GRADUATE PROGRAMS

• Ph.D. in Engineering Science and Mechanics
• M.S. in Engineering Science and Mechanics (*Thesis and Non-Thesis Tracks*)
• M. Eng. in Engineering Mechanics
• M.D./Ph.D.
• M.S. in Engineering at the Nanoscale
Mechanical anisotropy of 3D printed composite

Below: Carbon whisker composites manufactured through fused filament deposition

3D Printer (fused filament deposition)

Printing Head

Whisker and void morphology

Flat Unidirectional Specimens

[0]₈

[90]₈

Micromechanical modeling

PI: Dr. Charles Bakis
Mechanical anisotropy of 3D printed composite

Above: A set of resonators mounted on a plate reflect the incident wave

No transmission!

Incident wave

Pls: Drs. Shokouhi & Lissenden
Ultrasound allows nondestructive microscale characterization

Above: Defect detection in metallic alloy; polycrystalline microstructure and corresponding ultrasonic scattering signals.

PI: Dr. Andrea P. Arguelles
Additive manufacturing of shape memory alloys (SMAs)

Above: Hierarchical SMA structures; nano-/micro-/meso-scale test approaches to locally probe deformation mechanisms; performance of two compositions

PI: Dr. Reginald Hamilton
Wearable and Degradable Devices

Transient implantable devices

Above: Transient Sensor on Low-Cost Substrate for Implantable devices; Fully degradable 3D Electronics on Curvilinear Surfaces.

3D degradable electronics

Skin-conforming

Energy harvesting

Integrated system

PI: Dr. Larry Cheng

Department of Engineering Science and Mechanics
Understanding the neural control of blood flow and fluid movement in the brain using optical imaging and modeling.

PI: Dr. Patrick Drew
Dynamics, stability, and control of human walking

Above: Experimental measurements of stepping behavior used to develop models to test theories of motor regulation and design interventions to mitigate fall risk

PIs: Drs. Cusumano & Dingwell
Theory of Nanoscale Plasmonic Materials

Examples of modeling of nanoscale antennas (near-field tip, nanotube polariton).

Theoretical vs. experimental maps of twisted graphene plasmonic disk.

PI: Dr. Slava Rotkin
Nanophotonics characterization of 2D- and Bio-materials

Maps taken by scattering Scanning Near-field Optical Microscope on different materials, revealing material properties with sub-diffractive resolution.

Viral particles

Polar 2-dimensional metal (Indium)

Multilayer twisted graphene: exfoliated and CVD crystals; sub-um plasmonic compartment

Photonic crystal

PI: Dr. Slava Rotkin
Materials for MRI and 5G

**ELECTROMAGNETIC SIMULATION**
FDTD, MoM, FEM

**MATERIALS**
Properties and Processes
- Permittivity
- Permeability
- Conductivity

**DEVICES**
Antennas, Filters, MRI
- Integration
- Tractable Fabrication

**HDC Material**
High Field Bore
RF coil

Dielectric Helmet with High Permittivity Material

Simulated and measured electromagnetic fields in human head at MRI frequency

PI: Dr. Mike Lanagan
Biomembranes and membrane-mediated processes

Above: Coarse-grained modeling of: vesicle shape transition pathways; two-component vesicle phase dynamics; Drug or DNA delivery via nanoparticles

PI: Dr. Sulin Zhang
Doing optics at the exceptional points

From optical sensing to control of light propagation

PI: Dr. Sabin Ozdemir
Additive manufacturing of metals for energy applications

Rethinking Materials for the Energy Sector Through Additive Manufacturing

Above: Solutions for the energy sector through additive manufacturing and repairs of corrosion resistant, high strength, and creep resistant materials.

PI: Dr. Todd A. Palmer
Theory-driven functional materials synthesis and fabrication to produce next generation materials by merging synthetic biology and materials science.

Above: From self-assembly to molecular composites.

PI: Dr. Melik Demirel
Mathematical models of brain-on-a-chip and brain’s non-locality

Non-local Blood Flow

Non-local Action Potential

Above: Design of a brain-on-a-chip, mechanotransduction and non-locality

PI: Dr. Corina Drapaca
Environmental Degradation

An array of sensors could be used to sense degradation occurring in a large space

Assessing corrosion response of AM metals
Developing new, corrosion resistant alloys for varied applications. Sensing and measuring corrosion in hard to access areas

PIs: Drs. Sikora & Shaw

Department of Engineering Science and Mechanics