

## Undergraduate Research Activities and Opportunities

Department of Electrical and Computer Engineering, University of Miami

Fall 2016

Faculty	Project Title and Description
Dr. Mohamed Abdel-Mottaleb	<b>Biometrics research</b>
Dr. Hammam Alsafrjalani	<ol style="list-style-type: none"> <li>1. <b>Embedded systems design</b></li> <li>2. <b>User experience research</b></li> </ol>
Dr. Xiaodong Cai	<ol style="list-style-type: none"> <li>1. <b>Dynamic Modeling and Simulation of Gene Networks</b></li> <li>2. <b>Identification of Gene Regulatory Elements</b></li> </ol>
Dr. Sung Jin Kim	<ol style="list-style-type: none"> <li>1. <b>Nano for Sensors</b></li> <li>2. <b>Nano for optoelectronics</b></li> </ol>
Dr. Miroslav Kubat	<b>Machine Learning</b>
Dr. Shahriar Negahdaripour	<ol style="list-style-type: none"> <li>1. <b>Recognizing fish in video images</b></li> <li>2. <b>Recognizing/locating 3-D objects on the seafloor using forward-scan sonar data</b></li> <li>3. <b>GUI for Human-Assisted Control of a Commercial Submersible Robotics Platform</b></li> </ol>
Dr. Kamal Premaratne Dr. Manohar Murthi	<b>Multi-modal data fusion</b>
Dr. Manohar Murthi	<b>Quantization of signals for robustness to packet loss</b>
Dr. Michael Scordilis	<b>Affective Acoustic Signal Processing</b>
Dr. Mei-Ling Shyu	<ol style="list-style-type: none"> <li>1. <b>Multimedia Multimodal Content Analysis, Data Mining, and Big Data Analytics</b></li> <li>2. <b>Network Security, Intrusion Detection, and Cybersecurity</b></li> </ol>
Dr. Onur Tigli <a href="http://www.ece.miami.edu/tigli">www.ece.miami.edu/tigli</a>	<ol style="list-style-type: none"> <li>1. <b>Nanotechnology and Biosensors for Cancer Diagnosis and Therapy</b></li> <li>2. <b>Energy Harvesting Microdevices</b></li> <li>3. <b>Evolvable Hardware / Digital Cryptography</b></li> </ol>
Dr. Michael Wang	<b>3D Finger Print Image Acquisition and Display</b>
Dr. Jie Xu	<ol style="list-style-type: none"> <li>1. <b>Cloud Security</b></li> <li>2. <b>Online learning for social recommender systems</b></li> </ol>

## Detailed Project Descriptions

Supervisor	Project Title and Description
Dr. Mohamed Abdel-Mottaleb	<p><b>Biometrics research</b>            Recognizing people from facial and ear images. Student who will participate in this project will work closely with Ph.D. students who are performing their research in these topics. Students will learn basics of image processing and will get involved in some interesting topics including face and ear modeling and matching.</p>
Dr. Hammam Alsafrjalani	<p><b>1. Embedded system design</b>            Portable consumer electronics have many design constraints such as low power, lightweight, and high performance requirements. Meeting the design requirements is contingent on careful consideration of hardware and software design options. Students will be involved in system modeling, simulation and evaluation, using state-of-the art simulators. Intermediate programming in C, basic Linux, and computer organization skills are required. Successful projects have the opportunity to be presented at a national conference.</p> <p><b>2. User experience research</b>            The consumer-defined quality of service is becoming the new bottleneck in system designs. To address consumer concerns, system designers must consider consumer expectations. This project proposes new methods and frameworks that enable dynamic (post-fabrication/design) consumer-specified system optimization. Basic VHDL, intermediate programming in C, or Matlab skills are required. Successful projects have the opportunity to be presented at a national conference.</p>
Dr. Xiaodong Cai	<p><b>1. Dynamic Modeling and Simulation of Gene Networks</b>            Apply dynamic systems and control theory as well as signal processing methods to model and simulate the dynamics of gene networks. Possible collaboration with professors in the medical school. The project is particularly suitable for engineering students who are interested in biological or biomedical research.</p> <p><b>2. Identification of Gene Regulatory Elements</b>            Use computational methods to analyze genome sequences and gene expression data and to identify possible gene regulatory elements in the genome. Possible collaboration with professors in the biology department. Good programming skills are required.</p>
Dr. Sung Jin Kim	<p><b>1. Nano for Sensors</b>            This research will focus on nanophotonics and their Biosensor applications. Surface Plasmon Resonance (SPR), Meta-materials/structures and photonic bandgap structures, which are currently a cutting-edge research area, will be studied. This project will include FDTD (Finite Difference Time Domain) simulation for light-matter interaction and BPM (Beam Propagation Method) for waveguide structures. Also, there will be device fabrication for a prototype sensor system using optics and photonics based theory. This project will lead to students having deeper understanding of optics and nanophotonics</p>

	<p>for sensors.</p> <p><b>2. Nano for optoelectronics</b>  This research will focus on optoelectronic devices (solar cell, light emitting devices) using nanomaterials and nanostructures. There has been lots of research regarding unique optical properties of nanomaterials, which can be used for display or LED devices. This research will include techniques for solution processed device fabrication using nanomaterials and nanostructures. For example, next (3<sup>rd</sup>) generation solar cell will use nanotechnologies for flexible, low cost production. Various organic/inorganic materials (e.g., quantum dots, nanoparticles, carbon nanotube, grapheme and polymers) will be studied and students will have opportunities to learn how nanomaterials are synthesized and used for solution based device fabrication as well as electrical/optical device characterization techniques.</p>
Dr. Miroslav Kubat	<p><b>Machine Learning</b>  The use of machine learning techniques in domains with highly unreliable data.</p>
Dr. Shahriar Negahdaripour	<p><b>1. Recognizing fish in video images</b>  Novel machine learning techniques and object labels on massive amount of internet data have enabled fast and accurate searches, in addition to recognition objects from their images. In this project, the objective is to apply similar ML methods to large volume of deep-sea optical and sonar data from the Virgin Islands to classify certain fish, namely various types of grouper (yellow-fin, grouper, Nassau, tiger, yellow-mouth) and snapper (cubera, dog).</p> <p><b>2. Recognizing/locating 3-D objects on the seafloor using forward-scan sonar data</b>  In recent years, high-resolution sonar video cameras have been commercialized that produce images with high target details. In this project, application of computer vision techniques are explored to classify and (or) identify 3-D objects using 2-D sonar images. In other related work, we are also interested in fusing information from both optical and sonar images.</p> <p><b>3. GUI for Human-Assisted Control of a Commercial Submersible Robotics Platform</b>  There are a number of projects involving the development of graphical User Interface with Visual C++, or comparable environments (e.g., Python) for sensor output display, control and interaction of the submersible robotics platform owned by the Underwater Vision and Imaging Lab.</p>
Dr. Kamal Premaratne Dr. Manohar Murthi	<p><b>Multi-modal data fusion</b>  In many applications, one is confronted with massive amounts of various forms of data (e.g., text data, sensor data). For example, doctors are confronted with transcriptions of patient statements, blood pressure readings, and so forth. This project involves investigations into fundamental methods for making sense of and fusing various forms of data (e.g., text and sensor data).</p>
Dr. Manohar Murthi	<p><b>Quantization of signals for robustness to packet loss</b></p>

	<p>This project involves fundamental work on signal/data compression for transmission of networks that feature packet loss. In particular, we are investigating distributed source coding principles (commonly known as Wyner-Ziv principles) to code speech with robustness to packet loss while featuring efficiencies closer to predictive coding models. This has applications to audio/video coding and transmission.</p>
<p>Dr. Michael Scordilis</p>	<p><b>Affective Acoustic Signal Processing</b>  For affective computing to become meaningful in future human-machine interaction there is need for robust and versatile methods of spoken emotion recognition so machines can understand and act upon human emotion.</p>
<p>Dr. Mei-Ling Shyu</p>	<p><b>1. Multimedia Multimodal Content Analysis, Data Mining, and Big Data Analytics</b>  To extract information about the content conveyed by the big data, possibly in various media types:</p> <ul style="list-style-type: none"> <li>(a) Image, video, and audio processing</li> <li>(b) Feature selection</li> <li>(c) Segmentation and data preprocessing</li> <li>(d) Event/Concept detection - Sports highlights (touchdown, corner kick, dunks, etc.), Surveillance (people entering and exiting room under security surveillance), Concept detection and classification (weather, sports, indoor, outdoor, etc.)</li> <li>(e) Information integration and fusion</li> <li>(f) Deep learning</li> <li>(g) Distributed and cloud-based computing, storage, and infrastructure - Hadoop, MapReduce, MongoDB, Hive, Spark, NoSQL, etc.</li> </ul> <p><b>2. Network Security, Intrusion Detection, and Cybersecurity</b>  To develop effective and efficient frameworks for network intrusion detection and cybersecurity:</p> <ul style="list-style-type: none"> <li>(a) Network traffic generator/simulator</li> <li>(b) Network programming/multi-threaded programming</li> <li>(c) Intrusion detection systems</li> <li>(d) Autonomous and self-adaptive security (multi-agent, data mining, etc.)</li> <li>(e) Access control and privacy management</li> <li>(f) Cyber-physical systems, cyberattacks and defense strategies</li> </ul>
<p>Dr. Onur Tigli  <a href="http://www.ece.miami.edu/tigli">www.ece.miami.edu/tigli</a></p>	<p>We are interested in developing nanotechnologies for the early diagnosis and therapy of cancer. Students carry out research at our state-of-the-art lab facilities at UM Miller School of Medicine as a part of Biomedical Nanoscience Program.</p> <p><b>1. Nanotechnology and Biosensors for Cancer Diagnosis and Therapy</b>  My lab's interest is in the field of bioMEMS/ NEMS to develop smart point-of-care diagnostic tools for clinical applications. Our current research deals with the development of zinc oxide (ZnO) nanowire based biosensors, as well as development of integrated micro/nano systems for rapid and comprehensive blood, serum and other bodily fluid analysis. This work involves the use of micro/nano fabrication methods, microfluidics, micro/nano sensor and actuator development,</p>

	<p>and their biomedical applications. Additionally, he also conducts research for monolithic lab-on-a-chip, integrating nanotechnology with conventional CMOS technology.</p> <p><b>2. Energy Harvesting Microdevices</b>  This project is focused on the design of micron scale devices for harvesting energy. Students can participate in the modeling and simulation of such devices using cutting-edge MEMS software tools (COMSOL, ANSYS, Coventorware etc.) Students will also be involved in basic microfabrication tasks to post-process CMOS fabricated microchips that employ energy harvesting components. They can also assist in experiment setup that will include basic electrical circuits and mechanical apparatus for testing and characterization.</p> <p><b>3. Evolvable Hardware / Digital Cryptography</b>  Hardware description languages (HDL) and logic synthesis made high levels of integration and large gate count ASICs and FPGAs possible. Our primary interest in this field is to utilize FPGAs in developing evolvable hardware component libraries for applications in cryptography through the introduction of evolvability at behavioral, RTL, logic synthesis, or in physical layout by localized evolution engines. Strong background in Verilog HDL, digital design on FPGAs and C programming is required. Students can assist graduate researchers in algorithm, coding and performance testing.</p>
Dr. Michael Wang	<p><b>3D Finger Print Image Acquisition and Display</b>  Currently, human finger prints are acquired mainly in 2D images. It would be interesting to acquire 3D finger prints without contact. An imaging device can help the acquisition of 3D image data. In this project, the goal is to acquire 3D finger prints and make a suitable display. Require software processing skills to make this possible.</p>
Dr. Jie Xu	<p><b>1. Cloud security</b>  Cloud computing has the potential for a profound impact on our daily life and world economy. However, security and privacy protection is a critical concern in the development and adoption of cloud computing. This project involves developing and applying machine learning and artificial intelligence techniques to solve security and privacy problems that are unique to the cloud.</p> <p><b>2. Online learning for social recommender systems</b>  Social networking allows people to share information and opportunities in a mutually beneficial fashion. This project aims to develop mechanisms to promote cooperation among individuals in an efficient way under uncertainty. Online learning algorithms and incentive mechanisms will be developed to achieve this goal for the social recommender systems.</p>