

2019 Engineering Graduate Research Symposium Research Categories

AI, ML, Data Science:

- **Artificial Intelligence**
 - Evolutionary Computing
 - Computational Optimization
 - Multi-agent systems
- **Machine Learning and Pattern Recognition**
 - Face Recognition
 - Biometrics
 - Computer Vision
 - Multimedia Systems, Augmented Reality
 - Deep Learning
 - Human Computer Interface
 - Information Retrieval
 - Natural Language Processing
 - Text Mining Studies
 - Social Network Analysis/Social Computing/Computational Social Science, Text Mining/Web Mining/Data Mining, Dimension Reduction/Similarity Learning/Machine Learning

Computing:

- **High Performance Computing and Big Scientific Data Analytics (HPC & Big-Data)**
 - Computational mathematics
 - Comparative Genomics, Computational Biology, Bioinformatics
 - Numerical Analysis
 - Quantum field theory
 - Genome Assembly
 - Phylogeography
 - High order numerical methods for Hamilton-Jacobi equations.
 - Sparse grid methods for high-dimensional PDEs.
 - Fast convolution methods
 - Multi-scale modeling
 - High order numerical methods
 - Weighted essentially non-oscillatory methods
 - Defect correction methods
 - Kinetic theory
 - Energy materials and phase field models
 - Molecular dynamics
 - High-performance Supercomputers
 - Computer Architecture
- **Networks and Systems**
 - Computer Architecture
 - Computer Security
 - Fault Tolerance
 - Distributed Systems
 - Computer and Network Security, Networking
 - Network and Pervasive Computing; P2P Computing
 - Wireless and Mobile Systems
 - Internet of Things, Pervasive Sensing
 - Mobile Computing, and Networked Embedded Systems
 - Cyber-Physical System
 - Cognitive networks, wireless sensor networks, cyber-physical systems, wireless communications, digital signal processing, and information theory

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Computing:

- **Algorithms**

- Graph Theory
 - Applied Topology
 - Topological Data Analysis.
- Algorithms for the analysis of large and high dimensional data sets
- Software engineering, Formal Methods

Mobility, Robotics

- **Connected Automated Vehicles**

- Sensors and actuators
- LIDAR, RADAR
- Machine vision, pattern recognition
- Sensor fusion
- AI-based automation
- Pathfinding
- Fault tolerance
- Robotics and Autonomous Vehicles
- Reinforcement Learning, Vehicle Dynamics, and Optimal Control.
- Smart Infrastructure, embedded sensors and transponders

- **Robotics & Control System**

- Sensors and actuators
- Biomimetic robotic fish
- Embedded control systems.
- MEMS/NEMS technologies and systems
- Control of Nonlinear system
- Conformal antennas, engineered materials for microwave applications, and computational electromagnetics.
- Fiber-optic sensing/actuation devices and systems

- **Traffic and Transportation System**

- Highway Design
- Traffic Engineering
- Pavement Management/Rehabilitation
- Intelligent Transportation Systems
- Transportation systems analysis

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Electrosystems:

- **Fabrication & Circuit Design**
 - Manufacturability, reliability, analysis, and control of linear and rotating electrical machines and drives
 - Thermoelectrics, and later on a group for printing technologies
 - Film coating technologies for industrial applications.
- **Signal Processing**
 - Compressed Sensing
 - Nonlinear ultrasonics
 - Finite element modeling
- **Power Electronics**
 - Control of power electronic systems
 - Power converter topologies
- **High-frequency integrated circuits and systems**
 - Antennas, scattering, radar target identification, measurement of the electromagnetic properties of materials, electromagnetic theory.
 - Millimeter-wave Electronics, IR Sensors, Microsystems Packaging, RF-MEMS, BioMEMS, and Flex Electronics.
 - Design of analog/mixed-signal/RF circuits and systems including wireless transceivers and RF power amplifiers
 - Thin Film Solar Cells, Supercapacitors, Optical Thin Films, Functional Coatings, Electronic Materials and Semiconductor Devices
- **Computational Electrosystems**
 - Computational plasma physics, electromagnetics, beam physics, high field effects
 - Theory and modeling of nanoelectronics, electromagnetic fields and waves, plasmas, and accelerator technology Quantum kinetic theory; Transport theory; Quantum Boltzmann equation.
 - Wavelet and local spectral methods for PDEs; Computational electromagnetics; Computational fluid dynamics; Richtmyer-Meshkov instability; Structural analysis.
 - Mathematical molecular biosciences
 - Computational plasma physics
 - Theoretical & Computational Astrophysics
 - Ultra-cold atomic systems and quantum simulation

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Health, Food Safety, and Biomechanics:

- **Health**
 - Bioimaging
 - MEMS/NEMS technologies and systems, micro sensors and actuators, biomimetic devices and systems, microfluidic and lab-on-chip systems, and microsystem integration and packaging technologies
 - Characterize, modulate, and regenerate neuronal responses at the interface of electrodes implanted in the brain
 - Biomedical optics, MEMS/MOEMS, multi-modal targeted imaging, wearable and implantable medical devices, ultrafast laser applications.
 - Biomedical optics
 - Biosensors and actuators
 - Nanotechnology and diamond NEMS-biosensor solutions in biomedical diagnostics, automation of biotechnological processes, and food analysis as well as in the development of diamond high-power terahertz systems
 - Bio-imaging and medical decision-making
 - Integrated medical diagnostics
 - Tomographic image reconstruction
 - Hybrid machine learning algorithms
 - Kinetic data analysis
 - Application of AI to healthcare delivery
 - Cell plasticity and tissue remodeling in health and disease
 - Computational toxicology
 - Macroscopic and microscopic optical imaging tools and uses imaging to assess tissue responses to stress
 - Genomics and computational biology
 - Biology and the function of extracellular vesicles (EVs)
 - Mathematical molecular biosciences; Mathematical biophysics; Variational multiscale models; Ion channel transport; Proton transport; PDE modeling of biomolecular surfaces; Virus capsid modeling.
 - Nanotechnology-based strategies to harness the power of the immune system
 - Protein expression; fermentation engineering; multiphase biocatalysis; biobased products.
 - Health diagnostics
 - Health risk assessment
- **Food Safety**
 - Food processing
 - Food testing
 - Food sterilization
 - Probiotics
- **Biomechanics**
 - BioMEMS, microfluidics, biosensors, and point-of-care diagnostics [ME]
 - Biomechanics of human movement, motor learning and control, rehabilitation robotics
 - Biomaterials with bioactive and bactericidal properties for tissue healing and regeneration
 - Biomedical Informatics
 - Cardiovascular mechanics
 - Vascular growth and remodeling, mechanobiology and tissue engineering, and computational and statistical interventions for vascular disease

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Mechanics, and Structures:

- **Computational mechanics and modeling**
 - Design optimization,
 - Finite element method
 - Micro-mechanics of soft and bio-inspired materials
 - Experimental studies of thermo-fluids and reacting flows
 - Turbulent combustion physics
 - Mathematical modeling of turbulence
 - Whole-body biomechanics
 - Experimental Thermo-fluids, Turbomachinery Flow Analysis and Design, Design and Testing of Centrifugal and Regenerative Flow Compressors and Pumps, Gas Turbine Combustion, Biogas for Power Generation
 - Friction dynamics
 - Fluid mechanics and biophysics
 - Thermal-fluid science and engineering
 - Unsteady fluid mechanics and aerodynamics,
 - Turbulent flows, hydrodynamic instabilities, and compressible flows
 - Computational fluid dynamics
 - Dynamical systems; Controlling chaos ; Controlling turbulence; Controlling pattern formation.
 - Stochastic modeling and uncertainty quantification
- **Structures**
 - Composite structures,
 - Experimental mechanics, process control and optimization
 - Material issues in design and manufacturing; manufacturing processes; mechanical behavior of materials; microstructured and graded materials.
 - Biomaterials
 - Nanomanufacturing, nanomaterials, and microfabrication
- **Modeling and Analysis**
 - Multi-material joining
 - Computational design of materials and structures
 - 3D micromechanical modeling
 - Pavement response and performance modeling, dynamics of pavements and truck-pavement interaction
- **Mechanical systems**
 - Turbomachinery, centrifugal compressors, wave rotors, refrigeration and HVAC
 - Dynamic systems, noise and vibration, engines and propulsion systems, and integrated systems design and development.
 - Mechatronics and robotics.
 - Manufacturing/3D Printing using laser energy
 - Thermodynamics, combustion, optical diagnostics, turbulence, internal combustion engines
 - Fluid-structure interaction
 - Dynamics and vibration, and smart structures and energy harvesting
 - Combustion, ignition, alternative fuels, thermodynamics and internal combustion engines
 - Heat transfer; thermophysical property measurement; parameter estimation; thermal biology

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Materials & Manufacturing

- Design of novel composite materials
- Plasma Sources, Plasma-Material Interactions
- Plasmas for synthesis of semiconductor nanostructures, gas-phase processing
- Plasma-assisted semiconductor materials processing
- Electronic materials, including temperature dependent electrical conductivity, Seebeck coefficient, thermal conductivity, Hall effect, and current vs. voltage measurements for materials and devices
- Mechanical deformation of metallic materials
- Composites
- Polymer synthesis techniques
- Inorganic-organic hybrid polymers
- Polymer surfaces and interfaces, molecular self-assembly, nanostructured biomimetic interfaces
- Functional thin film, coatings, adsorption, adhesion and particles
- Dynamics of lithium-ion battery and solid oxide fuel cell electrodes
- Nanoscale inorganic materials
- **Electrochemical engineering**
 - Systems biology and bioinformatics, metabolic engineering, cellular and tissue engineering
 - Fiber-resin composites
 - 3D printing process chemistry

Sustainability and Environment:

- Sustainable building materials
- Sustainable design
- Building material reuse
- Environmental impact of solar technologies (scarcity, toxicity and energy payback)
- End-of life management of photovoltaic wastes
- Process design and life cycle modeling of wastewater treatment
- Soil and water contamination
- Analytical method development for harmful algal toxins
- Large-scale (global to continental) water cycle modeling
- Irrigation pumping and groundwater depletion
- Water quality engineering, emphasizing protection of public health and prevention of waterborne disease.
- Water chemistry