Project Lead: **Jennifer Bauman, Assistant Professor, Electrical & Computer Engineering**
JELF Funding: **$80,000**
Project Title: **Electrified Powertrain Modeling Laboratory: The Optimization of Efficiency, Cost and Lifetime of Electric Vehicles**

Since 2010, many vehicle manufacturers have released plug-in electric vehicles (EVs), and sales of these vehicles are growing each year, although globally they still account for less than 1% of new automobile sales. The main obstacles to widespread adoption of EVs are: high initial costs, range and battery lifetime concerns, and charging infrastructure availability. This project will allow researchers to create a state-of-the-art modular and flexible electrified powertrain test-bench to study the interactions between EV powertrain components to find opportunities for cost reduction, efficiency improvement, and extension of battery lifetime. It will provide immediately useful and applicable new insights in the development of EV powertrains for the next generation of electrified vehicles.

Project Lead: **Gianluigi Botton, Professor, Materials Science & Engineering**
JELF Funding: **$800,000**
Project Title: **Advanced Electron Spectroscopy Tools**

The development of new materials with finer scale structures relies on electron microscopy characterization techniques to extract information on the composition of materials down to the atomic level and to observe materials in their operating state. A new detector with significantly improved characteristics will enable fundamental studies on the structure of superconducting materials and analyses of novel catalyst for fuel cells and lithium based battery materials for energy storage. In addition, a versatile sample holder will allow for the evolution and degradation of catalysts and battery materials to be studied in the liquid state, providing the necessary insight to understand how materials with practical application related to energy conversion and storage can be modified and improved. Researchers will be able to develop more efficient catalysts for cheaper and more durable fuel cells, and for safer, longer lasting and higher capacity rechargeable batteries.

Project Leads: **Kathryn Grandfield, Assistant Professor, Materials Science & Engineering**
Nabil Bassim, Associate Professor, Materials Science & Engineering
JELF Funding: **$$799,980**
Project Title: **Plasma Focused Ion Beam (PFIB) for Mesoscale Tomography of Materials**

Materials are the "stuff" from which modern technology is engineered and the natural "stuff" with which it interacts. Materials are in everything and, therefore, have a major affect on the human condition. A better understanding of biomedical materials can alleviate pain, prolong healthy living, and reduce medical costs to society; and improved materials for aging infrastructure are critical for extending lifetimes, reducing maintenance and having sustainable impact on the environment. The PFIB microscope will allow researchers to probe the structure of materials at the mesoscale (from 10s of nanometers to 100s of micrometers) in 3D. Using a specialized ion beam and electron imaging optics, researchers will sequentially slice material and record images over hundreds of microns with nanometer resolution. They'll also develop smart data applications to perform segmentation on-the-fly to teach the instrument to recognize and measure critical features, compensate for large computational overhead and self-correct during data acquisition. These 3D models will lead to better understanding and design of materials used in the treatment of an aging society and aging infrastructure.

Project Lead: Zeinab Hosseini-Doust, Assistant Professor, Chemical Engineering
JELF Funding: $135,361
Project Title: Building a Bacteriophage Biotechnology Platform

Bacteriophages (phages) are the most abundant biological entities on earth and have remarkable biological, chemical, and physical properties that can help researchers tackle global challenges in human health. This research platform focuses on three main applications. **Antibiotic resistance**: Being bacteria's natural predators, phage was employed as the sole antibacterial treatment against infectious disease for 25 years before being overshadowed by antibiotics. The rise of antibiotic resistance has rekindled interest in using phage against antibiotic-resistant infections. **Point-of-care diagnostics**: Bacteriophages have a high specificity for their host bacteria and can thus be employed as biorecognition elements to develop biosensors and diagnostic tools. Unlike antibodies and enzymes, phages are cheap to produce, have a long shelf life, and do not require refrigeration. **Advanced biomaterials**: To develop novel materials, researchers will introduce new peptides on the phage protein coat through genetic engineering. These peptides can be chosen to specifically recognize organic or inorganic molecules, biomaterials that are smart and bioactive.

Project Lead: Thia Kirubarajan, Professor, Electrical & Computer Engineering
JELF Funding: $100,000
Project Title: Computational Suite for Emerging Concepts in Target Tracking and Information Fusion

Information fusion – the systematic combination of data from multiple sensors – has many applications in safety and security, intelligent transportation and autonomous vehicles. In recent years, the types of data sources have been evolving, with large amounts of social media data (e.g., text, video, audio) being made available for fusion with traditional sensors such as radar and sonar. While the problem of space has become more challenging with large amounts of data from diverse heterogeneous sensors, available computing resources, ranging from massively parallel graphical processing units (GPU) to cloud-based computing with real and virtual computers distributed across the globe, have become more affordable, powerful and diverse. It's these inter-related evolutions that provide the motivation for this work which will develop new object tracking and sensor fusion algorithms that specifically take advantage of emerging computational resources such as cloud computing, GPU and hardware systems to handle large amounts of soft, hard and augmented-reality data.