accuracy and are restricted to contactors with simple geometries. This study develops a modeling framework for the ozonation process by combining computational fluid dynamics (CFD) with a kinetics-based reaction modeling for the first time. This computational framework has been applied to the full-scale ozone contactor operated by the City of Tampa Water Department. Flow fields, residence time distribution, ozone concentration distribution, and disinfectant concentration-contact time (CT) distribution within the contactor have been predicted via the computational framework. The predictions of ozone and bromate concentrations at sample points agree well with physical experimental data measured in the contactor. The predicted CT values at the contactor outlet demonstrate that the disinfection performance of the ozone contactor operated by the City of Tampa Water Department is sufficient to meet regulation requirements. The impact of seasonal flow rate change on disinfection performance is found to be significant and deserves attention during the management and operation of a water treatment plant.

Research Category # 2: ***Materials Science, MEMS/NEMS, Nanotechnology, Biomedical, and Health***

A MDP Model for Breast and Ovarian Cancer Intervention Strategies for BRCA1/2 Mutation Carriers

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Keywords: Hereditary breast and ovarian cancer, BRCA1/2 mutations, Markov decision process, Intervention strategies.

Women with BRCA1/2 mutations have higher risk for breast and ovarian cancers. Available intervention actions include prophylactic surgeries and breast screening, which vary significantly in cost and effectiveness. We develop a model to obtain effective intervention strategies for mutation carriers between ages 30 and 65.

A Markov decision process (MDP) model is developed that considers state transitions for mutation carriers from one year to the next and state dependent intervention actions. State is defined as a vector comprising mutation type, health states, prior intervention actions, and age. A discounted cost value iteration algorithm is used to solve the MDP model.

The results from MDP model show that for 30 year old women with BRCA1 mutation and no prior intervention history, the optimal strategy is a combination of prophylactic mastectomy (PM) and prophylactic oophorectomy (PO) at age 30 with no screening afterwards. For BRCA2 mutation carriers of age 30, the optimal strategy is PO at age 30, PM at age 40, and yearly screening only after age 56. Strategies for all other ages are obtained and presented. We also demonstrate that the strategies derived from the MDP model offer near maximum survival rate and near minimum cancer incidence rates by age 70, when compared to a number of ad hoc strategies.

Miniature Photonic Platform with Micro-fluidic Sensing Capabilities

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Keywords: spectroscopic, optofluidic, microfluidics

All real world fluids usually contain particles that interfere with the spectroscopic measurements. We propose to overcome this challenge by developing miniature portable spectroscopic probe that can work with real world samples without any preprocessing. It is based on a new optofluidic platform that combines microfluidic filtration with miniature spectroscopic chamber on top of an optical fiber. Small size and flexibility of optical fiber together with the excellent optical properties allows using them for different spectroscopy techniques.

Microfabricated chamber with a thin micro-porous membrane is attached to the cleaved fiber interface and locally filters fluid. Light transmitted through the optical fiber illuminates the filtered fluid and then collected by the same fiber and used for spectroscopic analysis. We demonstrated the filtering out bulk particles and human breast cancer cells. Absorption spectrum of the fluid can be taken using single-fiber configuration. Additional information can be extracted from the same signal with additional processing.

The Role of BK channels in Shaping Receptive Field Properties in the Inferior Colliculus

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Keywords: BK Channels, Inferior Colliculus, Receptive Field

The slow, Ca^{2+} activated, K+ channels of the BK-type are responsible for controlling nerve cell (neuron) action potential duration, firing frequency, and spike frequency adaptation. BK channels can be found in the axon terminal, soma, and dendrites of neurons; and open in response to a rise in intracellular Ca^{2+}. These channels play an important role in regulating firing frequency and adaptation via control limits on the repolarization of neurons during the repeated presentation of stimuli. Along with adding control to the regulation of stimulated firing, BK channels can also modulate non-stimulus firing, e.g., spontaneous activity. We investigated the effect of applying a specific BK channel blocker, paxilline, on BK channel function, as measured by receptive field (RF) properties of inferior colliculus (IC-auditory midbrain) neurons in CBA/CaJ mice.

Young adult CBA/CaJ mice (6-8 months, N=7) were mildly tranquilized and placed in a stereotaxic frame using head bolt fixation. The IC was mapped, and a location which yielded at least 10 active channels and that was within the central portion of the topographic map was chosen as the recording location for the experiment. This protocol resulted in 1 animal/dose/experiment. Paxilline was diluted to concentrations of 1µM and 0.1µM in 1% DMSO. RFs were measured using 25ms pure tones, presented in the contralateral hemi-field at frequencies between 4 & 64 kHz, from 0 to 80dB SPL in 5 dB steps and replicated 5 times. For each RF the best frequency (BF), minimum threshold (MT), bandwidth at 10 dB (Q10) and 40 dB (Q40) above MT, maximum driven rate, and spontaneous rate were recorded.

RFs were obtained from 58 units where 1µM paxilline was applied and 64 units where 0.1µM was applied, both resulted in a median decrease in driven rate measured at BF of 97% and 94% respectively. Relative to pre-drug recordings, threshold shifts of 21dB and 19.5dB were immediate and were maintained over approximately 7 hours for the 1µM dose and 5 hours for the 0.1µM dose. Although there was a wide range of BFs encountered, the majority of BFs shifted towards lower frequencies following blockade of BK channels, with observed median shifts of approximately 1-2 kHz for neurons with BFs > 20 kHz. Both concentrations of drug produced stable BF shifts for over 6 hours.

These results suggest an important role of BK channels in the formation and maintenance of receptive field properties of auditory midbrain neurons. Preliminary data indicates that expression of BK in the aged IC is down-regulated and therefore may contribute to central auditory processing deficits found in aged listeners.

SI Traceable Certification of Thermal Cantilever Vibrations in a LDV

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Keywords: LDV, interferometer, AFM, certification, SI-traceable, nanomechanical properties

Atomic force microscopes (AFMs) utilize micro-fabricated cantilevers to measure physical and mechanical properties of materials. Manufacturing these cantilevers introduces variability in both dimensional and material properties in the cantilevers. It is these variations that cause the cantilever spring constants to be commonly specified with a ±50% accuracy range. Because the accuracy of the nanomechanical property data acquired from an AFM is dependent on the accuracy of the cantilever spring constant, it is imperative to determine the spring constant values as definitely as possible. To promote accurate nanomechanical property measurements, NIST is developing reference cantilevers with highly accurate spring constants that AFM users can purchase and test their commercial cantilevers against, allowing for accurate determination of commercial cantilever spring constants.

We are utilizing a Laser Doppler Vibrometer (LDV) to certify the reference cantilevers and, therefore, we must certify the LDV in an SI-traceable manner for low displacement (subnanometer) and high frequency (>10kHz) systems, which has never been done before. To accomplish SI-traceability, our LDV is certified with a custom designed homodyne interferometer. Homodynes are programmed to emit known wavelengths of light and, as such, are SI-traceable. Both the LDV and homodyne systems take displacement measurements of cantilevers that resonate at a natural frequency in room temperature or from a driven frequency provided from a voltage to displacement transducer. Once this displacement data is collected (from both systems) and transformed into comparable forms (by applying Fast Fourier Transforms and sensitivity values), they can be plotted against each other for similarity and accuracy determination. If these comparisons are within a certain margin of error, the LDV can be considered certified to the SI and the certification of reference cantilevers with highly accurate spring constants can be completed.

Empirical Study of Part Geometry, and Direction of Motion on Microscale Capillary Self Assembly

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Keywords: assembly, costs, part geometry, incidence angle

At the microscale, assembly by “grasp and release” is generally challenging. Recent research efforts have focused on adapting nanoscale self-assembly (SA) processes to the microscale. By harnessing attractive forces (most commonly, capillary forces) to spontaneously assemble components, SA allows significant reduction of assembly equipment costs. However, successful application of SA requires high assembly rates and yield (i.e. few process errors). In this work, an experimental SA system was implemented that controls process parameters independently while measuring SA process performance. As a first step towards a complete scaling model, this work evaluates the effects of part geometry, and part travel direction. Experimental results show minimal dependence of assembly yield on the incidence angle of the parts, while significant effects induced by changes in part geometry. This effort is a key step towards a parametric kinetic model of capillary SA.

Antenna miniaturization and bandwidth enhancement using a novel PDMS-Fe_3O_4 magneto dielectric polymer nanocomposite engineered substrate.

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Keywords: Bandwidth enhancement, Antenna miniaturization, Fe_3O_4 Nanoparticles, Magneto-Dielectric, Permeability, Permittivity, Polymer nanocomposites.

This poster presents the application of a novel PDMS-Fe_3O_4 Magnetite dielectric polymer nanocomposites (MDPNC) loaded with superparamagnetic Fe_3O_4 nanoparticles with diameter of 7.5 ± 2nm as an engineered RF substrate for the implementation of miniaturized multilayer patch antennas at 4 GHz (C Band). Four different PDMS-Fe_3O_4 nanocomposites based multilayer patch antennas with different loading concentrations of Fe_3O_4 nanoparticles (i.e., 0%, 30%, 50% and 80% by weight) were systematically explored. The performance of the constructed antennas was measured with and without externally applied DC biasing mangentic field. Comparisons between the different designs were thoroughly conducted demonstrating the correlation between the Fe_3O_4 nanoparticles loading concentration and the resultant dielectric and magnetic properties. Paticuarlly, antenna miniaturization up to 57% and an antenna bandwidth enhancement of 58% (from 4.7% to 7.45%) have been demonstrated successfully along with a decent antenna gain of 2.12 dBi by the employment of PDMS-Fe_3O_4 nanocomposites at the maximum 80% w.t. concentration under a DC magnetic field of 0.2-0.35Tesla. It was observed that both dielectric and magnetic losses could be greatly reduced for antennas made of PDMS-Fe_3O_4 nanocomposites with reduced loading concentrations of 50% and 30%, thus leading to much higher antenna gains of 4.063dBi and 5.085dBi, respectively. Aside from their high gains on par with that of unloaded device counterpart, appreciable bandwidth enhancement in the range of 47.5% and 39.5% have been realized for patch antennas made of PDMS-Fe_3O_4 nanocomposites with 50% and 30% w.t. concentrations, respectively. The research work towards implementation of this new class of functional in future RF and microwave devices are ongoing, which is anticipated to enable the next generation 3D printed microwave antennas to possess unprecedented performance.

Part Geometry effects on capillary Self-Assembly for Micro-Component Integration

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Keywords: assembly, costs, part geometry, incidence angle

Self-assembly is a potential alternative for current micro-scale integration methods, which provide relatively slow rates, and require high equipment costs. The present work studies how part geometry affects capillary self-assembly. More specifically, this work provides insight on how part geometry influences the probability for a part to be correctly oriented for assembly. For this purpose, parts of different geometries were dropped on a flat surface with uncontrolled initial orientation. Observations confirmed that the percentage of parts landing on their bonding surface (hence correctly oriented) directly correlated with part geometry. Standard deviations were generally low (mostly < 5%). Additionally, high speed videos allowed for observing how much parts could be misaligned, and yet assemble correctly. Further tests then measured assembly rate for different part geometries. Results confirm that self-assembly process performance is considerably affected by part geometry. Moreover, results contribute towards full understanding of basic self-assembly process.

Acoustic Force Effects on Cell Viability and Patterning

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Keywords: Acoustics, Bioparticles, Cell Viability, Vibrations

Manipulation of micro-particles, such as mammalian cells, therapeutic carriers, or microorganisms, has many important applications in the study of life sciences and in biomedicine. Previous studies have shown that micro-particles can be manipulated and positioned using acoustic forces, yet cell viability has not been addressed. This study investigates the effects of varying energy levels of acoustic force on cell viability and positioning in vitro. Two different probe style sonicators and a bulk acoustic transducer were used to produce the acoustic force. These devices were connected to a signal generator which converts the conventional AC line power to a specified electrical frequency. This electrical frequency is then fed into a converter where it is transformed into an acoustic force. Adherent cells were then subjected to this force for a specified period of time and their viability was then analyzed using fluorescence microscopy.

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Microfluidically Controlled Frequency Tunable Liquid Metal Monopole Antenna Array

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Keywords: Liquid metal, Frequency tunable antenna, Broadside array, Electromagnetics (EM), RF switches, microchannel

Liquid metals dynamically manipulated within microfluidic tubes or channels have recently drawn interest in electromagnetics (EM) community for developing highly reconfigurable RF devices such as flexible/stretchable antennas, frequency-agile filters, frequency tunable frequency selective surfaces, and RF switches. In this paper, we introduce a unique way of using liquid metals to develop a monopole antenna that is tunable over an extremely large frequency band (1.294GHz-5.4GHz) as compared to conventional variable capacitor or switch loaded monopole technologies. In addition, we demonstrate that the proposed monopole can be utilized to realize low-cost frequency tunable antenna arrays without necessitating additional microfluidic control mechanisms other than a single bi-directional micropump unit.. Specifically, the monopole antenna is formed by liquid metal residing inside microchannels fabricated in Polydimethylsiloxane (PDMS) substrate. The feed network of the monopole consists of a conventional printed circuit board based microstrip line. The excitation of the monopole by the microstrip line is accomplished with electromagnetic coupling. To maximize this coupling, a novel fabrication procedure that bonds the microchannel carrying PDMS substrate to a thin (25um) liquid crystal polymer (LCP) is developed. The design principles, measured return loss, gain and pattern performances of the monopole antenna and the array will be detailed during the presentation.

Predicting the chiral enrichment of metallic SWCNTs on Ni-Cu bimetallic nanoparticles by epitaxial matching

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Keywords: carbon nanotubes, chirality, Ni-Cu bimetallic nanoparticles, epitaxial matching, cap nucleation, nanotube growth

The chiral enrichment of metallic nanotubes grown on Ni, Cu and Ni_xCu_{1-x} nanoparticles is explored by studying nanotube cap nucleation and the nanotube growth rates of various nanotube chiralities. We have used the epitaxial nucleation model, as used in our previous work of SWCNT growth on Ni_xFe_{1-x} bimetallic nanoparticles, to explore the binding strengths of various nanotube cap chiralities. Nanotube growth on various catalyst surfaces is studied by calculating differences in armchair and zigzag dangling bond energies, relative chemical activity ratios and nanotube growth rates of various nanotube chiralities. All the energetics of the nanotube cap nucleation and differences in dangling bond energies are calculated using density functional theory (DFT). Based on the binding strengths of various nanotube chiralities obtained from the DFT calculations, certain armchair and zigzag nanotube caps show higher binding strengths than the chiral caps and the stability of the caps on the various surfaces decreases as Ni > $Ni_{0.5}Cu_{0.5}$ > Cu in accordance with the respective carbon-metal adhesion strengths. Both the relative chemical activity ratios and the nanotube growth rates, obtained from differences in the armchair and zigzag dangling bond energies on various catalyst surfaces, suggest that the Ni_xCu_{1-x} bimetallic nanoparticles with increased bond length or lattice-strained surfaces can be excellent metal catalysts in growing metallic nanotubes preferentially.

Investigation of highly ordered Self-Assembly Multilayers of Metal Organic Frameworks on functionalized Au substrate

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Keywords: Metal Organic Frameworks, Density of States, Photoemission Spectroscopy

Metal Organic Frameworks (MOFs) are promising material candidates for highly ordered self-assembly[1], solution processable with tailorable electronic and ionic conductivity on wafer surfaces[2].

In this work, the synthesized Porphyrin with Carboxylic acid functional end groups and $Cu(NO_3)_2$ metal centers which are self-assembled on top of 4-Mecaptopyridine functionalized Au substrate by direct fabrication method using layer by layer growth. Subsequently, we investigated the electronic interfacial reactions of the materials by Low Intensity X-ray Photoelectron Spectroscopy (LIXPS), Ultraviolet Photoelectron Spectroscopy (UPS), and X-ray Photoelectron Spectroscopy(XPS) systems with the correlation of computational simulations of the (DOS) which provide an essential protocol in determining the corresponding binding energy and nature of the supramolecular orbitals which are responsible for charge transfer through the materials, and identify the electronic structure at the metal/molecular interface.

[1] J. R. Long and O.M. Yaghi: “The pervasive chemistry of metal-organic frameworks”, Chemical Society Reviews 38 (5), pp.1213-1214 (2009)
[2] G. Givaja, P. Amo-Ochoa, C. J. Gomez-Gracia and F. Zamora: “Electrical conductive coordination polymers”, Chemical Society Reviews 41 (1), pp. 115-147 (2012)

Immobilization and characterization of physisorbed antibody films using pneumatic spray as deposition technique.

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Keywords: Physical adsorption, Pneumatic spray, antibody, *E. coli* O157:H7

Physical adsorption (solid–liquid interface) is a process governed by chemical equilibrium limiting the amount of antibody deposited. The physical adsorption method is known as a simple and rapid option to immobilize biomolecules on various surfaces. However, physical adsorption has been often labeled in the past with disadvantages like variability, reversibility, denaturation and low surface density of immobilized biomolecules. The presented research shows that a commercial pneumatic spray apparatus (non-equilibrium process) can be used to immobilize antibody on glass surfaces with a high surface coverage, insignificant denaturation and good mechanical stability.

Pneumatic spray (PS) anti- *E. coli* O157:H7 IgG films were analyzed using different physicochemical characteristics and compared with the avidin-biotin (ABB) films. The influence of antibody film thickness in the capture ability of antigen (*E. coli* O157:H7), the specificity and shelf-life was studied.. Furthermore, the research also focuses on the surface morphology of the PS films to better understand the capture cell performance. The chemical and mechanical stability of the films was analyzed by infrared spectroscopy, x-ray photoemission spectroscopy and ellipsometry. The surface wettability of the PS and ABB films was determined by contact angle measurements and related to the deposition time.

The results showed that the PS films have comparable characteristics (sensitivity, specificity and shelf-life) to films prepared with the ABB. Pneumatic spray allowed the creation of higher surface density compared with the ABB method as well as the flexibility to create multilayers with minimal or none conformational changes in the outer layer. ABB films were more hydrophilic than PS films due possibly to high surface roughness and results also suggested a film growth by flat layers.

Interventions as an alternative to penalties in preventable readmissions

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Keywords: Readmissions, Healthcare policy, Health interventions, Medicare

For the federal year 2013, the Center of Medicare and Medicaid Services (CMS) has been directed by the Affordable Care Act to reduce the reimbursement through the Inpatient Prospective Payment System (IPPS), to hospitals that have higher rates of preventable readmissions.

These readmission rates are calculated using 2012 claims and discharges for Acute Myocardial Infarction (AMI), Heart failure (HF) and Pneumonia (PN) (which involves 20% of all discharges in the IPPS). Penalties are applied to all claims submitted by the hospital (not just AMI, HF or PN), which are estimated in $280M for 2013. Penalties are expected to increase in the next years.

This work explores the use of disease-specific health interventions (interventions) that have proven to reduce preventable readmissions as well as improve quality in the delivery of care.

First, we conducted an economic feasibility analysis using public available data from CMS and other sources. Results show that implementing interventions for all hospitals when possible instead of imposing penalties leads to better outcomes in terms of readmissions and would cost less to CMS ($240M).

Finally, an integer optimization model is proposed as an alternative to verify the results and help hospitals to decide on implementing (or not) interventions based on their outcomes and opportunity cost.

Selective Enhancement of Macropinocytosis for the Intracellular Delivery of Lytic Peptides to Lung Tumors

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Keywords: KGF= Keratinocyte growth factor, KGFR = Keratinocyte growth factor receptor, ELP= Elastin like peptides, KLAK= Lytic peptide

Current available cancer treatments have two major drawbacks, the killing of healthy cells and the development of drug resistance. These two weaknesses result in side-effects and the recurrence of cancer after a seemingly successful treatment. Therefore, the development of a therapy that would selectively target and kill cancer cells while preventing them from becoming resistant seems to be a promising alternative. In this work, we propose the development of a platform that comprises a growth factor (GF) and a lytic peptide, each of which is fused to elastin like polypeptide (ELP). The GF portion will selectively target cells overexpressing a particular receptor, as it occurs in cancer cells, while at the same time will make them more active; the lytic part will kill and prevent drug resistance from occurring by targeting the mitochondria. The ELP domain of the platform facilitates its proximity to the cell surface for increase uptake. This system takes advantage of the process of macropinocytosis for the internalization of the treatment. Macropinocytosis is a type of endocytosis that occurs transiently and can be activated by GFs. Once this process starts, cells will be able to engulf particles that are in the proximity of the cell surface.

Tribological and Mechanical Behavior of Nanostructured Al/Ti multilayers

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Keywords: Al/Ti multilayer, Nanoindentation, Nanowear, Material Characterization.

Metallic nanostructured multilayered films (NMFs) exhibit excellent physical and mechanical properties due to the nano-scale layered structure.Nanoidentation and nanowear tests were performed on sputter-deposited Al/Ti multilayers with individual layer thickness of 2.5 and 30 nm. Elastic modulus, hardness, and wear resistance of the multilayers are measured using a triboindenter. Decreasing the layer thickness from 30 to 2.5 nm leads to an increase of hardness from 3.7 to 5.8 GPa, which also leads to significant improvement of wear resistance.

For both NMFs, the measured wear rates decreases with increasing wear cycles and approach a steady state after 5 cycles. Nanoindentation tests on the worn surface reveal significant work hardening of the NMFs, which result in 24% and 17% of increase for 300 and 60 layers.

Transmission electron microscopy study and orientation mapping of the deformation microstructure underneath nanoindents was performed. This TEM characterization highlights the co-deformation of Al and Ti under severe plastic deformation.

Purification of Recombinant NGF-ELP Fusion Protein for Nerve Regeneration

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Keywords: Elastin Like Peptide (ELP), Nerve Growth Factor (NGF), Inclusion Body, Urea

Spinal cord injury (SCI) involves a complex process that results in nerve degeneration, partial loss of mobility, or in severe cases, paralysis. Over 90% of spinal cord injuries occur traumatically via automobile accidents, athletic injuries, or any other sudden trauma. More than 200,000 Americans live day-to-day with the disabling effects of SCI (National SCI Center 2011). There is an increasing demand for identifying a treatment that will increase motor and sensory function, as well as elicit nerve regeneration.

Nerve growth factor (NGF) is a potential therapeutic agent to SCI. NGF plays a critical role in regulating neuronal survival, regeneration, and maturation. It has also been noted to provide an increase in motor and sensory function. However, when in solution, NGF quickly diffuses into the extracellular fluids and cannot be sufficiently retained at the site of injury. A delivery system is needed to efficiently sustain NGF at the site of injury. Elastin-like peptides (ELPs) are a class of biopolymers that are of particular interest because of their stimuli responsive properties. ELPs are soluble in aqueous solution below their transition temperature (Tt) however; when the solution temperature is raised above their transition temperature (i.e. 37˚C) ELPs will self-assemble into an insoluble protein. Fusing recombinant human NGF to an ELP will create a novel protein that will self-assemble into nanostructures that can act as drug depots, which will enhance the bio-availability of NGF at a treatment site.

Protein fusion of NGF to ELP was done using recombinant DNA technology. The NGF-ELP fusion was prepared using a bacterial expression system (*E. coli*). NGF-ELP was overexpressed in the prokaryote host system (*E. coli*) and accumulated in inclusion bodies (inclusion bodies occur when proteins misfold and form aggregates). A novel methodology was performed to solubilize and purify the protein via urea and inverse transition cycling (ITC). To verify that the NGF-ELP fused protein was expressed and purified from the inclusion body, Western blot analysis and SYBR Safe DNA gel stains were done, respectively. As a result, a novel protein has been developed, expressed, and purified in order to elicit nerve regeneration.

Spatiotemporal Pattern Recognition of Multi-Channel Sensing Data for Health Applications

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Keywords: Multi-channel Sensing, Dynamic Time Warping, Medical Automation, Feature Embedding, Cardiovascular Diseases

Multi-channel sensing data are increasingly available in healthcare environments. This poster presents a novel spatiotemporal warping approach to quantify the dissimilarity of multi-channel profiles of cardiovascular function. Furthermore, functional profiles from each patient are embedded as a node in a high-dimensional complex network. This, in turn, greatly facilitates the recognition of disease patterns and smart health management.

The proposed method is evaluated through a real-word case study. The case study is aimed at differentiating myocardial infarctions in different locations. The hypothesis testing shows that there are significant spatiotemporal differences between healthy control and MI-related subjects (MI-anterior, MI-anterior-septal, MI-anterior-lateral, MI-inferior and MI-inferior-lateral). Furthermore, we optimize the embedding of each functional recording as a feature vector in the high-dimensional space that preserves the dissimilarity distance matrix. This novel spatial embedding approach facilitates the construction of classification models and yields an averaged accuracy of 95.1% for separating MIs and Healthy Controls (HCs) and an averaged accuracy of 95.8% in identifying anterior-related MIs and inferior-related MIs.

Microcavities Bandstop Structure on SAW Device

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Keywords: SAW, ST-Quartz, Microcavities, Bandstop

In this work, a surface acoustic wave (SAW) device with an array of cavities has been developed to allow wave propagation in a range of frequencies except for a particular frequency. This is achieved by placing square cavities with a periodicity of 40 micrometers and varying the periodicity of the interdigitated transducers (IDTs). All geometric parameters of the cavities were kept constant for various IDT periodicity. The substrate used is ST-Quartz. Both numerical simulations and experimental design are used to demonstrate the validity of the phenomenon observed.

The results of the study are presented as insertion loss (dB) as function of frequency. When the periodicity of the cavities and IDTs match, the wave is not allowed to propagate as indicated by an insertion loss of -75.4 dB. As the difference between cavity and IDT periodicity increases, insertion loss is lowered indicating greater wave propagation. To the authors' knowledge, the design and fabrication of a SAW-based device using quartz has not been investigated.

Predicting the chiral enrichment of metallic SWCNTs on Ni-Cu bimetallic nanoparticles by epitaxial matching

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Keywords: Nanomaterials, electrochemical biosensing, nanodiamond (ND)-polyaniline (PANI), Phosphate buffer saline (PBS)

Early and accurate detection of life threatening physiological indicators are key aspects for treatment of many diseases. Glucose blood concentration, for an example, represents a key measurement to manage diabetes. In this research work, we have synthetized different ratios of nanodiamond (ND)-polyaniline (PANI) based conducting composite on imprinted platinum electrodes, which are later thoroughly studied for electrochemical biosensing applications. Attempts are made to vary ND-to-aniline monomer ratio for optimal electroactive surface using comparative studies based on electrochemical response and roughness measurements. Cyclic voltammetry and Atomic Force Microscope (AFM) measurements have demonstrated that the inclusion of ND particles yields to an increment in active surface area, which promotes a higher electron exchange rate at the electrode surface. Glucose oxidase was used as a model to study the performance of nanomaterials for specific sensing applications. Synthetized structures were analyzed under dynamic as well as steady state condition using electrochemical techniques. Phosphate buffer saline (PBS) containing different concentrations of glucose were examined to obtain the calibration curve. Also, robustness of the biosensing structure was tested using glucose-free PBS buffer and PBS containing analytes different than glucose.

Expression and Purification of Epidermal Growth Factor Fused with Elastin-like Polypeptide

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Keywords: EGF= Epidermal growth factor, EGFR = Epidermal growth factor receptor, ELP= Elastin like peptides, T_t = Transition temperature

Cancer is the second leading cause of death in the United States. Even though much progress has been accomplished in its treatment, the side-effects due to the killing of healthy tissue are still very challenging to prevent. In this work, we propose the development of a targeted platform that will selectively aim at cancer cells overexpressing the epidermal growth factor (EGFR) as it occurs in lung and colon cancer cells. Our platform will consist of the epidermal growth factor (EGF) fused to elastin like polypeptides (ELP). EGF is the ligand to the EGFR; it will make our system specific for EGFR overexpressing cells. ELPs are polypeptide polymers that self-assemble to nanostructures at their transition temperature (T_t). Our fusion protein, EGF-ELP, will self-assemble when temperature rises above its T_t and will form a nanostructure with an ELP core and EGF presented at the periphery. In the future, we plan to use this system for targeted therapy.

The Impact of Inverse Photoemission Spectroscopy measurements on regioregular poly(3-hexylthiophene) films

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Keywords: IPES, PES, P3HT, Raman, and Radiation

In this study, the impact of inverse photoemission spectroscopy (IPES) measurements on regioregular poly(3-hexylthiophene) (rr-P3HT) films was investigated. IPES enables the characterization of the density of states of unoccupied energy states above the Fermi level. However, due to the relatively high electron currents required to achieve useful signal to noise ratios, sample damage is a concern. Regioregular poly(3-hexylthiophene) (rr-P3HT) was used to systematically study the influence of electron radiation during IPES measurements on a prototypical conductive polymer. A series of IPES measurements exposing the samples to a range of electron fluxes was performed. An analysis of the electronic structure and the morphology showed that significant changes occurred in the investigated samples depending on the electron flux. X-ray diffraction (XRD) results revealed that the root cause of the spectral changes is most likely related to a crystallization of the film in an edge-on orientation. This was confirmed by Raman spectroscopy where the C-C and C=C modes shifted to a lower frequency after 5 scans indicating a more ordered molecular structure. The observation of these stretch modes even after exposure to higher electron flux indicates that the chemical structure of P3HT remains mostly intact during the IPES measurements. The absence of significant changes in C 1s and S 2p photoemission core level lines confirmed this observation.

Three Dimensional Modeling and Kinematic Analysis of a String Bass and French Horn Player

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Keywords: motion analysis, music

Motion capture techniques provide accurate information about musicians' joint angles and range of motion that can be used to improve their technique and for rehabilitation purposes. Music expression has focused extensively only on sound, ignoring the key role that a performer's posture and movements play. In this study, two instrumentalists, a bassist and a French horn player, were part of a fitness class that included a seminar, yoga, physical and mental exercises, improvisation, and motion capture. The motion capture data that were obtained before and after the class was studied here.

An eight camera motion analysis system was used to track reflective markers placed on the student's upper body. Markers were placed on the musicians' head, torso, shoulders, elbows, wrists, hands, and fingers. Visual 3D software was used to create joint centers, define limb segments and calculate joint angles. Joint angles that were obtained before and after the class were compared for the two musicians. The results of this study show how the fitness program affected each of the musician's posture and movement.

The results showed that both the bassist and French horn player increased their left shoulder rotation internally and increased their right shoulder rotation externally. The French horn player also decreased his right elbow flexion. The bass player's range of motion generally increased which is shown in Figure 1. The guided physical exercises that were parts of the class have shown to improve the musician's awareness and flexibility. Before, musicians may have been focusing more on the sound that they were producing rather than their body movements. After, they are more conscious of their body, preventing injuries that can result from poor posture. This study only focused on two musicians. Additional musicians are currently being studied.

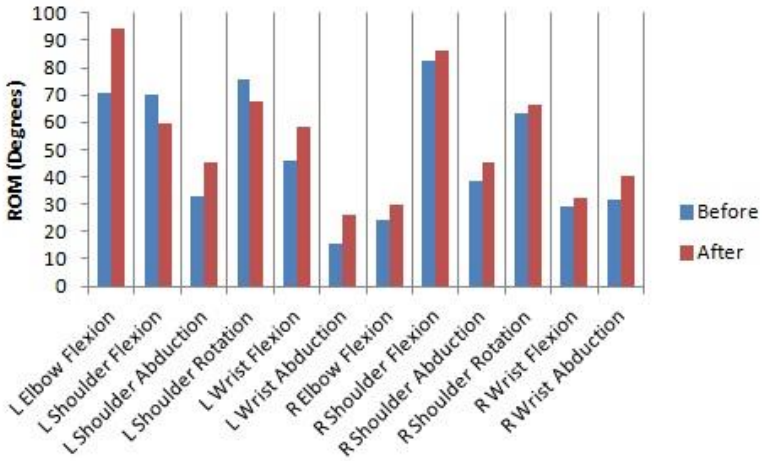

Figure 1: Bass Player's Range of Motion (ROM).

Design and Analysis of a Compliant Bimanual Rehabilitation Device

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Keywords: Bimanual, Rehabilitation, symmetry, coupling stiffness

Coupled bimanual rehabilitation allows an individual with hemiparesis to use their sound arm to assist their impaired arm during rehabilitation. This method of self-rehabilitation could be used as a low cost alternative for home rehabilitation. However, few studies have looked at the effect of coupling stiffness and symmetry mode on bimanual task performance.

We have developed a compliant bimanual rehabilitation device (CBRD) that allows for the symmetry mode and stiffness of the coupling to be easily changed. Our results show the CBRD effectively couples the motions of two individuals in a task simulating hemiparesis, and that for some tasks, the symmetry mode and stiffness affect completion time. A stiffer coupling resulted in faster completion times and lower error. The device also reduced the completion time and error of bimanual tasks performed by healthy individuals.

Expression and Purification of Elastin-Based Fusion Protein for Bone Regeneration

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Keywords: Bone regeneration, Elastin Like Peptide (ELP), Purification

Bone regeneration is necessary in bone injuries and diseases. Normal bone healing process includes inflammation, soft callus formation, hard callus formation and remodeling. Growth factor application as one of the common treatment methods has certain issues such as short half life and couldn't stay at the injury site. A better delivery method for these growth factors is required. Elastin-like peptides (ELPs) are repetitive polypeptides in the form $(Val\text{-}Pro\text{-}Gly\text{-}X\text{-}Gly)_n$, where X can be any amino acid except for proline. They are genetically encodable and biocompatible. The use of ELPs as a drug delivery vehicle has been an object of recent interest due to their phase transition properties at transition temperature (T_t), also known as lower critical solution temperature, which is a direct function of the ELP chain length and guest residue. In this study, we were able to fuse BMP-2 to ELP at gene level, express the fusion protein in E. coli, and purify it using inverse temperature cycling. We observe that the fusion protein was able to transition at physiological temperature. ALP assay for C2C12 cells suggested that it also retained bmp-2 bioactivity.

Tumor Microenvironmental Effect on Cell Adhesion Strength

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Keywords: Adhesion Strength, Tumor Microenvironment, pH buffering, Hypoxia

This poster shows the current progress on the exploration of how varying pH and oxygen levels affect cell adhesion strength across a range of cancerous breast epithelial cell lines. Adhesion is implicit in cellular activities such as migration, proliferation, growth, differentiation, survival and apoptosis. These behaviors are transformed in cancer cell lines. Hypoxia and pH are two major influences in the tumor microenvironment and a relationship with adhesion has been noted, yet due to the heterogeneity of the tumor microenvironment, specificities of that relationship remain unclear. A hydrodynamic shear assay is utilized to measure the mean shear adhesion strength across cell populations.

Current data on the poster compares invasive MDA-MB-231 with tumorigenic MCF7 lines across several variables. Collagen Type 1 and Fibronectin are common ECM proteins that have been used as an intermediate of adhesion. In this way, future proteomics may pinpoint ligands of interest. Cells were grown in media of pH 7.4 (normal) or 6.7 (low) for ≥ 3 months. They were then plated 24 hours before the shear assay in the pH media of origin and the opposite. In this way, changes that occur may be appropriately described as a genetic or phenotypic change. Independent of pH changes, cells were grown in 0.2% oxygen (hypoxia) for 72 hours and compared to those grown in 20% oxygen (normoxia). The full range of interest is not represented on this poster due to experimentation in progress, yet already, significant changes in shear strength are correlating to cell cancer progression in mechanistically supportive and novel ways.

Combinatorial High Throughput Soft Biomaterial to Screen Cell Mechanotransduction

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Keywords: biomaterials, tissue engineering, combinatorial methods, cell adhesion, mechanotransduction

Combinatorial biomaterials that encompass a wide range of mechanical and biochemical properties have the potential to offer a comprehensive understanding of complex cell-substrate interactions. An added advantage includes rapid screening of multiple variables that accelerates the pace at which this knowledge is attained. This has a direct impact on the evolution of functional biomaterials for tissue engineering applications. The long term objective is to fabricate biomaterials with optimized design parameters that precisely control cell adhesive interactions to direct cell fate.

A cross-linked network of polydimethylsiloxane (PDMS), a silicone polymer, is used as a model material since both its mechanical and chemical properties can be modulated independently to develop novel combinatorial materials. Presented here is the fabrication of two independent gradient materials. One is a mechanical gradient with a high elastic modulus (~1.5 MPa) at one end that linearly transitions to a low elastic modulus (0.02 MPa) at the other end. The other is a surface chemistry gradient that was obtained through a spatiotemporally regulated Ultraviolet-Ozone-Oxidation (UVO) of the silane monolayer on the polymer which causes the exposure dependent transition from hydrophobic (~100°) to hydrophilic (~ <15°) over the length of the sample. Water contact angle characterization of the substrates confirmed the formation of a continuous gradient in surface chemistry. Cell response to a surface chemistry gradient generated on PDMS was investigated using NIH3T3 fibroblast cells seeded on gradient substrates following sterilization and coating with fibronectin, an adhesive protein. These experiments indicated a strong dependence of cell adhesion and spreading on the hydrophobicity of soft substrates along with a strong influence of fibronectin adsorption and conformation on cell response. Future experiments involve fabrication of a truly combinatorial material with a ligand density gradient superimposed on an elastic modulus gradient to probe endothelial cell mechanotransduction events.

Effect of composition and microstructure on the pitting corrosion of Al-Mn alloys

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Keywords: Al-Mn alloys, microstructure, pitting corrosion, Mott-Schottky.

Al-Mn alloys with Mn concentration from 0 to 20.5 at.% far beyond equilibrium solubility limit were successfully magnetron sputtered on silicon substrate. The composition and microstructure of the alloys were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), energy dispersive X-ray spectroscopy (EDS), and transmission electron microscope (TEM). Increasing Mn concentration leads to a microstructure evolution from single phase nanocrystalline at low Mn% to completely amorphous at 20.5 at.% Mn. A change in surface morphology from rough angular to smooth rounded structure was observed as the Mn content was increased. The corrosion behavior was investigated in 0.01 M and 0.6 M NaCl aqueous solution by electrochemical impedance spectroscopy and potentiodynamic polarization, respectively. The electrochemical measurement showed an increase in pitting corrosion resistance as Mn content was increased. Mott-Schottky analysis revealed an n-type semiconducting behavior of the passive film formed on the Al-Mn alloy where the carrier density increases as a function of immersion time.

A Method to Evaluate the Cytotoxicity of Neural Materials Used in Constructing Neural Interfaces Based on ISO-10993-5

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Keywords: cytotoxicity assays, neural implants, biocompatibility

A material for a neurological implant must possess some characteristics, such as chemical stability, corrosion resistance and biocompatibility. ISO-10993-5 standard was established to solidify methodologies with which to determine the cytotoxic reactions of cells within physiological environments. ISO-10993-5 provides a very reliable protocol to initially test novel biomaterials and biomedical devices in vitro. The standard, which was compiled from previous cytotoxicity studies, does fall short in completeness in that; it targets only particulates and chemical compounds that have leached away from the material and into the cell media. In this work, we present a new method which was developed to test not only the compounds that were extruded from novel biomaterials, but also tests the cellular reactivity due to their proximity to the material.

Test material coupons, 8 × 10 mm in size, were mounted on tissue culture treated (CT), 22 mm diameter, round polycarbonate (PC) cover slides, using Hystoacryl® glue. The slides were cured for at least 72 hours at 37 °C allowing the solvent to evaporate completely so as not to affect the cytotoxicity results. ISO-10993-5 condones the use of NCTC clone 929 (L-929) immortalized cells for the initial cytotoxicity tests. These cells were plated directly on the samples placed within CytoOne® 6-well TC plates. 2 mL of Gibco® DMEM Media infused with 10% fetal bovine serum, 2 mM GlutaMAX™-I CTS™, and 1% antibiotic/ antimycotic solution was added to each well. The cells were incubated at 95% relative humidity, 5% CO_2, and 37°C for 96 hours. The sample/slide combination were carefully removed from the well, 1 mg/ml calcein dye and 2 mM ethidium homodimer dye in 10 mM phosphate buffered solution were added to the cells to provide a fluorescent tag with which to determine the live or dead status of the cells. The cells were imaged using a Zeiss Axioscope M2 fluorescent microscope. The cellular reactions were normalized using a baseline of a CT PC cover slide. Although it is not a requirement of ISO-10993-5 compliance, the effect of cell adhesion to the materials surface was also evaluated. To determine the validity of this effort, we used ISO-10993-5 control material standards of copper, polyvinyl chloride (PVC), and polyethylene (PE) along with ISO non-standards of gold and platinum. The L929 cellular cytotoxic reactions were completely consistent with the results expected from the ISO-10993-5 controls. Moreover, this method has the advantage of operating several tests simultaneously, which will result in saving resources and time.

This work was sponsored by the Defense Advanced Research Projects Agency (DARPA) MTO under the auspices of Dr. Jack Judy through the Space and Naval Warfare Systems Center, Pacific Grant/Contract No. N66001-12-1-4026 - Biocompatibility of Advanced Materials for Brain Machine Interfaces**.**

Pubic Bone Segmentation for Diagnosis of Pelvic Organ Prolapse on MRI

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Keywords: Pelvic Organ Prolapse, pubic bone segmentation, preventive strategies

Pelvic Organ Prolapse (POP) is a major health problem affecting up to 30-50% of women. POP is a herniation of the female pelvic floor organs into the vagina causing significant problems such as bothersome vaginal bulge. Diagnosis of POP through dynamic MRI has become popular due to current inaccuracies of clinical examination. During the diagnosis of POP on MRI, anatomical landmarks are identified manually to determine lines and measurements for grading POP. Unfortunately, the manual identification of these points is a time-consuming and inconsistent procedure. We present a new segmentation approach for automating pelvic bone point identification on MRI. The pelvic bone structure is segmented using a multi-stage mechanism based on texture-based block classification, leak detection, and prior shape information. The reference points are then identified using morphological skeleton operation. This research aims to enable faster and more consistent pelvic floor measurements on MRI to facilitate and improve the diagnosis of female pelvic organ prolapse.

A set of dynamic MR images were obtained from an existing patient database and de-identified. Noise reduction, contrast stretching (image normalization), and calibration were performed to decrease image noise, obtain better contrast, and enable the gathering of real measurement values. The proposed framework integrates the strengths of texture-based block classification and K-means clustering analysis to improve the segmentation of bone structures on images with low contrast and image inhomogeneity. We finalize the segmentation process by incorporating the prior shape information of the pelvic bone to the initial segmentation. Morphological skeleton operation is integrated to find the reference points located on the pubic bone while a corner detection algorithm is used to find reference points located on the vertebra.

The accuracy of the presented method is measured by quantifying the region overlap between the ground truth images extracted by an expert using the Dice Similarity Index (DSI) and comparing it with commonly used segmentation methods. These results demonstrate that our segmentation technique achieves higher accuracy compared to other methods.

In this study, we present a new algorithm for the segmentation of bone structures on MRI to automate the identification of pelvic floor reference points. A multi-stage segmentation mechanism based on texture block classification, leak detection, and prior shape information is presented to overcome the current challenges of bone segmentation on MRI. Reference points located on the pubic bone are identified using a morphological skeleton operation while points located on the vertebra are identified using a corner detection algorithm. Experiments demonstrate that the presented method is faster and achieves higher accuracy compared to other commonly used segmentation methods. Results also show that the presented method can correctly identify reference points faster and more consistent compared with points identified manually by experts.

A Vision based P300 Brain Computer Interface for Performing Activities of Daily Living using a Wheelchair-Mounted Robotic Arm

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Keywords: robotics, brain computer interface, wheelchair

Advances in assistive robotics devices are inaccessible to severely disables patients as they lack the means to control such devices. For example patients who are suffering from multiple sclerosis or patients who are “locked-in” do not have voluntary muscle control and therefore is unable to use a conventional user input device such as a joystick or a mouse. For these patients the only viable alternative is to use a brain computer interface. However it takes a long time to make a selection via a brain computer interface and furthermore causes mental fatigue if used continuously for a long time. These drawbacks makes it difficult to control robotics manipulators via brain computer interfaces.

This abstract describes a novel vision based interface for selecting an object via a Brain Computer Interface (BCI), and then grasping the selected object using a robotic arm mounted to a powered wheelchair. As issuing commands via BCIs are slow, this system was designed to allow a user to perform a complete task via the BCI issuing as few commands as possible, without losing concentration on the stimuli or the task. A scene image is captured by a camera mounted on the wheelchair is displayed to the user with a group of command options. The user then selects an object and then a command to be performed on the selected object such as “pick up.” For object selection the scene image is divided into a grid of stimuli which is then displayed to the user. A seed point is placed in the center of each cell and indicates the target point if that cell was selected. In this method an object is selected by selecting a cell whose seed point lies on the desired object. If no seed point present on the object a zoom operation is available to enlarge a region and create another grid on that area. Furthermore the grid cell sizes are dynamically determined using edge detection information which increases the probability of a seed point falling on objects and thus increases object selection efficiency. Once selected, object segmentation and matching is used to identify the object. Then the user, using BCI, chooses an action to be performed on the object via the wheelchair mounted robotic arm (WMRA).

Oddball paradigm and P300 event related potentials (ERP) are used to select stimuli, the stimuli being each cell in the grid. In this method the stimuli are visually intensified randomly and the user is asked to concentrate on the desired stimulus. When the desired stimulus is intensified a spike in EEG activity can be detected 300ms after stimulus onset.

Tests on 6 healthy human subjects validated the functionality of the system. An average accuracy of 85.56% was achieved for stimuli selection over all subjects. With the proposed system, it took the users an average of 5 commands to grasp an object. The system will eventually be useful for completely paralyzed or locked-in patients for performing activities of daily living (ADL) tasks.

Photocatalytic Activity Enhancement of Titania by Addition of Plasmonic Ag Nanocubes

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Keywords: Nanotechnology, sustainability and catalysis

Optically active Ag nanocubes were combined with TiO2 to form a model composite material to study the conditions at which the photochemical activity of TiO2 is enhanced via plasmonics. Using varying compositions of the composite material, the photocatalytic degradation of methyl orange under ultraviolet and “day-light” spectrum irradiation was measured using UV-Vis spectroscopy. Interpretation of the results has aided in determining the conditions at which the plasmonic properties of the Ag nanocubes can enhance the system.

Prediction of Cancer Patient Radiosensitivity using Genomic Expressions

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Keywords: decision-making, cancer, genomic expression, treatment selection

Clinical decision-making regarding radiation therapy (RT) is still based on estimated overall level of tumor aggressiveness, and current decision models are not personalized for predicting the benefit from RT for a specific patient. The adverse effects after RT treatment for rectal cancer include gastrointestinal disorders, genitourinary and sexual dysfunction, and secondary cancers, pelvic or hip fractures, and thromboembolic diseases.

We hypothesize that it is possible to determine which patients will more likely benefit from using RT as part of their cancer treatment using their genomic expression information and predicting radiosensitivity (sensitive or resistant).
Radiosensitivity is defined based on cellular clonogenic survival after 2 Gy (SF2) for 48 cell lines. Since gene expression profiles are available for all cell lines, gene expression is used as the basis of the prediction model. We present current work in the creation and validation of a prediction model. The procedure includes the steps used to select to identify independent statistically significant variables (gene expressions) and a transformed response (SF2) to enhance the extremes (radio-sensitive and radio-resistant responses).

This model is created with genes found as significant predictors based on statistical procedures. Radiosensitivity prediction has also been studied in the literature where a clinically validated radiosensitivity index (RSI) has been defined to estimate radiosensitivity using known genes and where the gene's role is known (biology-biased).

ALD Manufactured Films: A Systematic Study - Transition from Conceptual Design to First Results

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Keywords: ALD, in-situ, XPS, UPS, IPES, band lineup, LabVIEW, Arduino (MCU)

Atomic layer deposition (ALD) is a modern, highly anticipated technique were, compared to similar methods like chemical vapor deposition (CVD) or physical vapor deposition (PVD), a self-terminating surface reaction takes places, which makes use of the so called *key-lock principle* (Fig. 1) and thereby gives full control over the film thickness. This principle stops the reaction automatically after one monolayer has been formed regardless of time. The process itself is split in two half reactions (metal and oxidizer injection) which make use of special precursor gases (e.g. Trimethylaluminum (TMA), H_2O, NH_4, etc.) that make it possible to create a wide variety of thin films respectively composites [1].

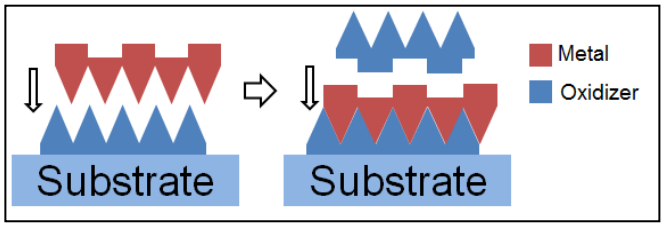

Fig. 1: Key-Lock principle as used in ALD processes

As part of this project, the poster presented here resembles the first steps from a conceptual design to the implementation of an ALD reactor into a pre-existing UHV photoemission spectroscopy analysis chamber (XPS, LIXPS, UPS and IPES). Additionally, first preliminary results to characterize the reactor will be presented.
The biggest advantage of this system, compared to commercially available standalone ALD reactors, is the possibility to manufacture and analyze films without exposure to ambient air. Furthermore, by means of the above mentioned analytical methods, it is possible to study the complete band lineup. The reactor itself is controlled by a self-written program, based on C++, which makes use of the open source Arduino microcontroller platform and LabVIEW by National Instruments.

For the future, the implementation of a nano particle injector as well as ongoing studies of new in-situ manufactured systems are planned.

Acknowledgement: We hereby want to offer our sincere gratitude to NSF for their kind funding (Grant-Nr.: ***NSF-CBET 1133239***).

Reference:

[1] Nicola Pinna, Mato Knez, *Atomic Layer Deposition of Nanostructured Materials,* Wiley-VCH (2011)

Effects of Elastomer Stiffness and Thickness on Fibroblast Cell Adhesion and Morphology

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Keywords: PDMS, cell adhesion, stiffness, spreading area.

Fully understanding of cell response to the properties of biomaterials is an essential step in the development of new materials for medical devices. Cell adhesion is central to numerous cell functions, such as cell proliferation, migration, and differentiation, and is critical for integration of implanted devices. Polydimethylsiloxane (PDMS); a crosslinked silicone biomaterial was used in this research to test cell adhesion as function of material thickness and stiffness using a spinning disk device. 10:1, 30:1 and 50:1 ratios of PDMS elastomer to crosslinker were used and 1mm, 500 µm, and 50 µm thicknesses were tested. After seeding the PDMS samples with fibroblast cells, these samples were subjected a range of hydrodynamic forces and the mean adhesion strength was measured. Since cell shape modulates cell behavior and strongly attached cells can spread more that the weakly attached cells, cell spreading area was also measured using fluorescent microscopy.

There was no significant effect of material stiffness on cell adhesion of 1mm and 500 µm thickness, while the effect of stiffness was clearly observed on 50 µm PDMS. Regarding the spreading area measurements, both 1mm and 50 µm PDMS show the same trend of stiffness effect, in which the cells were spreading more in high PDMS stiffness (10:1) comparing with the lower stiffness (30:1). In general, the primary results of this work indicate that cell adhesion is affected by the mechanical properties of biomaterials

Rapid Prototyping of a RF Ion Funnel

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Keywords: Electrospray, RF Ion Funnel, Rapid Prototyping, 3-D Printing

Rapid prototyping, also known as 3-D printing, has recently become available as a novel method to produce structures that in the past have been limited due to machining techniques or cost. Electrodes used for generating electric fields often require specific, difficult to machine geometries. Rapid prototyping allows for the realization of these devices quickly and at a fraction of the cost compared with traditional machining processes. In this study an electrospray RF ion funnel is under development using rapid prototyping techniques. The ion funnel is part of a macromolecular patterning system that utilizes electrospray ionization (ESI) as the ion source. It is the first of three focusing devices within the system and its function is to focus and transport the cloud of ions generated from the ESI source. Numerical simulations indicate equivalent function when compared to existing, traditionally constructed device. The prototype created also represents a 60 fold reduction in production costs when compared with this device. Preliminary tests are currently underway to determine the functionality within the macromolecular patterning device.
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Three Dimensional Modeling and Kinematic Analysis of a String Bass and French Horn Player

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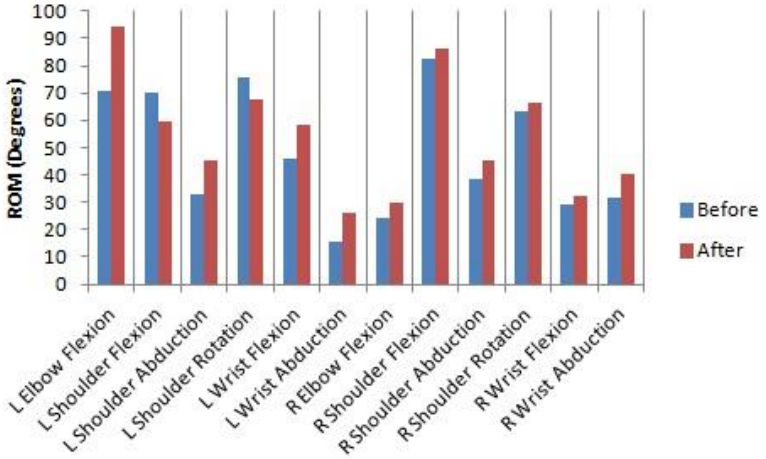
Keywords: motion analysis, music

Motion capture techniques provide accurate information about musicians' joint angles and range of motion that can be used to improve their technique and for rehabilitation purposes. Music expression has focused extensively only on sound, ignoring the key role that a performer's posture and movements play. In this study, two instrumentalists, a bassist and a French horn player, were part of a fitness class that included a seminar, yoga, physical and mental exercises, improvisation, and motion capture. The motion capture data that were obtained before and after the class was studied here.

An eight camera motion analysis system was used to track reflective markers placed on the student's upper body. Markers were placed on the musicians' head, torso, shoulders, elbows, wrists, hands, and fingers. Visual 3D software was used to create joint centers, define limb segments and calculate joint angles. Joint angles that were obtained before and after the class were compared for the two musicians. The results of this study show how the fitness program affected each of the musician's posture and movement.

The results showed that both the bassist and French horn player increased their left shoulder rotation internally and increased their right shoulder rotation externally. The French horn player also decreased his right elbow flexion. The bass player's range of motion generally increased which is shown in Figure 1. The guided physical exercises that were parts of the class have shown to improve the musician's awareness and flexibility. Before, musicians may have been focusing more on the sound that they were producing rather than their body movements. After, they are more conscious of their body, preventing injuries that can result from poor posture. This study only focused on two musicians. Additional musicians are currently being studied.



Crossed ERG Recordings with an Adjustable LED-Microelectrode Placing Apparatus

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Abstract: Electroretinogram, LED, microelectrode, retina, cornea

Electroretinogram (ERG) measurements show voltage signals emitted by light-sensitive cells in the retina of the eye. These recordings have clinical significance since they can be used to determine physiological abnormalities in vision. ERG data is collected by placing an electrode on the cornea and repetitively flashing a LED light.

A problem with this procedure is the rat's eye is very small which makes the set up tedious and time-consuming. An LED and microelectrode placing apparatus was designed and constructed to reduce the setting up time, increase precision of set up and guarantee fixation. Two L-shaped clips adapt to a plastic platform wherever desired. One of the clips holds the LED light and the other one holds the microelectrode directly on the eye. The clips have six degrees of freedom, which allows flexibility of approximation and direction of both the LED light and the microelectrode.

The apparatus was successfully used to record ERGs from rat eyes, and it was found that an ERG signal could even be picked up when light is flashed to the opposite eye. A plastic coupler was designed to assure light was only delivered to one eye. The data showed that there is a measurable ERG from crossed light flashing, something that has not yet been demonstrated in vision related research. This signal must come from retinal ganglion cells, and could thereby become a measure for tracking ganglion cell health in diseases like glaucoma.

Distributed Switched Capacitor DC-DC Converter for High Power Efficiency and Low Noise

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Keywords: DC-DC conversion, switched capacitor, integrated power converter, distributed voltage regulation, IR voltage drop

Switched capacitor (SC) DC-DC voltage converters are a promising alternative to achieve high efficiency on-chip voltage conversion. Traditional multiphase SC converters suffer from reduced efficiency at low output current since the power losses within the converter do not scale with output current. To increase the power efficiency and reduce the IR voltage drop, an adaptive distributed SC converter is proposed.

In the proposed work, the number of active interleaved stages within a multiphase SC converter is adaptively controlled based on the output current demand to minimize the internal power losses of the converter, maintaining a high conversion efficiency for a wide output current range. Reducing the number of active stages may increase the output voltage ripple, however, in the proposed design, the capacitors within the inactive stages are utilized as decoupling capacitors to reduce the ripple voltage. The power efficiency and output voltage ripple of the proposed converter are shown in Fig. 1.

To reduce the IR voltage drop, each interleaved stage is distributed throughout the power grid. This distributed architecture provides a fast response to load transients. The voltage drop map of the distributed converter is given in Fig. 2. Maximum voltage drop with the distributed converter is 20 mV whereas the maximum voltage drop with a single converter, which is connected to the center of the power grid, is over 70 mV.

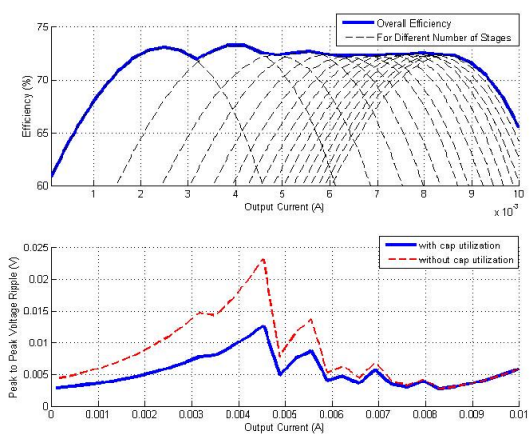

Fig. 1. Efficiency and ripple voltage.

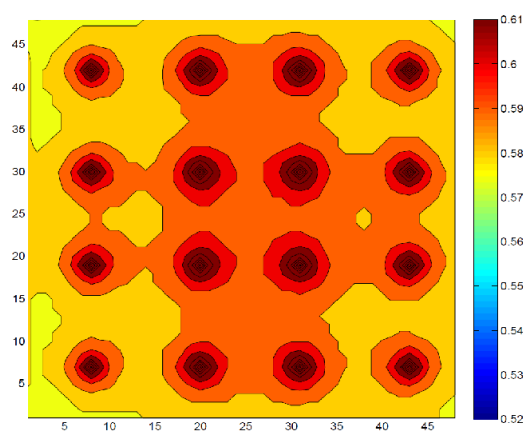

Fig. 2. Voltage drop map with the proposed conv

ABR Gap Responses Start to Decline in Middle Age Mice

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Keywords: Presbycusis, ABR Gap-in-noise, Middle Age

The CBA/CaJ mouse strain's auditory function is normal during the early phases of life and gradually declines over its lifespan, much like human age related hearing loss (ARHL), but on a mouse life cycle "time frame". This pattern of ARHL is relatively similar to most humans, and currently is not treatable medically. For this reason, CBA mice were used for the present study to analyze the beginning stages and functional onset markers of ARHL. The results from Auditory Brainstem Response (ABR) and Gap-in-Noise (GIN) ABR tests were compared between two groups of mice of different ages, young and middle aged as well.

For this study, CBA/CaJ mice were used; 10 female and 20 male, and classified into two groups: young adult (Y, N=18, 3 to 4 months old) or middle aged (MA, N=12, 15 to 18 months old). After being anesthetized, ABR GIN ABRs were measured at 80 dB SPL, using wide band noise bursts with gap durations ranging from 0.1 ms to 48.1 msec. ABR tests included an ABR audiogram on each mouse.
For long gap durations the response amplitudes for peak 1 (P1) and peak 4 (P4) to the initial noise burst (NB1) were significantly larger for the Y group. Similarly, P1 and P4 amplitudes to the second noise burst (NB2) were also larger for Y as compared to MA group. P1 amplitudes to NB1 were higher when compared to the NB2 response for the MA group. For NB2, there was a systematic decrease in P1 latency with increases in gap duration for both age groups; however, the NB2 P1 latency was longer for the MA group, particularly for the shorter gap intervals.

At 15 to 18 months old, mice start to show temporal deficits in the GIN test as observed by prolongation of the NB2 P1 latency for shorter gap durations. Effects of ARHL for the MA group were also seen in that the P1 amplitude did not fully recover compared to Y. These findings indicate that age-linked degeneration of the auditory is just beginning in middle age, allowing for biomedical preventative measures to still be a possibility for attenuating further damage due to ARHL.

Elastin Based Biomaterial for Treatment of Chronic Wound

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Keywords: Chronic wound, Elastin Like Peptide (ELP), Fibroblast

Chronic wounds affect 5.7 million patients and cost an estimated 20 billion dollars annually. Recently, we developed a growth factor delivery platform based on elastin like peptides (ELPs) for growth factor delivery to chronic wounds. Elastin like peptides are repeats of the pentapeptide (VPGXG, X=guest residue can be anything but Proline) derived from natural elastin. They are attractive delivery vehicles due to their unique phase transition properties and are genetically encodable and biocompatible. The unique phase transition property of ELPs is a direct function of the chain length and guest residue, which allows us to design biomaterial delivery systems with desirable physical properties. Interestingly, we also observed that ELPs were not only useful for delivery of growth factors but also enhanced granulation in the wound through modulation of fibroblast growth and function. In this study, we aim to elucidate the effect of chain length and guest residues on the ELP induced modulation of fibroblast function.

We observed that ELPs self-assembled into nanoparticles with different hydrodynamic diameters depending on their chain length and proportion of cysteines. We further found that ELPs increased fibroblast proliferation significantly. Interestingly, this increase was dependent on the chain length and proportion of cysteines. This increase of proliferation was successfully blocked using lactose suggesting that ELPs bind to the elastin receptor to induce proliferation. Our study suggests that ELPs induce fibroblast proliferation. This biological activity of ELPs is dependent on chain length as well as guest residues which also determine the physical phase transition properties of ELPs. Furthermore, our data suggest that ELPs induce their biological effect on fibroblasts through interaction with the elastin receptor complex present on the fibroblast surface.

Research Category #3: ***Sensing, Networking, Communications, Computing, Biometrics and Pattern Recognition***

Intentional-Overlapping in Multicarrier Systems based on User-specific Filters

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Keywords: FMT Roll-off factor Root raised cosine Intentional overlapping Adaptive filtering

In this study, we introduce controlled overlapping in time and frequency between neighboring symbols in multicarrier schemes to increase spectral efficiency. Conventionally, multicarrier schemes are designed based on Nyquist criterion to avoid inter-carrier interference and inter-symbol interference. Also, the time–frequency lattice and the prototype filter are designed considering the worst-case of time-varying multipath channel. However, this approach ignores to make use of multi-user diversity and leads excessive spacings between successive symbols in time and frequency. Unlike the conventional methods, in this study, symbols are allowed to be overlapped (depending on time–frequency dispersion of their individual channels) as long as the signal-to-interference ratios observed by all users are kept above a certain level. Additionally, in order to achieve more flexibility in packing symbols, user specific filters that have different time–frequency characteristics are utilized. This enables further spectral efficiency improvement in our system design.

Increased Quadruped Stability over Uneven Terrains using Mass Redistribution

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Keywords: Robot, quadruped, stability, center of mass, mass redistribution, control algorithms, multi-tiered terrain

Contemporary designs of quadruped robots allow a robot to transverse terrains by leaning in response to terrain conditions. However, mainly multi-tiered terrains cause quadruped systems to fail. This research proposes a method to solve issues traversing these terrains, while reducing the complexity of the control algorithms. The technique uses mass redistribution to alter the center of gravity allowing it to walk in terrains containing obstacles of various heights and viscosity. As normal walking motion requires lifting each leg of the robot to lift from the ground, only 3 of the legs are in contact with the ground, yet the body needs to remain stable and balanced. Otherwise, the robot will tilt towards the lifted leg and fall over. This can be alleviated by adjusting other stability parameters and through intercommunication of the robot's limbs, this becomes a complex controller to design and even intractable in unknown terrains. The proposed algorithm alters the position of a mass situated below the center of mass with 2 degrees of freedom, used to move the center of gravity away from the origin. This results in gravitational force being redistributed in the system and the robot no longer stumbling.

This proposed method contributes to the field by using mass redistribution, alongside various other techniques, for adjusting to multi-tiered terrain without the complexity of sensing algorithms such as processing computer vision. This will aid in the development of various applications, such as quadruped rescue robots or exploration drones, to aid in fulfilling the civil need for robots.

Collaborative Innovation Networks Simulation Model

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Keywords: Collaborative innovation networks, technologically dynamic industries, knowledge complementariness.

A simulation model is constructed to observe innovation performance of organizations with certain collaboration strategies at different levels of technological dynamism and different types of products. Organizations aim to increase their innovations, which is possible through their own knowledge capabilities or through partnerships. Members of the innovation network are categorized by the three distinct strategies when deciding on partnership: cognitive, relational or success-driven cooperation (CC, RC and SC). Based on its strategy, each organization propose partnership to other organizations and the collaboration network is determined by whether or not the latter accept to collaborate with the former. The model is developed in R language.

Innovation performances are observed over two central characteristics of an environment for technology development: i) technological dynamism (i.e., the spectrum of industrial tendencies to utilize in-house capabilities versus partnerships, α) and ii) knowledge complementariness (i.e., the spectrum of products that require partners with minimal or maximal distance in technological knowledge levels, β).

The results indicate important messages to organizations about which strategy (CC, RC or SC) to attain success at which points of the parameter space of the technological dynamism and the product type.

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LEGO Evolved

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Keywords: robotics, LEGO

RoboBulls is a student's organization located at University of South Florida for students who share a passion in robotics. Our goal is to have students impacted by the technology and desire to participate in future competitions. Students challenge themselves in robotics and develop their computer skills. We at RoboBulls wish to have a fully autonomous robot soccer team that can maneuver, find an object, and deliver it to a goal. RoboBulls is currently developing a team AI system. This entails writing the behavior the robots take on the field. Our goal is to take our research to other schools and create a new type of RoboCup soccer competition under the name LEGO small size league.

Human Intention Recognition for Assistive Robotic Devices

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Keywords: vision-based human-robot collaborative system, human intentions, recognition

In order for assistive robots to collaborate effectively with humans, they must be endowed with the ability to perceive scenes and more importantly, recognize human intentions. These intentions are often inferred from observed physical actions and direct communication from fully-functional individuals. For individuals with reduced capabilities, it may be difficult or impossible to observe their physical actions or easily communicate with them. Therefore, their intentions must be inferred differently. To this end, we propose an intention recognition framework that is appropriate for persons with limited physical capabilities. At the core of this framework is a novel Markov model formulation entitled Object-Action Intention Networks, which recognizes and learns human intentions based on scene objects and their affordances, as well as past interaction history. These networks form the crux of a vision-based human-robot collaborative system that reduces the necessary human interactions for communicating tasks to a robot. We demonstrate this in our experiments where our approach achieves approximately 81% reduction in interactions after learning when compared to a naıve intention recognition approach based only on scene content.

Terrain invariant, feed forward control of SLIP landing conditions for constant stride period and apex height adaptation

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Keywords: robotic limbs, biomimicry, passive mechanics, self-stabilization, feed-forward adaptation, legged locomotion in uneven terrain

Legs allow robots to negotiate terrain inaccessible with wheels alone, but necessitate more complex controls. The incorporation of passive dynamic principles observed in nature into robotic limb design can significantly reduce the control burden and energetic cost of legged locomotion. However, much remains to be learned about the extent to which passive mechanics allow animal limbs to self-stabilize. The spring-loaded inverted pendulum (SLIP) model provides a minimal template with which the passive mechanics of leg springs can be studied. Extending previous work on late-swing retraction and stiffening, a SLIP model is presented that stabilizes stride period and apex height on uneven terrain through feed forward control of landing conditions. Results indicate that stride period preserving rates of retraction and stiffening are nonlinear functions of falling time that allow the horizontal velocity of the foot at touchdown to match that of the center of mass at top of flight in variable terrain with a purely feed forward controller. The effects of controlled apex height adjustments that allow the SLIP model to maintain stable periodic motion in conditions impossible for apex height preserving systems--such as going up and down stairs--are also presented.

Robotics Learning Lab

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Keywords: robotics, LEGO

RoboBulls is a student's organization located at University of South Florida for students who share a passion in robotics. Our goal is to have students impacted by the technology and desire to participate in future competitions. Students challenge themselves in robotics and develop their computer skills. We at RoboBulls wish to have a fully autonomous robot soccer team that can maneuver, find an object, and deliver it to a goal. RoboBulls is currently developing a team AI system. This entails writing the behavior the robots take on the field. Our goal is to take our research to other schools and create a new type of RoboCup soccer competition under the name LEGO small size league.

Feasibility of Creating Virtual Environment for Pedestrian Safety Studies

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Keywords: Virtual Reality, Computer Animation, Pedestrian Safety, 3D Rendering

State of Florida has a high occurrence rate of vehicle and pedestrian accidents/incidents [1]. Therefore, it is desirable to investigate the hazardous conditions for pedestrians so that the safety guidelines can be proposed. It is very costly and potentially dangerous to undertake a study with real pedestrians and infrastructure (intersection/vehicles, etc.) Thus, a virtual environment that simulates a traffic scenario becomes very attractive, because it can be much cheaper as well as highly safe. In this undergraduate research project, we propose to investigate feasibility of creating virtual environment that simulates a pedestrian crosswalk. Two approaches are being investigated:

- 3D Wall: A standard handheld video camera will be used to obtain video of a crosswalk. Utilizing the ultra-high resolution visualization wall at the USF Advanced Visualization Center, a pre-recorded video of traffic at a pedestrian crossing will be converted to an interleaved stereoscopic 3D video. This will utilize software that converts frames of raw video into separate interleaved images that creates a vertical and horizontal parallax within the interleaved frames.
- 3D Glasses: In the gaming world, recently huge strides have been made in creating very realistic game environment. In this approach, we utilize 3D glasses and the ATLAS environment [2] to create virtual environment for the pedestrian studies. Maya ® and Unity® computer animation software frameworks are employed to create various virtual traffic scenarios.

In this poster, we will present the first set of results of this feasibility study.

References

[1] Chan young Lee, Meeta Saxena, Pei-Sung Lin, Enrique Gonzalez-Velez, Jeanette Rouse . Aggressive Driving and Safety Campaigns. *Transportation Research Record*, Volume 2182, Number 1 (December 2010), pp. 79-87

[2] ATLAS: Virtual Reality Made Real.
URL: http://www.kickstarter.com/projects/62367895/atlas-virtual-reality-made-real

Prediction of Treatment Response and Metastatic Disease in Soft Tissue Sarcoma

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Keywords: Sarcoma, Segmentation, Fuzzy clustering, Support Vector Machine

Soft tissue sarcomas (STS) are a heterogenous group of malignant tumors comprised of more than 50 histologic subtypes. Based on spatial variations of the tumor, predictions of the development of necrosis in response to therapy as well as eventual progression to metastatic disease are made. Optimization of treatment as well as management of therapy-related side effects may be improved with information earlier in the course of therapy. Multi-modality pre- and post-gadolinium enhanced magnetic resonance images (MRI) were taken before and after treatment for 30 patients. Regional variations in the tumor bed were measured quantitatively. The voxel values from the tumor region were used as features and a fuzzy clustering algorithm was used to segment the tumor into three spatial regions. The regions were given labels of high, intermediate and low based on the average signal intensity of pixels from the post-contrast T1 modality. These spatially distinct regions were viewed as essential meta-features to predict the response of the tumor to therapy based on necrosis (percentage of dead tissue of tumor) and metastatic disease (spread of tumor to sites other than the primary). The best feature was the difference in the number of pixels in the highest intensity regions of tumors before and after treatment. This enabled prediction of patients with metastatic disease and lack of positive treatment response (i.e. less necrosis). The best accuracy, 73.33%, is achieved by a Support Vector Machine in a leave-one-out cross validation on 30 cases predicting necrosis < 90% post treatment and metastasis.

A Microwave Radiometer Used for the Measurement of the Absolute Subsurface Temperatures of Pressure Sores

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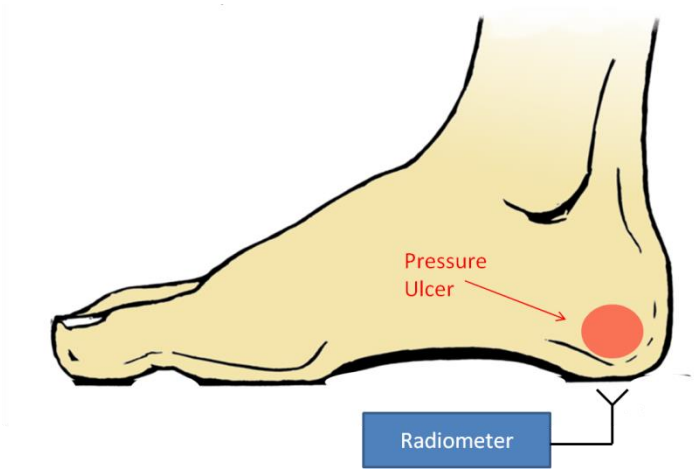
Keywords: Radiometric measurements, temperature, pressure ulcers

The research involved supports efforts to monitor the subsurface temperatures of pressure sores (bed sores). Improved knowledge on the long-term monitoring of pressure sores for hospitalized and bed-ridden patients will result in enhanced clinical outcomes and reduced healthcare costs for the elderly and chronically ill. The system uses a microwave radiometer to non-invasively, wirelessly, and accurately measure thermal emissions originating at a certain distance within the human body. These thermal emissions are modeled for the human body, taking into account the influences of the antenna and the monitoring device, to resolve the actual subsurface temperature. To date, the antenna and radiometer system is limited to a bench top assembly. This work will enable the creation of a portable radiometer and a contacting antenna able to perform agile subsurface human body temperature measurements.



Subsurface Temperature Measurements with a MW Radiometer

Secure Communication in Frequency Selective Channels using Artificial Fade-Filler Noise

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Keywords: Artificial noise, frequency-selective fading, secrecy capacity

Although broadcast nature of the radio waves leads to security and privacy issues in wireless communications, random nature of channel fading turns out to be an enabling factor for achieving secrecy against eavesdropping. Considering the frequency selectivity of the wireless multipath channels, we propose an adaptive transmission scheme in which the subchannels that the legitimate receiver experiences deep fading are populated with artificially-generated noise, instead of being used for data transmission. Thus, capacity reduction in legitimate channel is minimized while maintaining reduction for the eavesdropper's capacity proportional to the unused subchannels. Besides improving information theoretic secrecy capacity with the intelligent subchannel usage, filling the unused subchannels with noise further disturbs the eavesdropper's reception. Since each receiver has its own channel state information (CSI) but not other's, eavesdroppers cannot discard the distortion that is integrated into the transmitted signal as a function of the legitimate pair's CSI. Nonzero secrecy capacity and outage probabilities show that the intelligent subchannel usage creates a security gap between eavesdroppers and legitimate receivers even without the artificial noise. Also, error performance in a communication scenario shows that the artificial noise provides an error floor for eavesdropper regardless of the channel quality. The proposed simple countermeasure without the need of eavesdropper’s CSI provides a remarkable secrecy gain for frequency selective channels in wireless communication systems.

A Location-Based Incentive Mechanism for Participatory Sensing Systems with Budget Constraints

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Keywords: Reverse auction; Budgeted Maximum Coverage Problem.

Participatory sensing (PS) systems rely on the willingness of mobile users to participate in the collection and reporting of data using a variety of sensors either embedded or integrated in their cellular phones. Users agree to use their cellular phone resources to sense and transmit the data of interest because these data will be used to address a collective problem that otherwise would be very difficult to assess and solve. However, this new data collection paradigm has not been very successful yet mainly because of the lack of incentives for participation and privacy concerns. Without adequate incentive and privacy guaranteeing mechanisms most users will not be willing to participate. This paper concentrates on incentive mechanisms for user participation in PS system. Although several schemes have been proposed thus far, none has used location information and imposed budget and coverage constraints, which will make the scheme more realistic and efficient. We propose a recurrent reverse auction incentive mechanism with a greedy algorithm that selects a representative subset of the users according to their location given a fixed budget. Compared to existing mechanisms, our incentive scheme improves the area covered by more than 60 percent acquiring a more representative set of samples after every round, i.e., reduces the collection of unnecessary (redundant) data, while maintaining the same number of active users in the system and spending the same budget.

Effect of Texture Features in Computer Aided Diagnosis of Pulmonary Nodules in Low-Dose Computed Tomography

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Keywords: Computed Tomography, Computer Aided Diagnosis; Pulmonary Nodule Classification, Texture Features

Low-dose helical computed tomography (LDCT) has facilitated the early detection of lung cancer through pulmonary screening of patients. Accurate classification of pulmonary nodules is key to determining further diagnosis and treatment options. In order to provide medical personnel with the information to accurately determine the nature of the nodule, several computer aided diagnosis systems have been created to classify pulmonary nodules. Traditionally, these systems have been based on shape features. By adding texture features to the classification process, we show an improvement in accuracy, sensitivity, and specificity that will provide better information for medical personnel.

In this work, texture and shape features were extracted from pulmonary nodules selected from the Lung Image Database Consortium and Image Database Resource Initiative (LIDC/IDRI) data set. Several classifiers including Decision Trees, Nearest Neighbor, and Support Vector Machines were used for classifying malignant and benign pulmonary nodules. An accuracy of 90.91% was achieved using a 5-nearest-neighbors algorithm and a data set containing texture features only. Laws and Wavelet features received the highest rank when using feature selection. This higher rank implies that these features provide a larger contribution to the classification process. Considering the improvement in classification accuracy, the use of texture features appears to be a promising direction in computer aided diagnosis of pulmonary nodules using LDCT.

A humanoid platform to evaluate spatial cognition models

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Keywords: Aldebaran NAO robot, Robot self-localization

Robot self-localization has been shown to be needed in both real robotic tasks and in current robotic competitions as the humanoid soccer league and Standard Platform League (SPL) of Robocup. In this paper we describe a platform to reproduce animal navigation experiments in robots that aim to develop a bio-inspired approach to the SLAM problem. The platform is based on an Aldebaran NAO robot navigating inside an open circular maze with external landmarks for the robot to perceive. We describe the robot architecture and the platform used to support spatial cognition model evaluation.

Multi Sensor System for Pedestrian Tracking and Activity Recognition in Indoor Environments

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Keywords: Smartphone, Sensor Fusion, Pervasive Computing, Inertial Navigation, Ubiquitous Localization

Tracking pedestrians in indoor environments is one of the most challenging areas of application for Global Navigation Systems (GNSS) in personal navigation devices. The capacity of following and recognizing pedestrian behavior and localization accurately can lead to significant growth in location-based applications.

The goal of this poster is to present and evaluate a system for accurate and ubiquitous tracking of pedestrian activity and localization in indoor environments using exclusively wearable sensors embedded in smartphones (Accelerometer, Gyroscope, Magnetometer and Barometric Pressure sensor). The knowledge in biomechanical patterns of the human body while accomplishing basic activities (such as walking, or climbing up and down stairs), with the identifiable signatures that certain indoor locations (such as turns or elevators) introduce on sensing data are the base for our set of algorithms.

The experiment results show a reliable level of accuracy in pedestrian tracking and activity classification for indoor activities.

Microfluidic Based Highly Reconfigurable Bandpass RF Filters

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Keywords: RF filters, microfluid, resonators

The demands for compact multifunctional portable devices and small-unmanned vehicles place stringent requirements for the physical sizes of RF front-ends that conventionally employ multiple bulky filters. Frequency-agile filters that are capable of functioning at different frequencies with similar performance (e.g. constant fractional or absolute bandwidth) are therefore currently considered as an upcoming technology to reduce the hardware and footprint requirements. Yttrium-Iron Garnet (YIG), varactor diode, ferroelectric, and RF micromechanical systems (MEMS) based filter implementations are the current technologies utilized to realize frequency-agile filters. However, the performances of these technologies are very limited in terms of frequency tuning range and power handling capability due to the fundamental device limitations. For example, varactor loadings can provide a frequency tuning range of 30% due to their restricted capacitance variation. Cavity resonator based filters can provide a wide frequency tuning range of 3:1, however, they are physically large to find use in portable devices. MEMS technologies are great in terms of miniaturization, but their tuning range is very small and can be only enlarged by resorting to tuning in discrete steps rather than the highly desired continuous tuning capability.

This presentation presents a game-changing method for the realization of highly reconfigurable bandpass filters. The technical approach relies on employing a new class of microfluidically loaded and reconfigured open loop resonators within the filter design. The filter is implemented as a multilayered structure such that the printed circuit board based open loop resonators are integrated with microfluidic channels by using thin insulator walls. The microfluidic channels carry a dielectric solution with partial metal (in liquid or solid state) loading to realize a reconfigurable capacitive loading mechanism for the printed open loop resonators. Due to the ability of completely removing or maximizing the capacitive loading (with the use of a compact micropump), the proposed technique provides a great solution in terms of filter miniaturization and frequency tunability. The concept will specifically be demonstrated through a three pole bandpass filter design that shows a remarkable 2:1 tuning range with a 5% constant fractional bandwidth (FBW) performance, less than 2.5dB insertion loss (IL), and over 40dB of out of band rejection. The design steps of the filter which include a detailed study of coupling coefficient and unloaded Q of the microfluidically loaded resonators will be further explained in the presentation. On-going studies for transitioning to hard substrates to improve power handling and utilization of micropumps as the controlling mechanism will be discussed as well.

Computer Vision Coprocessor

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Keywords: Non-Boolean Computing, Perceptual Organization, Nano-Magnets, Quadratic Optimization.

A computer vision coprocessor with magnetic field based computing is introduced, in which we exploit the energy minimization nature of a group of nano-magnets to solve quadratic optimization problems. The Hamiltonian of a group of nano-magnets is administered by the dipolar pairwise coupling energy depending on the spacing between the nano-magnets. The ground state of a collection of nano-magnets minimizes this Hamiltonian. We have used a statistical method called Multidimensional Scaling to find a 2D spatial arrangement for a group of nano-magnets, which can solve a particular quadratic minimization problem. We experimentally demonstrated this unconventional form of computing to solve perceptual organization problem (computer vision domain) in few clock cycles that would otherwise take orders of magnitude more clock cycles using traditional computing. Perceptual organization is a pivotal step in object recognition process (see Fig. 1) and is computationally intensive.

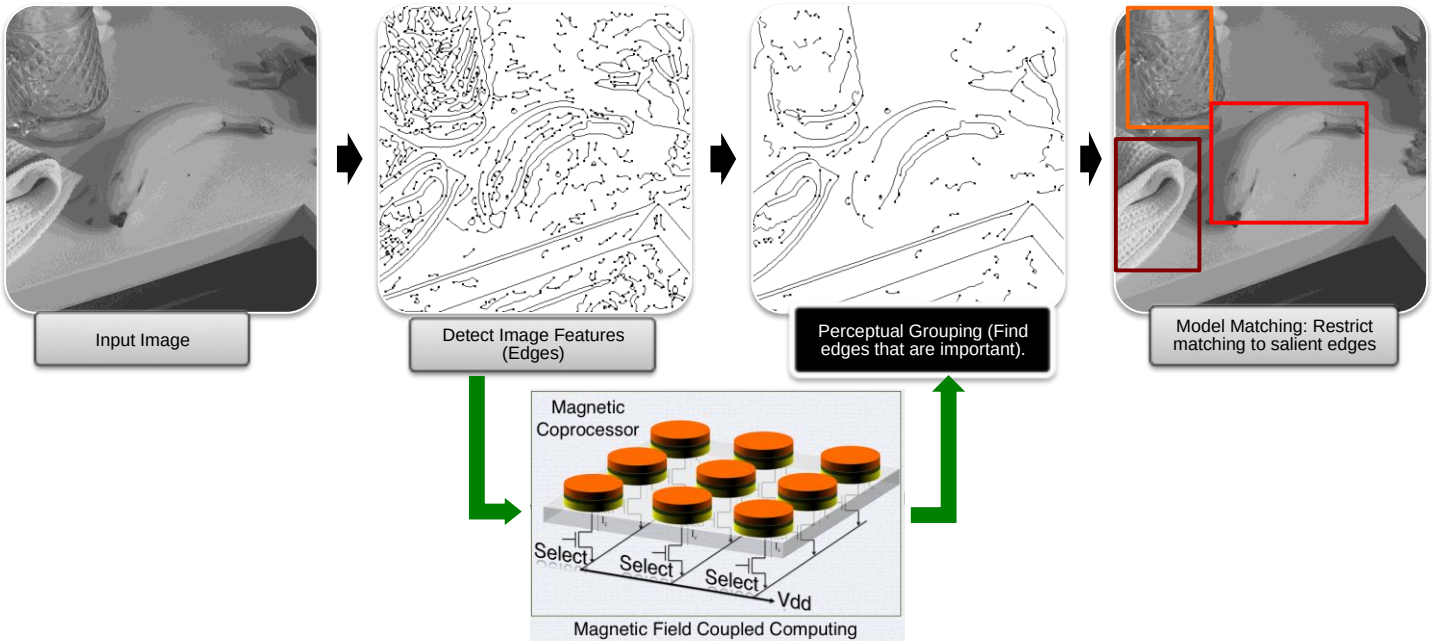

Figure 1: Steps involved in Object Recognition

Wireless Cardiac Rhythm Management Communicator and Learning System

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Keywords: *in vivo* communications, CRM systems, Learning Systems, Artificial Neural Networks

In this poster, we present a project, directed towards architecting, designing, and ultimately realizing, in conjunction with Jabil Inc., a wireless *Communicator* with an embedded *Learning System* that is a key component in an innovative Cardiac Rhythm Management (*i*CRM) system, The *iCRM* is intended to increase the level of monitoring and actuation of existing CRM systems with the assistance of the resources onboard the *Communicator*. Our approach is to leverage existing technologies (i.e., an external ECG and an internal ECG) by adding a *Communicator* that contains a *Learning System* to provide an enhanced multi-dimensional networked ECG, using the internal and external sensors, with the expectation of improving patient outcomes.

This *iCRM* system consists of a network of two CRM device emulators and a *Communicator* housing the *Learning System*. The *Learning System* processes input (internal and external) ECG signals and provides reliable real-time diagnosis. An Artificial Neural Network (ANN) architecture is being designed and tested to effectively fuse the internal and external ECG signals and accurately classify arrhythmia with minimal processing delay. It is also expected to be extensible to other abnormalities of the heart. The system may be enhanced by inclusion of an optional Subject Matter Expert who verifies the accuracy of the classification (diagnosis) of the *Learning system.*

Preliminary tests on the ANN learning algorithms with external ECGs were conducted with a dataset that consisted of time samples of patients with, Atrial Fibrillation, Atrial Flutter and a Normal Sinus Rhythm. These tests showed high accuracy (~99.00%) in correct classification of arrhythmia. The next step is to design algorithms that incorporate the internal ECG as well and expand the number of heart abnormalities

How Does Force Feedback Improve Hexapod Walking Over Uneven Terrain?

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Keywords: robotics, robot control, legged systems, force feedback

Legged robots have promise for exploration, search and rescue, and military reconnaissance by offering a level of agility not capable by wheeled systems. Many current control methods are unreliable on uneven terrain due to use of central pattern generators that produce predefined leg motion. While this is acceptable on flat surfaces, poor foot placement could lead to unstable support of the body on uneven terrain.

Research into animal control systems supports the use of inter-leg communication; however, the method by which animals achieve this is currently unknown. This research centers on the premise that significant agility can be achieved without a direct connection between legs, which simplifies the control algorithm. This will be accomplished through local force feedback, where the amount of ground force experienced by a leg is indicative of the level of support it is currently supplying to the body, amounting to a form of indirect communication between legs. Research into distributed, local force feedback has shown that stable locomotion over uneven terrain is possible without any form of inter-leg communication. However, by considering the measured ground force at each leg, it may be possible to discern the activity of neighboring legs and their current support of the body. A leg may be lifted without compromising the system's balance or walking progress if its neighbors are currently supporting the body. This force based strategy for gait timing leads to a variable stride period that adapts to the terrain and ensures the robot always has solid footing.

The direction of this research is to determine if it is possible to use force feedback to achieve a variable, adaptive stride period over uneven terrain without any explicit neural/electronic communication between legs, utilizing an existing hexapod platform as a test bed for developing such control algorithms.

Random Subcarrier Allocation with Supermodular Game in Cognitive Heterogeneous Networks

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Keywords: Resource Allocation, Supermodular game, Nash equilibrium, Primary user, Secondary user

Cognitive heterogeneous networks (HetNets) have been recently introduced as a promising solution to meet the user demand for higher data rate. Due to the physical coexistence of microcells, femtocells and the lack of available spectrum, there is a need for techniques that allows users to share the same spectrum while maintaining required performance level for each user by adopting interference mitigation techniques. In this paper, we focus on resource allocation algorithm for orthogonal frequency-division multiple access (OFDMA) cognitive networks using game theory. In particular, we consider supermodular game theory, where given the problem meets specific requirement, the game has two significant features; it has at least one pure Nash Equilibrium (NE) and its best responses are monotonically increasing. Our main objective is to solve the problem of subcarrier allocation for the SU. In previous studies, subcarriers are selected based on the payoff of each subcarrier via utilizing supermodular games. Each SU sweeps through the all subcarriers to determine the ones which have the highest payoff. If the payoff of the best selected subcarriers is larger than the ones which are selected in previous iteration, SU changes its subcarriers. While this approach has an advantage in terms of fast convergence rate, i.e. to reach the NE faster, it requires high feedback load. On the other hand, in random subcarrier allocation technique, each SU picks certain number of random subcarriers based on its need and only considers these subcarriers when making a decision. This has the advantage of limited feedback since only the number of subcarriers considered in each iteration is much less than considering all subcarriers. Our objective is to use this technique with supermodular games. This should provide lower feedback load against higher convergence rate. While the feedback load is equal to ‘280’ subcarriers in our algorithm, it is equal to ‘3072’ subcarriers in the previous algorithms. Our results indicate that we can have significant reduction in feedback on the expense of convergence, which makes our algorithm beneficial in slowly varying channels.

Survival Time Analysis Based on Multi-scale Texture Feature Selection

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Robert A.Gatenby[2], Robert J.Gillies[2]

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Keywords: Brain tumor, Survival time prediction, MRI, Feature selection

This poster presents a computer-assisted framework to tackle the survival time prediction problem for brain tumor patients. Automated prediction of patient-specific brain disease progression can significantly contribute to clinical treatment. Inspired by the assumption that niche tumor regions may play a significant role in cancer diagnosis, we explore local visual variations from multiple MRI sequences. The image-guided research consists of three parts: 1) the extraction of multi-scale Local Binary Patterns (LBP) to describe the visual variations; 2) a supervised forward feature selection approach, called the Feature Ranking Model (FRM) which captures single feature predictive ability efficiently, and combines the top features to form a feature subset; 3) We cast the clinical survival time prediction task as a binary category classification problem. We tested the framework using a dataset of 32 cases collected from The Cancer Genome Atlas (TCGA). We obtained a 93.75% accuracy rate for the prediction of survival time.

Research Category # 4: ***Other***

A Virtual Reality System for Vocational Rehabilitation of Individuals with Disabilities

Evren C. Bozgeyikli[1,4], Lal G. Bozgeyikli[1,4], Matthew Clevenger[2,4]
Andrew Raij[3], Redwan M. Alqasemi[4], Rajiv Dubey,[2,4]

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Keywords: virtual reality simulation, vocational rehabilitation, disabilities, autism spectrum, traumatic brain injury, severe mobile impairment, activities of daily living, gamification

In this poster, a virtual reality vocational rehabilitation system that is currently in development at the Center for Assistive, Rehabilitation, and Robotics Technologies (CARRT) is presented. The most distinctive novelty of the developed system is using virtual reality for job training. This allows for changing job environments, which would otherwise be costly and labor intensive. The main advantages of using virtual reality are the ease of adaptation, automated data collection, safety, repetitive training and motivation.

The aim of the developed system is to provide an effective and innovative vocational rehabilitation service using virtual reality to: assess the capabilities of individuals with severe disabilities, detect the most suitable job for them and train them in a safe and motivating environment. Being employed is important for individuals with disabilities since it improves the quality of their lives by providing a sense of self-achievement and economic independency. Three underserved groups are aimed in this study: autism spectrum disorder (ASD), traumatic brain injury (TBI) and severe mobile impairment (Such as SCI patients).

The designed system involves different virtual reality simulations at controlled environments, such as production, customer service and hospitality industry. Users can be trained with various tasks under changeable conditions in these environments by being tracked in real time using motion capture system. The designed system is immersive to be as realistic as possible and to ease the transition between virtual and real environments after training. Several performance measures will be used for assessment, such as accuracy, number of prompts given and completion time. During training, various distractors will be applied to find out individual's fears or irritations, which constitute a serious barrier in getting employed. Help will be provided to overcome these fears and irritations through training. To provide effective learning and encouragement, gamification is employed in the system which emphasizes users' special needs that are related to their disabilities.

Expected major outcomes of the study include a virtual reality job training system, a trained workforce consisting of 15 individuals with severe disabilities.

A Virtual Reality System for Vocational Rehabilitation of Individuals with Disabilities

Lal G. Bozgeyikli[1,4], Evren C. Bozgeyikli[1,4],Matthew Clevenger[2,4]
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New Method for Predicting Estrogen Receptor Status Utilizing Breast MRI Texture Kinetic Analysis

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Robert A. Gatenby[2], Jennifer S. Drukteinis[2]

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Keywords: breast cancer, DCE- MRI, Estrogen receptor, texture features, kinetic maps

MRI scans of breast cancers are typically heterogeneous with spatial variations in blood flow and cell density. Quantitative metrics of heterogeneity are rarely used in the clinic and the biological causes and consequences of imaging heterogeneity are not well understood. We hypothesize that this heterogeneity on breast MRI scan,are governed by evolutionary dynamics and that these Darwinian interactions will affect clinical outcomes including metastases, invasion, and response to therapy. To examine this potential link between clinical tumor imaging and the underlying evolutionary dynamics, we hypothesized expression of estrogen receptors (ER) in breast cancer cells would correlate with blood flow on MRI could We reasoned that evolutionary persistence of ER expression only if local estrogen concentrations remained sufficient. That is, tumor properties persist only if they confer a competitive advantage and, thus, the presence of ER indicates that estrogen must also be present.. Since estrogen is largely delivered by blood flow, we reasoned that ER negative tumors (or regions of tumors) will be relatively avascular and vice-versa. We, thus, hypothesized that, in general, quantitative analysis of blood flow on imaging features, defined on dynamic contrast enhanced MRI (DCE-MRI), will predict the ER status of the cancer cells. Here Image analysis of 20 cases included generating parametric/kinetic maps from pre and post contrast images, extracting texture features from these kinetic maps, feature selection and utilization of features to classify tumors into ER positive or ER negative status. Texture features utilized were; gray level co-occurrence matrix, gray level run length matrix features and local binary pattern histogram features. The algorithm could predict ER expression with an accuracy of 85% using Naives Bayes classifier in leave-one-out cross-validation. We conclude that our data support our hypothesis that imaging characteristics can, through application of evolutionary principles, provide insights into the cellular and molecular properties of cancer cells. This novel technique provides a framework for quantitative image analysis that may be applicable to other definable clinical aspects of breast cancer.

A Virtual Reality System for Vocational Rehabilitation of Individuals with Disabilities

Matthew Clevenger[2,4], Evren C. Bozgeyikli[1,4], Lal G. Bozgeyikli[1,4]
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Keywords: virtual reality simulation, vocational rehabilitation, disabilities, autism spectrum, traumatic brain injury, severe mobile impairment, activities of daily living, gamification

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Expected major outcomes of the study include a virtual reality job training system, a trained workforce consisting of 15 individuals with severe disabilities.

RGB-D Updated Encoder-Based Motion Control for an Autonomous Power Wheelchair

Mustafa Mashali[1,3], Redwan Alqasemi[3], Sudeep Sarkar[2], Rajiv Dubey[1,3]

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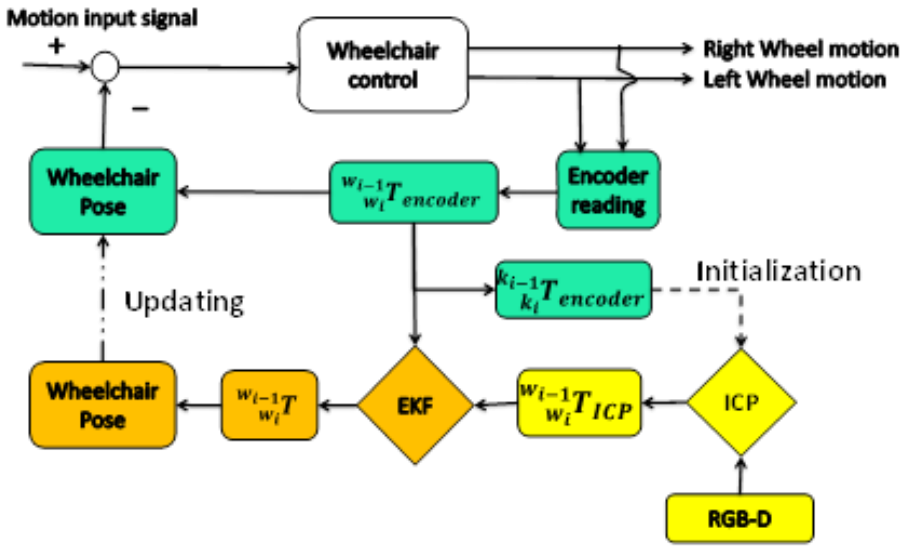
Keywords: Localization, Visual odometry, Kalman Filter, ICP, motion control, Kinect

In this work, we present a motion control scheme for a robotic mobile platform, consisting of a power wheelchair, using low-cost RGB-D sensors to update encoder values. We track the pose of a power wheelchair using wheel encoders along with a Microsoft Kinect camera. Two methods of pose estimation are implemented and tested. These methods are a) encoder-based odometry and b) RGB-D optimized odometry. We evaluate the performance of each method using precise wheelchair pose ground truth data acquired via a state-of-the-art 8 camera VICON motion capture system. Offline data processing is performed to refine the ICP (Iterative Closest Point) parameters and estimate the covariance matrices of the Kalman filter.

The results demonstrate that our RGB-D optimized odometry has near perfect pose tracking. To demonstrate the robustness of our approach, we apply it for real-time obstacle avoidance. By implementing our control scheme, the position error is improved by a factor of 15 and the localization orientation error is improved by a factor of 13 A wheelchair-mounted robotic arm (WMRA) is also included in this platform and will be used for future work on combined mobility and manipulation control with sensor assistance.



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Passive Dynamic Synchronization of Uncoupled Rotating Systems

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Keywords: Passive Synchronization, Nonlinear Systems, Uncoupled Systems, Pendulum, Kinematic matching

Passive kinematic synchronization enables two independent dynamic systems to generate the same motion without any interaction. This research demonstrates a generalized kinematic matching technique to passively synchronize two physically dissimilar systems, which allows the relationship between kinetics and kinematics of these systems to be further studied. This method has implications for the modeling of system dynamics, the study of swinging limbs in humans, animals, and robots, and in prosthesis design.

This method is demonstrated by matching the dynamics of systems with different masses and mass distributions. Specifically, we matched the nonlinear motion between three single-link pendulums and between two double-link pendulums. Despite the chaotic motion of a double-link pendulum, temporal and spectral analysis results show that the two different and kinematically-matched systems generate nearly identical motion. The method is generalizable and can be used to describe and match the kinematics of any open-ended rotating system chain such as rotors, cams, or pendulums.

With this novel synchronization method it is possible to manipulate limb movements such as evening out asymmetric walking patterns created by some trauma or neurological disorder. This can be done by adding weight to key locations along limbs. Further applications include matching healthy limb motion with a prosthetic limb yielding symmetric kinematics.

Although we have found much success in the kinematic realm of synchronization, we hypothesize that matching kinetics can only be done for certain instances such as the maximum reaction force of dissimilar passive systems. This hypothesis would suggest that relevant applications such as prosthetic design are limited to either similar inter-limb motion or forces exerted onto joints and extremities.

BehaviorSim – A Behavioral Approach to Cognitive Modeling

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Keywords: dynamical systems, agents, human behavior modeling, computational psychology

The behaviorSim project aims to create an architecture and toolkit which enables inter-model psychological simulation, development, and analysis. This is accomplished by encapsulating cognitive theory into an intuitive agent structure based on folk psychology and gauging the performance of different models based on behaviorist principles. By segmenting agent constructs into context, state, motives, and behavior (CSMB), a generalized information flow diagram can be defined. Using this agent architecture and a fluid-flow analogy developed to represent the Theory of Planned Behavior, flow of psychological information can be modeled as a dynamical system. By combining these innovations with ease of use and model customization, exploration of human behavior models to improve our understanding of environmental influence on psychology can be treated as an optimization problem rather than an a priori modeling exercise. A better understanding of human psychology as a dynamical system will enable creation of powerful, personalized interventions which could be used to empower user goals, end drug addiction, and stop the growing obesity epidemic.

This work builds upon decades of work in cognitive architectures, agent-modeling, and dynamical systems modeling to inform the generalized agent-based structure, but also includes contributions in the CSMB agent design, the information-hiding psychological construct definition approach, and the encapsulation of cognitive formulations within a behavioral perspective. A proof-of-concept example application to user-avatar intervention design is highlighted, but the generalized model structure presented is designed to enable modeling of behavior in general.

Android Device for Hands-Free Wireless Wheelchair Control

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Keywords: Arduino BT, Android based controller, Bluetooth communication protocol

Wheelchair users may face physical and psychological challenges due to difficulties to leave their houses and join social activities, especially in countries with fewer facilities for wheelchair users. In addition, wheelchair users may be dependent on another person to perform everyday activities. In this paper, we present the development of a hardware/software kit that can be added to most standard wheelchairs to provide hands-free control of power wheelchairs using an android-based handheld device. Quantitative and qualitative assessments of the users' acceptance and perception of the device are also presented. This novel wheelchair kit can help users with disabilities to practice physical exercises with music and to dance and entertain themselves with their hands free.

In this novel project, we have created an android-based controller that consists of hand-held Android device and a control box that can be attached to standard wheelchairs for hands-free navigation. Bluetooth communication protocol is used to communicate sensory and command information between the hand-held device and the control box. The control box is connected to the wheelchair, and the user can switch between the standard joystick control and the Android hand-held device control. A complete motor control system to control the high-powered DC motors was designed and implemented. The control algorithm to establish communication between the android device and the wheelchair was done using Arduino BT control board.

The user can perform exercise and entertaining wheelchair moves by attaching the Android hand-held device to his/her upper body, arm, or head and perform the desired wheelchair motion by moving the hand-held device in the same direction. A complete study was done using 10 human subjects and the usability issues were discussed and rectified. We gained a better understanding of why the user may like or dislike each feature of the system to adjust our design parameters accordingly.

Remote Controlled Multi-directional Rotating Platform for Stage Performances

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Keywords: multi-directional rotating platform, theatre and dance, torque

This project involves the design and development of a multi-directional platform with an independently rotating top to be used onstage during theatrical and dance performances. The project is the result of collaboration between the University of South Florida's College of The Arts (Merry Lynn Morris, MFA) and the Center for Assistive, Rehabilitation and Robotics Technologies (Mechanical Engineering). The problem has been the development of a robust, remote controlled, compact, transportable, and inexpensive moving platform with a rotating top. This platform adds an additional choreographic element to Ms. Morris' unique style of dancing, which involves the use of a variety of mobility devices and performers including dancers with disabilities. The platform is designed to hold up to five-hundred pounds with an independently rotating top while the base moves forward/backward, sideways, or diagonally using Omni-directional wheels. The existing design has a removable top surface, folding wing sections to collapse the unit down to fit through an average size doorway, and detachable ramp ends for wheelchair access. The top of the platform is driven by a compact gear train designed to deliver maximum torque within a limited space. The current structural, drive system, power system, and control system designs will be presented here.

Android Device for Hands-Free Wireless Wheelchair Control

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Keywords: Android device, Arduino BT control board, hands-free navigation

Wheelchair users may face physical and psychological challenges due to difficulties to leave their houses and join social activities, especially in countries with fewer facilities for wheelchair users. In addition, wheelchair users may be dependent on another person to perform everyday activities. In this paper, we present the development of a hardware/software kit that can be added to most standard wheelchairs to provide hands-free control of power wheelchairs using an android-based handheld device. Quantitative and qualitative assessments of the users' acceptance and perception of the device are also presented. This novel wheelchair kit can help users with disabilities to practice physical exercises with music and to dance and entertain themselves with their hands free. In this novel project, we have created an android-based controller that consists of hand-held Android device and a control box that can be attached to standard wheelchairs for hands-free navigation. Bluetooth communication protocol is used to communicate sensory and command information between the hand-held device and the control box. The control box is connected to the wheelchair, and the user can switch between the standard joystick control and the Android hand-held device control. A complete motor control system to control the high-powered DC motors was designed and implemented. The control algorithm to establish communication between the android device and the wheelchair was done using Arduino BT control board. The user can perform exercise and entertaining wheelchair moves by attaching the Android hand-held device to his/her upper body, arm, or head and perform the desired wheelchair motion by moving the hand-held device in the same direction. A complete study was done using 10 human subjects and the usability issues were discussed and rectified. We gained a better understanding of why the user may like or dislike each feature of the system to adjust our design parameters accordingly.

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