2011/12 Research, Development, and Activities

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Dual-Use Ground Vehicle Condition-Based Maintenance – The U.S. Army is poised to introduce Condition Based Maintenance (CBM) across its land-based vehicle fleet. CBM is expected to increase the vehicles’ readiness and operational availability and reduce the soldiers’ maintenance burden. Within this research our team was to develop an intelligent vehicle health management system for light tactical vehicles. Our focus was on the engine and the axles. We were also developing a secure vehicle identification method through RFID technology. The front-end of our vehicle health management system has the following elements: data acquisition, data manipulation, condition monitoring, and health assessment (diagnostics).

Bradley Bazuin and Liang Dong. Richard Hathaway and Claudia Fajardo, of the MAE Dept., were also members of the team.

TS-Type Fuzzy Automaton for Software Agents – In this project our objective is to develop a new, Takagi-Sugeno type fuzzy automaton. Tracking the status of an event driven, large control system is a difficult problem. Those systems often encounter unexpected events in an uncertain environment. The use of fuzzy automata offers an effective approximation method to model continuous and discrete signals in a single theoretical framework. A Max-Min automaton can successfully model a cluster of relevant states when a decision is to be made on the next state of a goal path at the supervisory level. However, to provide analytical proof for stability and other key properties for inference performed by a fuzzy controller the Takagi-Sugeno model is preferred. This project is a continuation of a previous one referred to as Generic Encapsulated Fuzzy Automaton Software Agent. This project is overseen by Janos Grantner, ECE Professor.

The $345,000 project is funded by the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) through CAViDS. In 2009 an additional $70,000 supplement was added to this project. Three vehicle demonstrations were carried out for TARDEC representatives. The project was successfully concluded in the fall, 2011. ECE faculty involved in this project were Janos Grantner, CoPI;
Nonlinear Circuits and Systems Laboratory
Room A-209
http://homepages.wmich.edu/~miller/NonlinearCircuitsAndSystems.html

This laboratory continues to explore electronic implementations of chaotic systems under the direction of Dr. Miller.

Mechanical engineering undergraduate student Ben VanDyken was awarded a NASA Michigan Space Grant Consortium Undergraduate Research Fellowship to implement a discrete time chaotic system as described in the 2012 article "Dead-beat full state hybrid projective synchronization for chaotic maps using a scalar synchronizing signal" by Dr. Giuseppe Grassi (University of Salento) and Dr. Miller in the journal Communications in Nonlinear Science and Numerical Simulation. That paper extended previous work by Drs. Grassi and Miller as published in Applied Mathematics and Computation. Ben is building on the work of previous and current students in the lab, including David Kirklewski and Donovan Squires. Former student James Truszkowski continues to support this research even after his graduation.

Undergraduate student Nate Noffsinger is designing an anti-aliasing low pass filter to support testing a continuous time coupled chaotic oscillator initially designed by a 2007 senior design group consisting of Chris Bommarito, Paul Kokney, and Donovan Squires. That project was inspired by the 2008 article "Generation of a four-wing chaotic attractor by two weakly-coupled Lorenz systems" in the International Journal of Bifurcation and Chaos by Dr. Grassi, Dr. Severance, Emil Mashev, and Dr. Miller.

Neurobiology Engineering Laboratory
Room A-211
http://homepages.wmich.edu/~miller/NeurobiologyEngineeringLaboratoryBrochure.html

Under the direction of Drs. Miller and Severance, the Neurobiology Engineering Laboratory investigates the principles and mechanisms of information processing and knowledge representation in biological neurons and neuronal networks. As described in a recent poster from the lab at the 2011 NASA Michigan Space Grant Consortium Conference in Ann Arbor, this research is truly an interdisciplinary effort, requiring close collaboration between faculty and students in biology, electrical engineering, and mathematics.
Doctoral student Michael Ellinger is investigating how to experimentally validate the theoretical concepts presented in the *Biological Cybernetics* article “Exploring Optimal Current Stimuli that Provide Membrane Voltage Tracking in a Neuron Model” by Mike, Dr. Melinda Koelling (Math Department), Dr. Miller, Dr. Severance, and Ph.D. student John Stahl. Dr. Cindy Linn of Biological Sciences has provided guidance and access to her electrophysiology equipment for studying biological cell electric potentials. Dr. Koelling and graduate student Jason Anyalebechi are working to extend application of this optimal control technique to neuron phase models.

One area of continued focus is the development of instrumentation to support experiments in neurophysiology, and in particular the measurement and stimulation of neuron electrical activity. Master students Donovan Squires and Kyle Batzer and doctoral student John Stahl are nearing completion of a neuron electrical stimulation and measurement system based in part on work by previous senior design groups, including the work of Leonard Morgan, Stephen Goveia, and Bryan Berger. Donovan is currently testing his printed circuit board implementation of the latest design that features A/D and D/A converters and slots for up to eight pre-amp/stimulator cards designed by John. Kyle developed a FPGA based solution for transfer of data between the system and a PC via a USB interface. Both John and Kyle secured NASA Michigan Space Grant Consortium support for this work. Kyle will return to an internship at NASA Glenn Research Center this summer.

The laboratory is perfecting cell culture protocols that will be applied to the culture of biological neurons for experimental studies. Under the direction of Michael Ellinger, undergraduate students Shannon Kloha and Matt Wolfe learned to culture cells and are now studying effects of surface coatings on cell growth. Shannon was awarded a NASA MSGC Undergraduate Research Fellowship and a WMU Seibert Undergraduate Research and Creative Activities Award to support this research.

Dr. Miller is supporting work by Biological Sciences student Sr. John-Mary Vianney and her advisor Dr. John Spitsbergen to study effects of electrical stimulation on cell cultures. Sr. John-Mary presented that work in a poster at the 2011 Society for Neuroscience Annual Meeting. Dr. Abdel-Qader is sponsoring a senior design group (David Anderson, Abdoulaye Ousseini, and Angie Paula) that is building a system for the acquisition and analysis of human EEG signals. The Neurobiology Engineering Laboratory has provided support for this based on its work in electronics for acquiring biological signals.
Earthworm giant axon experiment demonstrating the functionality of custom built equipment for electrophysiology. This experiment by Donovan Squires was made possible by the contributions of many lab members. Note that an action potential is visible on the scope.

Sr. John-Mary Vianney and a stimulation experiment in progress.

**Storing Grid Power with Retired Electric Vehicle Batteries**

Dr. John Patten (Manufacturing Engineering) is sponsoring senior design projects to investigate using retired electric vehicle batteries to store and provide energy to the power grid. Zach Hudson, Katrina Snyder, and Justin Soeder have designed a charge counting system to monitor the state of battery cells. Matt Kubacki, Mohammed Mousa, and Steven Ryder are working on a follow-on project to demonstrate a scaled version of a complete system. Drs. Bazuin and Miller are the ECE faculty mentors for these projects.
**Stryker Challenge**

Stryker invited teams of electrical and mechanical engineering undergraduate students from WMU, Michigan State, the University of Michigan, Purdue, and Notre Dame to compete in two design competitions. The first March 2011 competition required students to modify an R/C car to pickup-up and transport a hand tool through an obstacle course in timed runs. In the second and most recent competition in November 2011, teams had to build devices to remotely place balls in scoring positions in what was essentially a miniature golf course. WMU is now 2-0 in this competition! Plans are underway for the next competition to be held in the fall. Dr. Miller and Professor Sitkins (Industrial and Manufacturing Engineering) are the team coordinators.

**First Stryker Challenge team:** Colin Haire (ME), Wei Chiu (EE), Luke Burley (ME), and Kevin Thompson (ME)

**Second Stryker Challenge team:** Jolica Dias (EE), Ben VanDyken (ME), Ria Pereira (EE), and Avin Castelino (ME)

**Tau Beta Pi**

One mission of Tau Beta Pi is to recognize “distinguished scholarship and exemplary character” [tbp.org] among undergraduate engineering students. Undergraduate students invited to be considered for membership must be in the top eighth of the junior class and top fifth of the senior class in eligible engineering programs. The WMU Michigan Kappa Chapter of Tau Beta Pi initiates elected students each fall and spring semester. Our chapter serves the community and college through active volunteerism. Current chapter officers are Jessica Hartl, Mikkhao O’Dell, Shalinee Koonjal, Colin Haire, and Tom Strazanac. The advisory board consists of Dr. John Cameron (Chemical Engineering), Barry Frost (Lead Analysis Engineer, Johnson Controls), Provost Tim Greene, Vice President for Research Dan Litynski, Dr. Miller (Chief Advisor), and Dr. Bob White (Industrial and Manufacturing Engineering).
Many of the future jobs in the USA will be in the area of science, technology, engineering and mathematics (STEM), but many students have a difficult time making the transition from high school to university degrees in these fields. That is why WMU has implemented the STEM Talent Expansion Program (STEP), funded by the National Science Foundation with a to $2M grant with Dr. Ikhlas Abdel-Qader as a Co-PI. (Dr. Edmund Tsang is the principal investigator on this project). The focus of STEP is to improve the success rate of first-year STEM students and ultimately increase the number of students that graduate with degrees in these fields. The main components of STEP are living and learning communities aimed at providing students with the support and resources needed for success.

During the STEP project, a number of support programs for first-year STEM students have been put in place, including cohort enrollment, mentoring, joint programming with Residence Life, tutoring resources, and early-warning alerts for students experiencing academic or personal difficulties. Because students know their classmates (and their hall-mates in the Engineering House), they are more likely to interact socially and academically, easing the transition to college. As a result, student retention from first to second year has improved both within STEM programs and at Western Michigan University.

Under this grant, Dr. Abdel-Qader has developed and oversees a new program - Women in Engineering Mentoring Network (WEMN) aiming to increase the retention of female students in the college of engineering. This program is designed to connect freshman and sophomore female engineering students with female mentors who have taken similar paths, namely WMU CEAS alumni. Events and opportunities are held to facilitate the initiation of the mentoring relationship between the mentees and their mentors. The mentoring expected outcomes are:

- Help female students learn the skills and information needed to be successful in college and in engineering careers.
- Help female students get answers to their academic and career questions from WMU alumni who mentor and who have similar experiences during their studies at CEAS.

Dr. Ikhlas Abdel-Qader, Ms. Lynn Kelly of Career Services, and Mr. Peter Larr, the director of the Engineering House welcome the mentors and mentees to the CEAS-WEMN Program at the kick-off event in October 2012.

Electrical and Computing Engineering Department Hosts Workshop for Mattawan Middle School Group

The group pictured from Mattawan Middle School attended a workshop and toured the Parkview Campus. Dr. Gesink and Dr. Johnson of the ECE Department planned the event and the activity for the middle school students. The students arrived around 9:30 a.m. and toured the college, then after lunch they joined Dr. Johnson and ECE students Vincent Krause, Lalith Narasinhan, Chi-Park and Ryan Huber for a hands-on laboratory workshop. The activity centered on looking at the electronics and LCD display characteristics of a photo viewfinder.
Center for Advanced of Smart Sensors and Structures (CASSS)

Sensors provide a link between the digital world of computers, modern communications systems and the “real” or analogue world in which we live in, making it possible for us to obtain real time information about our surroundings, especially in inaccessible and inhospitable environments. In present-day biotechnological applications, the analysis of biochemical products is of utmost importance. The complexity of interfacing a biochemical environment directly to an electronic device needs to be overcome as smaller and faster devices are highly desired for replacing time-consuming laboratory-analyses. The attractive properties of biochemical sensors such as high sensitivity and high selectivity along with low detection limits are extremely promising for biochemical sensing applications. Researchers in this interdisciplinary program work towards: (a) understanding the cellular and molecular biology/chemistry of binding proteins at the sensor surface, (Bio/Chem); (b) develop tools, techniques and protocols to non-intrusively collect relevant bio/chemical information using an array of micro/nano probes, sensors and analysis protocols (Micro/Nano); (c) characterize the electrical parameters, choose appropriate materials for sensors and develop better models to understand the interface between sensors and bio/chemical (Bio/Micro/Modeling/Materials/Chem); (d) design and develop microelectronic integrated circuits for sensor control at the local level and processing at local and remote levels with wireless communication and distributed computing capabilities (VLSI/INFO). The Center for Advanced Smart Sensors and Structures is dedicated to performing research in wide variety of areas related to smart sensors and structures. This center forms the nucleus for cross-disciplinary research and provides a mentoring source for doctoral and masters level students. Some of the interdisciplinary research activities are as follows:

a) Impedance Based Electrochemical Biochemical Sensor
An efficient electrochemical biosensor for the detection of various chemical and biological species was successfully fabricated by incorporating gold (Au) interdigitated electrodes (IDE), with 5 μm width and spacing, on a glass substrate, using photolithography technique. Gold was chosen as the electrode material for this work due to its inertness and because of its known affinity for biomolecules, especially for its ability to bind to proteins. Also a flow cell, with inlet and outlet ports for the microfluidic chamber, was fabricated using an acrylic material with a reservoir volume of 78 μl. Analysis of the impedance based response of the two-terminal device successfully demonstrated the feasibility of the biosensor to distinguish among various concentrations of chemical substances like potassium chloride (KCl), lead sulphide (PbS), mercury sulphide (HgS) and cadmium sulphide (CdS) as well as some biological proteins such as mouse monoclonal IgG, sarcosine and D - proline at pico molar (pM) concentration levels. This project is overseen by Dr. Massood Atashbar, ECE Professor.

b) Printed Electrochemical Biochemical Sensors on Flexible Substrates
This project addresses the challenges of fabricating miniaturized, low-cost, flexible sensors via high - throughput techniques which are expected to be used for applications in chemical and biological detection. The researchers aim at printing (Gravure, Inkjet and Screen), characterization and testing of carbon nanotubes, graphite and silver inks as electrodes for interdigitated electrodes on paper, glass and polyethylene terephthalate (PET) substrates. An efficient electrochemical biosensor was successfully printed on a flexible PET substrate film using silver (Ag) nanoparticle based ink. The electrochemical impedance spectroscopy (EIS) response of the printed sensor for detecting low concentrations of biochemical species revealed a very high sensitivity at pico molar (pM) concentration levels of potassium chloride (KCI), lead sulphide (PbS), mercury sulphide (HgS), cadmium sulphide (CdS), sarcosine and D - proline. Fabricating arrays of organic thin film transistor

Printed Electrochemical Bio/Chemical Sensors

(a) Photolithographically fabricated biochemical sensor (b) Flow cell.
(OTFT) structures on flexible substrates using traditional printing techniques are also part of this research study. This project is overseen by Drs. Massood Atashbar, ECE Professor and Margaret Joyce, PCI Professor.

c) Printed Capacitive Based Humidity Sensors on Flexible Substrates
A capacitive type humidity sensor (Inter Digitated Capacitor (IDC)) was successfully printed on a polyethyleneterephthalate (PET) substrate by means of rotogravure printing using silver (Ag) nanoparticle based ink as metallization with dimensions of 200 µm electrode finger width and spacing. The fabricated device was spin coated with humidity sensitive hydrophilic polymer (Poly Methyl Methacrylate (PMMA)). The capacitive response of sensor towards Relative Humidity (%RH) was measured in the range of 40% RH to 80% RH. The capacitive response of the printed sensor towards humidity showed a maximum hysteresis of 8 % at 60% RH. The sensor showed a variation of only 0.8 % from the average value at 70% RH and 25°C. This project is overseen by Drs. Massood Atashbar, ECE Professor and Margaret Joyce, PCI Professor.

d) Printed Wireless Humidity Sensors On Flexible Substrates
In this research work, a wireless humidity sensor was inkjet printed on a flexible polyethyleneterephthalate (PET) substrate film using silver (Ag) nanoparticle based ink. The printed sensor consisted of an interdigitated capacitor (IDC) and an inductive coil pair in planar form. The IDC of the LC resonant circuit was spin coated with a humidity sensitive polymer poly (2-hydroxyethylmethacrylate) (pHEMA) and placed inside a Caron 6030 humidity chamber. It was observed that the capacitance of the IDC was directly proportional to the relative humidity. This change in capacitance resulted in a shift in the resonant frequency of the LC sensor which was remotely measured through an inductive detection coil. This project is overseen by Drs. Massood Atashbar, ECE Professor and Margaret Joyce, PCI Professor.

e) Fully Printed Wireless LC sensor for Heavy Metal Detection
This research project focused on the successful development of a fully printed wireless LC sensor for the detection of toxic heavy metals. The sensor, consisting of an inductor, detection coil and interdigitated electrodes (IDE) in planar form, was fabricated using screen and gravure printing technologies on a flexible polyethyleneterephthalate (PET) substrate with silver (Ag) based ink as metallization. The capability of the printed LC sensor for detecting very low concentrations of toxic heavy metals was demonstrated. The wireless response of the printed LC sensor revealed a very high sensitivity at picomolar levels of cadmium sulphide (CdS) and lead sulphide (PbS). This project is overseen by Drs. Massood Atashbar, ECE Professor and Margaret Joyce, PCI Professor.

Novel flexible strain gauge sensor fabricated using screen printing
A flexible strain gauge sensor was successfully designed and fabricated using screen printing on polyethylene terephthalate (PET) substrate using silver (Ag) based ink as metallization. The electromechanical characteristics of the printed strain gauge sensor were examined by subjecting the sensor to a 3-point bend test. A 1.89 % maximum change in the resistance was observed when the sensor was subject towards a displacement of 2 mm, for 10,000 cycles. This response of the sensor demonstrated the potential of the fabricated sensor to be used in sensing applications for safety measures. This project is overseen by Drs. Massood Atashbar, ECE Professor and Margaret Joyce, PCI Professor.
f) Guided Shear Horizontal Surface Acoustic Wave (SAW) Sensor

In this project a portable, rapid detection 64° YX LiNbO$_3$ SAW transducer was fabricated. Aluminum Nitride (AlN) layer was then deposited on the active area as acoustic wave guiding layer with 10 µm electrode width and spacing. Acrylic material was used to fabricate a flow cell with a 3 µl reservoir volume having inlet and outlet ports for the micro fluidic chamber. Structural studies and morphological analysis, conducted on fluid channeled between the delay-line interdigitated electrodes, revealed that the deposited AlN thin film layers have strong preferential c-axis orientation and is compact with grain dimensions of less than 80 nm respectively. Polyaniline nanofibers were polymerized and synthesized to obtain 50 nm average diameters. The nanofibers were deposited on the layered SAW device and were tested towards hydrogen (H$_2$) gas, while operating at room temperature. The device demonstrated a large and reproducible response to different concentrations of the H$_2$ gas making it an ideal candidate for H$_2$ sensing at room temperature. This project is overseen by Dr. Massood Atashbar, ECE Professor.

g) Solidly Mounted Thin Film Bulk Acoustic Resonator (SMFBAR)

This research study aims to develop a prototype device based on the SMFBAR technology that will measure prostate specific antigen (PSA) efficiently in a cost effective manner at very low concentration (pg/ml region). The SMFBAR based sensor is designed with a piezoelectric thin film sandwiched between the top and bottom electrodes, on top of an acoustic mirror structure also known as Bragg reflector layers. The specific aims for this project include: (a) Fabricating chips capable of detecting the binding of antibodies and their interactions with PSA based on FBAR technology, (b) Evaluation of the chips for the detection of PSA and (c) Development of on-chip detection system for point-of-care testing based on CMOS-MEMS technology. This project is overseen by Dr. Massood Atashbar, ECE Professor.

h) PMMA/64° YX-LiNbO$_3$ Guided SH-SAW Based Immunosensing System

In this study, a poly methylmethacrylate (PMMA)/64° YX-LiNbO$_3$ guided shear horizontal mode surface acoustic wave (SH-SAW) sensor was designed and fabricated for the detection of biological antigen-antibody interactions. Various thicknesses of PMMA guiding layer were spin coated on SH-SAW sensor. A test setup utilizing a small-volume flow cell with inlet and outlet ports for the microfluidic cell and employing polydimethylsiloxane (PDMS) based microfluidic channels, was also designed and fabricated using an acrylic material with a reservoir volume of 3 µl. The interactions between protein G and immunoglobulin G (IgG) solutions were measured and analyzed using the PMMA coated SH-SAW devices. The frequency shift of 64° YX-LiNbO$_3$ device with 0.4 µm PMMA guiding layer was measured from 3 kHz to 68 kHz as the concentration of IgG was increased from 1 µg/ml to 10 µg/ml. The calculated sensitivity of the guided SH-SAW was found to be 7.3 kHz/(µg/ml). This result showed that this guiding SH-SAW device was suitable for the liquid sensing applications. This project is overseen by Dr. Massood Atashbar, ECE Professor.

i) Development of Guided SH-SAW based Wireless Sensing Platform for Monitoring Protein Binding

In this study, a wireless biosensing platform was developed for the detection of protein binding. The system consisted of a layered ZnO/36° YX-LiTaO$_3$ guided shear horizontal mode surface acoustic wave (SH-SAW) device and a microfluidic flow cell. The influence of the interactions between protein A and mouse IgG on the
characteristics of the SH-SAW device was measured and analyzed for varying concentrations of mouse IgG. The experimental results demonstrated that the insertion loss of the device increased from -46.8 dB to -50.9 dB and the center frequency of the device decreased from 94.56 MHz to 94.49 MHz as the mouse IgG concentration was increased from 1 µM to 40 µM, respectively. This sensor platform enabled real time monitoring of protein binding within a microfluidic flow cell. The experimental results show that this guided SH-SAW based wireless sensing system is viable for biosensing applications. This project is overseen by Dr. Massood Atashbar, ECE Professor.

j) Fully Printed Skin-Like Flexible Pressure Sensor
A flexible pressure sensor was gravure printed on a polyethyleneterephthalate (PET) with silver (Ag) ink as the metallization layer. Initially, an array of 4 bottom electrodes with dimensions of 4 cm × 0.5 cm and 0.5 cm spacing were gravure printed. A 4 cm × 4 cm polydimethylsiloxane (PDMS) layer was then screen printed on top of the electrodes to act as the dielectric layer. This was followed by the gravure printing of an array of 4 top electrodes, with similar dimensions as that of the bottom electrode, with a 90° rotation in angle when compared to the bottom electrodes resulting in a grid structure. Finally, a passivation layer of PDMS was screen printed on the top electrodes. The overall thickness of the printed pressure sensor was measured to be 180 µm. The printed flexible pressure sensor was tested by placing varying weights on top of the passivation layer. This caused the distance between the top and bottom electrodes to be reduced, thereby resulting in a change of capacitance based on the change in the overall thickness and dielectric constant of the PDMS dielectric layer. A 4 %, 24 %, 39 % and 41 % change in capacitance was observed as the weight increased from 2.2 kPa to 8.6 kPa to 23.5 kPa to 0.1 MPa, respectively. This project is overseen by Dr. Massood Atashbar, ECE Professor.

k) A Field-Portable Potentiostat System with Full Onboard Function Generation
A handheld, field-portable potentiostat system was successfully designed and fabricated to perform a wide range of electrochemical impedance spectroscopy (EIS) experiments. The onboard function generation capabilities of this system produces reference signals to drive numerous types of voltammetry experiments and thus provides increased functionality over previously built potentiostat systems. The system produced is capable of AC signal generation ranging from extremely low frequencies up to 200 kHz and signal amplitudes from 15 mV to 3 V at the counter electrode. This system also has a 16-bit DC resolution to bias AC signals or to produce a wide range of DC waveforms with an operating range of ±10 V. The capability of the potentiostat system was demonstrated by performing EIS on varying concentrations of mercury sulphide (HgS), a toxic heavy metal. The EIS based response of the potentiostat system revealed a very high sensitivity at pico molar (pM) concentration levels of HgS. This project is overseen by Dr. Massood Atashbar, ECE Professor.

l) Surface Enhanced Raman Spectroscopy (SERS) Based Optical Sensors
In this research, novel flexible surface enhanced Raman spectroscopy (SERS) substrates were successfully fabricated by inkjet and gravure printing a thin film of silver (Ag) nanoparticle ink, with 20~50 nm particle size, on a silicon (Si) wafer and flexible polyethyleneterephthalate (PET). The feasibility of the fabricated SERS
substrates for detecting toxic heavy metals such as mercury sulfide (HgS) and cadmium sulfide (CdS) were demonstrated. The SERS based response of the printed substrates produced an enhanced Raman signal when compared to target molecules adsorbed on bare PET. An enhancement factor of 5 orders of magnitude due to existence of hot spots between nanoparticles was obtained. This response demonstrated the feasibility of the novel SERS substrate to be used in applications for detection of toxic heavy metals. This project is overseen by Dr. Massood Atashbar, ECE Professor.

The research group within the laboratory led by Dr. Atashbar consisting of Binu Baby Narakathu, Sai Guruva Reddy Avuthu, Chi-Jung Cheng, Chen-Tung Feng, Douglas J. Downer, Akhil Moorthi and Ali Eshkeiti are investigating the potential capabilities of various sensors for applications in the medical, environmental and defense industries. Sai Guruva Reddy Avuthu successfully defended his thesis for Master of Science in Electrical Engineering in the Fall of 2011 titled “Development of Flexible Printed Sensors”. Douglas J. Downer successfully defended his thesis for Master of Science in Electrical Engineering in the Summer of 2011 titled “A Hand-Held Field-Portable Potentiostat System”. Chi-Jung Cheng has successfully completed his Ph.D. candidacy exam. Binu Baby Narakathu and Sai Guruva Reddy Avuthu are currently pursuing the Doctoral Degree in Electrical and Computer Engineering at Western Michigan University. Douglas J. Downer is currently working as Research Engineer at Bose® in Bloomfield Hills, Michigan. As a result of the research activities during the 2011-2012 academic year, 8 journal papers (Sensors and Actuators B: Chemical, Biosensors and Bioelectronics, IEEE Sensors Journal and the Journal of Sensor Letters) and 9 conference papers (Proceedings of the IEEE Sensors conference, Eurosensors, Asia-Pacific Conference on Transducers and Micro/Nano Technologies, Annual Flexible Electronics and Displays Conference, International Meeting on Chemical Sensors and IEEE International conference on Information Technology) were published. In 2011, Sai Guruva Reddy Avuthu presented the research work at the 10th Annual Flexible Electronics and Displays Conference in Phoenix, Arizona, USA (February 7-10). In 2011, Dr. Atashbar presented the research work at the 10th IEEE Sensors Conference in Limerick, Ireland (October 28-31 and at the 25th Eurosensors Conference in Athens, Greece (September 4-7).

Sunseeker Displayed at Chrysler Technology Center

The Sunseeker team visited the Chrysler Technology Center recently where the Sunseeker car was displayed at the tech center as well (pictured below). After 2 days the students were ready to go to work for the company because of the experience they had with engineers who gave them an extensive tour of the their latest technology, labs, and facilities. This real world research and extensive exposure to the expertise, problem solving, sharing answers to the team’s questions, and materials they received gave the Sunseeker team an educational experience that they won’t forget. They plan on using all the information they gained from their trip on the existing Sunseeker car and for the next generation Sunseeker vehicle. Brad Bazuin is one of the faculty advisors for the team. He will be participating with a number of ECE and other CEAS students in the 2012 Formula Sun Guard Prix (July 6-12) and American Solar Challenge (July 14-21) races. The ASC race will be passing through Kalamazoo and has a formal stage stop at CEAS on July 17th.
NASA’s Satellite Hunter: An iPhone Application for Understanding NASA’s Earth Observational Systems

Dean R. Johnson, Summer Faculty Fellow, 2011
Western Michigan University

Introduction
An application that will help people understand the various roles that NASA’s satellites have in monitoring vital signs of the Earth has been designed for the Apple iPhone. The app is called NASA’s Satellite Hunter (SH), and with this app the iPhone can be turned into a Geiger-counter like gun which may be pointed into space to hunt and capture the closest NASA Earth-observing satellite in the sight-of-view. SH was sponsored by the Office of Communications and Education at JPL.

Design
The earlier incomplete 2009 SH app design was given a new program flow, which included displaying captured satellites in a trophy case and providing users with silver, gold and platinum captured satellite status levels (see right). The 2009 artwork was also given a fresh look by the design firm MooreBoeck. Lead programmer Paul Doronila redesigned the Xcode software architecture, to incorporate a satellite and device manager that handled all satellite location updates and iPhone attitude angle changes. My responsibilities included rewriting my earlier capture sequence software to use a common East-North-Up (ENU) coordinate system, plus writing new software that would show the statistics of a satellite after it was captured.

Results
In beta-tests, SH captured several NASA Earth-borne satellites in real-time and displayed them with correct stats in the trophy case. I thank Michael Greene and Randal Jackson (Office of Communications and Education) plus Kevin Hussey (Manager, Visualization Technology Applications & Development) for providing this worthwhile project.
David Florida Receives 2 Awards

Congratulations to David Florida, ECE Lab Supervisor, on his receiving the Make a Difference Award for this Fall semester, he was presented with his award at the Make A Difference ceremony December 5th. This qualifies him for the annual award also, which is held at the end of the academic year.

David was also the recipient of CEAS 2011 Outstanding Staff Award. This award was presented at the all-hands meeting in September:

2012 Engineers Week Dinner and Scholarship Awards

Four CEAS students received scholarships at the Engineers Week dinner which was held at the Fetzer Center recently. The 2012 recipients were Mitchell Zajac who is studying mechanical engineering, Kelly McCarthy who is studying graphic and printing science, Shannon Kloha who is studying electrical engineering, and Lindsay Fisher who is studying pre-chemical engineering. These students are all juniors at CEAS.

L-R: Mitchell Zajac, Kelly McCarthy, Shannon Kloha, and Lindsay Fisher.

ACTIVE IEEE STUDENT CHAPTER