2011

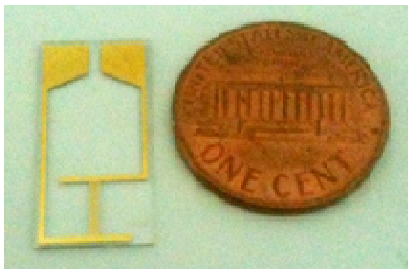
2010/11 Research, Development, and Activities

College of Engineering and Applied Sciences

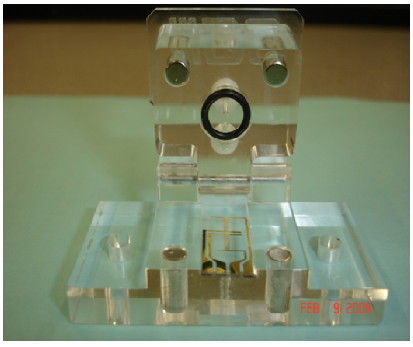
ECE DEPARTMENT
2010/11 RESEARCH, DEVELOPMENT, AND ACTIVITIES

Center for Advanced 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 bio/chemical products is of utmost importance. The complexity of interfacing a bio/chemical 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 bio/chemical sensors such as high sensitivity and high selectivity along with low detection limits are extremely promising for bio/chemical 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

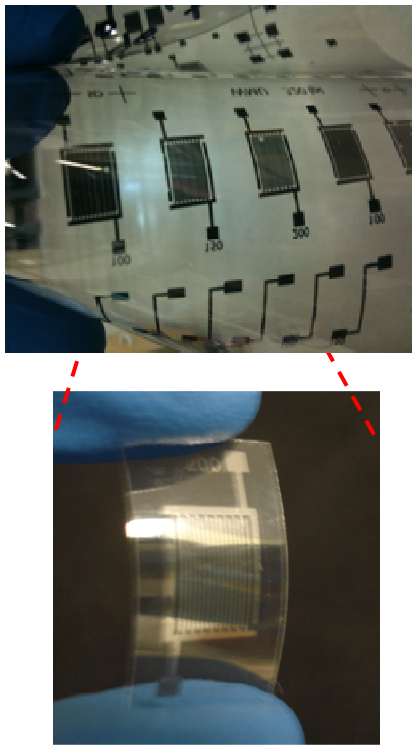


b

(a) Photolithographically fabricated bio/chemical sensor (b) Flow cell.

a) Impedance Based Electrochemical Bio/Chemical Sensor

An efficient electrochemical biosensor for the detection of various chemical and biological species was successfully fabricated by incorporating Gold (Au) Interdigitated Electrodes (IDT), 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 micro fluidic 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 .



Printed Electrochemical Bio/Chemical Sensors

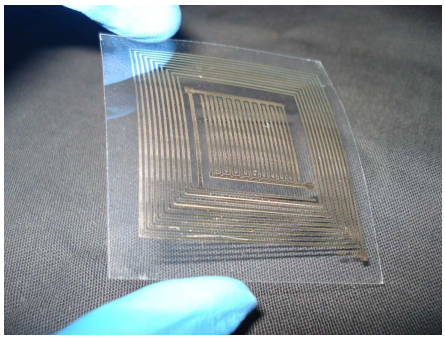
b) Printed Electrochemical Bio/Chemical Sensors on Flexible Substrates

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 Poly Ethylene Terephthalate (PET) substrates. An efficient electrochemical biosensor was successfully printed on a flexible Poly Ethylene Terephthalate (PET) substrate film using Silver (Ag) nanoparticle based ink. The Electrochemical Impedance Spectroscopy (EIS) response of the printed sensor for

detecting low concentrations of bio/chemical species revealed a very high sensitivity at pico molar (pM) concentration levels of Potassium Chloride (KCL), Lead Sulphide (PbS), Mercury Sulphide (HgS), Cadmium Sulphide (CdS), Sarcosine and D - Proline. Fabricating arrays of Organic Thin Film Transistor (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 and **Margaret Joyce**, PCI .

c) Printed Wireless Humidity Sensors On Flexible Substrates

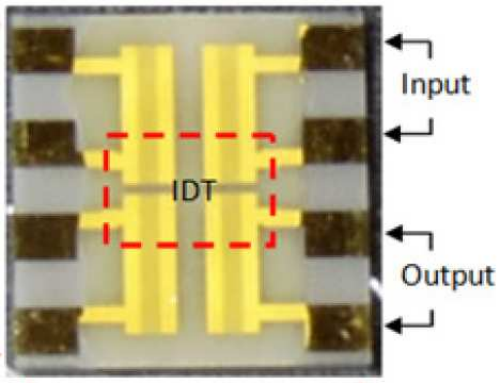
In this research work, a wireless humidity sensor was inkjet printed on a flexible Poly Ethylene Terephthalate (PET) substrate film using Silver (Ag) nanoparticle based ink. The printed sensor consisited of an interdigitated capacitor (IDC) and an inductive coil pair in planar form. The IDC of the LC 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 and **Margaret Joyce**, PCI .



Printed Wireless Humidity Sensors

d) Guided Shear Horizontal Surface Acoustic Wave (SAW) Sensor

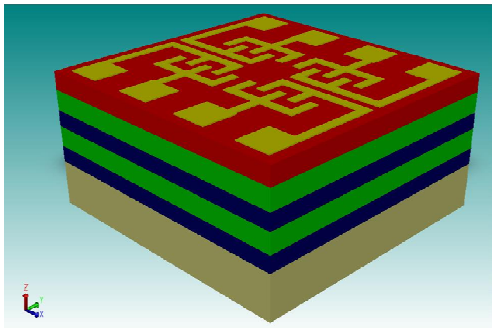
In this project a portable, rapid detection 64° YX $LiNbO_3$ SAW transducer was fabricated. Aluminum Nitride (AlN) layer was then deposited on the active area as acoustic wave guiding layer with 10 µm electrode width and spacing. Acrylic material was used to fabricate a flow cell with a 3 µl reservoir 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 .



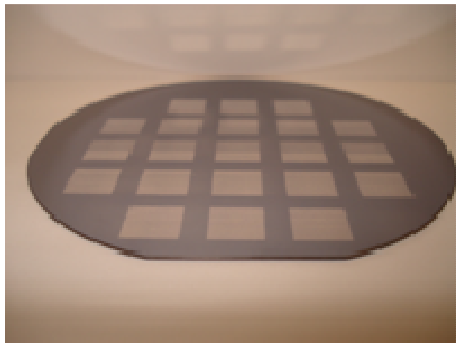
Guided Shear Horizontal Surface Acoustic Wave (SAW) Sensor

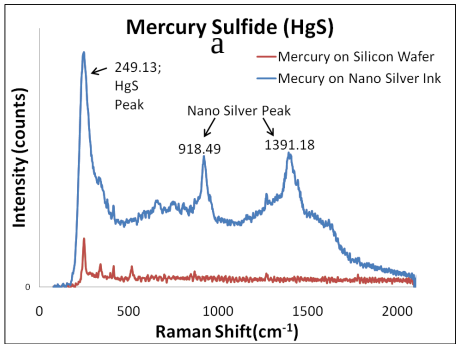
e) Solidly Mounted Thin Film Bulk Acoustic Resonator (SMFBAR)

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 .



Solidly Mounted Thin Film Bulk Acoustic Resonator (SMFBAR)





(a) Inkjet printed silver nanoparticle on silicon substrate (b) Comparison of the Raman spectrum of mercury sulfide on the silver coated surface vs. mercury sulfide on bare silicon substrate.

f)Surface Enhanced Raman Spectroscopy (SERS) Based Optical Sensors

An efficient Surface Enhanced Raman Spectroscopy (SERS) sensor was successfully fabricated on a silicon (Si) wafer using an inkjet printed thin film

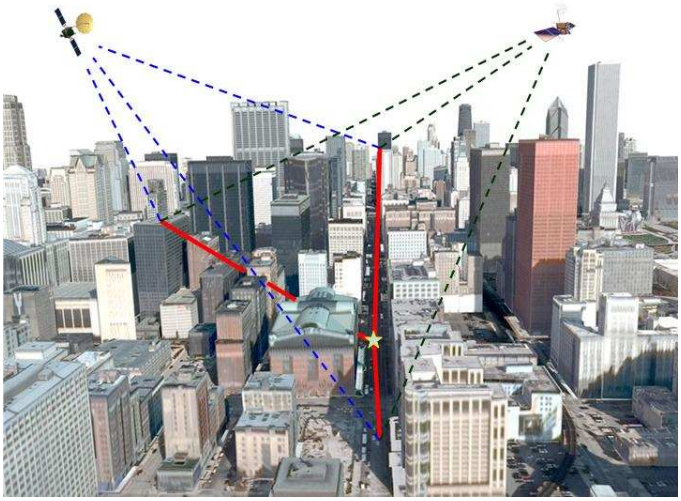
of silver (Ag) nanoparticle ink with 150 nm particle size. The feasibility of the fabricated SERS sensor for detecting toxic heavy metals such as mercury sulfide (HgS) and cadmium sulfide (CdS) was demonstrated. The SERS based response of the printed sensor produced an enhanced Raman signal when compared to target molecules adsorbed on bare Si wafer. The sensor response demonstrated the feasibility of the novel SERS sensor to be used in applications for the detection of an expanded array of bio/chemical species. This project is overseen by Dr. **Massood Atashbar**, ECE .

g) **FlexTech Printed Electronics Material Registry, this project is funded by Department of Army** and objectives of this research is to gather, validate, archive, organize and disseminate information on functional electronic materials (inks, pastes, substrates, barrier materials, etc.) and the associated manufacturing processes for which they are designed. The Materials Registry is being designed to assist scientists and engineers in the flexible and printed organic electronics (FPOE) industry. This will provide an accurate registry of technical information on the commercially available as well as developmental materials, inks, and substrates necessary to accelerate product and process development activities. In addition, information will be included with respect to how these materials may be utilized with the various manufacturing processes commonly being used for FPOE. This project is overseen by Drs. **Massood Atashbar**, ECE and **Erika Rebrosova** PCI.

A 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. **Binu Baby Narakathu** successfully defended his thesis for Master of Science in Computer Engineering in the Fall of 2009 entitled "Impedance Based Electrochemical Biosensor". As a result of the research activities, 7 journal papers (*Sensors and Actuators B: Chemical*, *Biosensors and Bioelectronics* and the *Journal of Sensor Letters*) and 13 conference papers (*Proceedings of the IEEE Sensors conference, Annual Flexible Electronics and Displays Conference, International Meeting on Chemical Sensors and IEEE International conference on Information Technology*) were published. In 2009, **Binu Baby Narakathu** and **Chi-Jung Cheng** presented the research work at the 8th IEEE Sensors Conference in Christchurch, New Zealand (October 25-28).In 2009, **Chi-Jung Cheng** presented the research work at the 6th IEEE International conference on Information Technology in Windsor, Ontario, Canada (June 7-9). In 2010, **Binu Baby Narakathu, Sai Guruva Reddy Avuthu** and **Chi-Jung Cheng** presented the research work at the 9th IEEE Sensors Conference in Hawaii, USA (November 1-4).In 2010, **Chen-Tung Feng** presented the research work at the 13th International Meeting on Chemical Sensors in Perth, Australia (July 11-14).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).

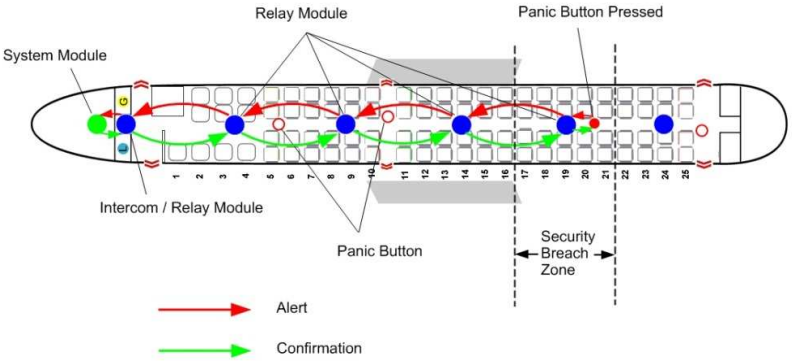
Vehicular Ad Hoc Network Augmenting GPS Systems -Smart vehicle involves a variety of technologies ranging from basic automotive engineering to vehicle navigation. GPS have been widely applied for identifying vehicle positions. However, large positioning errors may occur when the system is used in urban canyon environments, where tall buildings occlude satellite signals as well as reflecting them. There have been some efforts to improve the positioning accuracy: (1) using inertial navigation system (INS) to fill the gaps when GPS signals are temporarily interrupted; (2) using terrestrial television broadcasting or cellular signals for positioning in downtown areas; and (3) reducing the required minimum number of "visible" satellites by modeling the vehicle path in downtown areas and adding this information as a constraint. These possible solutions have their limitations due to cost and other implementation issues.

Future smart vehicle systems rely on vehicle-to-vehicle and vehicle-to-roadside-infrastructure communications. The vehicular ad hoc network (VANET) consists of the vehicles as mobile nodes and the roadside elements as anchor/reference nodes. This research aims at the development of a VANET that can be incorporated with the GPS to provide reliable navigation services for vehicles in urban canyons. Using pair-wise measurements among neighboring vehicles, the VANET system can generate relative position information of multiple vehicles. This relative map can be incorporated with accurate GPS information provided by, for example, GPS receivers on vehicles at the edge of the downtown area who have good GPS reception, or a few GPS repeaters that are installed on buildings at major intersections of the downtown area. (**Liang Dong**)



In-Flight Discreet Wireless Communication System - A basic necessity onboard a passenger aircraft is the ability to communicate quickly, efficiently and clearly between the cabin and flightdeck crew. With pilots safely barricaded behind their reinforced flightdeck doors, it is crucial that a reliable and clear communication tool be provided for the aircraft crew to communicate with one another in an emergency. Currently, the only tool available for intra crew communication is the interphone, with no existing communication tool to include Federal Air Marshalls (FAMS), or other law enforcement agencies. The failed bombing attempt of Northwest Airlines Flight 253 on December 25, 2009 raised questions of gaps which impeded communications between the cabin and flightdeck. The US Federal Aviation Administration (FAA) indicated that the pilots of Flight 253 were not alerted that a passenger had tried to ignite a bomb. The International Transport Workers' Federation (ITF) recommends that airline operators equip cabin crewmembers with discreet, secure, hands-free wireless communications devices. Such devices would enhance communications between cabin and flightdeck crewmembers, available law enforcement personnel including FAMS, and ground-based support staff.

This research collaborates with the College of Aviation



at Western Michigan University to develop an in-flight discreet wireless communication system. It allows all crewmembers to carry on their person the ability to communicate from anywhere in the aircraft at any time under any circumstance. The cabin crew can discreetly notify the flight crew in the event of suspicious activity or security breaches in the cabin. The wireless device has dedicated hardware to prevent jamming or tempering. When activated, it sends an alarm signal to the cockpit, effectively warning them of trouble, and the expectation of escalation of that trouble to the cockpit. The signal also tells the cockpit where in the aircraft the alarm was triggered, and therefore an indication of the time, which may be available to them to undertake appropriate actions before attempts at intrusions to the cockpit. The system provides a means of voice communication between the cabin crew and pilot at the cockpit door, and combined with the use of the door peephole provides the pilots with a good means of monitoring if anyone wishing entry to the cockpit is under stress and possible coercion. The system will be aircraft specific, extremely secure, and has designed-in safeguards against inadvertent activation. (**Liang Dong**)

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 solders' maintenance burden. Within this research our team is to develop an intelligent vehicle health management system for light tactical vehicles. Our focus is on the engine and the axles. We will also develop a secure vehicle identification method through RFID technology. The front-end of our vehicle health management system will have the following elements: data acquisition, data manipulation, condition monitoring, and health assessment (diagnostics).

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. ECE faculty involved in this project are **Janos Grantner**, CoPI; **Bradley Bazuin** and **Liang Dong**. Richard Hathaway and Claudia Fajardo, of the MAE Dept., are 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.

Nonlinear Circuits and Systems Laboratory - Under the direction of **Dr. Miller**, this laboratory continues to explore circuit implementations of chaotic systems. Undergraduate student David Kirklewski is continuing his work on the design of a discrete time chaotic circuit, building on work by previous WMU students, including Donovan Squires. James Truszkowski is working in this lab even after his recent graduation. Research in this laboratory is conducted in collaboration with Dr. Giuseppe Grassi of the University of Salento and **Drs. Bazuin and Severance**.

David Kirklewski in the Nonlinear Circuits and Systems Laboratory

Neurobiology Engineering Laboratory

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. The laboratory utilizes the theory and practice of electrical engineering, computer engineering, and computer science coupled with mathematics in its work. The lab has benefited from close collaboration with Dr. Melinda Koelling in Mathematics and Drs. John Jellies, Cindy Linn, and John Spitsbergen of Biological Sciences. The laboratory had its first journal paper entitled "Exploring Optimal Current Stimuli that Provide Membrane Voltage Tracking in a Neuron Model" to appear in *Biological Cybernetics* accepted for publication in March 2011. That paper was authored by Ph.D. student Mike Ellinger, Dr. Koelling, **Dr. Miller, Dr. Severance**, and Ph.D. student John Stahl.

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. Graduate students Donovan Squires and Kyle Batzer are developing a neuron stimulator based on work by a senior design group that included Kyle and recent graduates Richard Corsi and Edward Crampton. That senior design group also built on the work of previous senior design groups to produce a working amplifier capable of measuring the small voltages encountered in neuron studies. John Stahl has extensively studied the noise performance of that amplifier and will develop a miniaturized version of this circuit to support fifteen independent measurement channels. Both John and Kyle are supported by the NASA Michigan Space Grant Consortium. Kyle recently completed an internship at NASA Glenn Research Center. Bryan Berger, Stephen Goviea, and Leonard Morgan are building a data acquisition system as an interface to this instrumentation as a senior design project. **Dr. Miller** developed a circuit to support the research of Sr. John-Mary Vianney (Biological Sciences) based on a published design.

Dr. Miller and Sr. John-Mary Vianney in the Neurobiology Engineering Laboratory

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 and John Stahl and with the help of Sr. Vianney (Biological Sciences), undergraduate students Jolica Dias, Stephen Goveia, Shannon Kloha, and Matt Wolfe are learning to culture cells. Stephen and Shannon were each awarded a WMU Seibert Undergraduate Research and Creative Activities Award to research methods of improving the effectiveness of cell culture techniques.

John Stahl, Shannon Kloha, and Stephen Goveia in the Neurobiology Engineering Laboratory

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 Kristy Bellmer, Wei Chiu, Hannah Davis, Carlee McClintic, and Andy Peruski. 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. Damon Miller** (Chief Advisor), and Dr. Bob White (industrial and manufacturing engineering).

Fall 2010 Tau Beta Pi Initiation Ceremony Initiates and Participants

Stem Funding - The College of Engineering and Applied Sciences (CEAS) received an award from National Science Foundation (NSF) – Scholarships in Science, Technology, Engineering, and mathematics (S-STEM) program in the amount of $600,000. This award supports the College's efforts in enhancing retention and graduation rates of academically talented and financially needy CEAS students, and in preparing them to successfully have careers in the engineering and applied sciences fields. Financially needy students have to work to support their academic pursuit, thus reducing the time available for study or professional development. The NSF S-STEM scholarships will fund 8 first-time, first-year students in in the amount of $6,000 per year. The principal investigators (Drs. Andrew Kline, **Ikhlas Abdel-Qader**, Betsy Aller, and Edmund Tsang) work closely with the scholars to support them academically and professionally.

Student Success - CEAS received around $2,000,000 to support the College's activities in creating an effective academic and student affairs collaboration framework to enhance student success in Engineering and Applied Sciences. CEAS recognizes that the cognitive and affective development of students are intertwined and that students spend a significant amount of time outside of the classroom. CEAS and Division of Student Affairs (DOSA) together are collaborating to develop students' academic habits and skills along with their life skills through the Engineering House (EH) and Special Housing Options (SHO), building a sense of connection (connect with fellow students, faculty, CEAS, and WMU) necessary for success in CEAS. Project principal investigators are Drs. Edmund Tsang, Paul Engelmann, **Ikhlas Abdel-Qader** from CEAS, and Dr. Diane Anderson and Ms. Laura Darrah from DOSA.

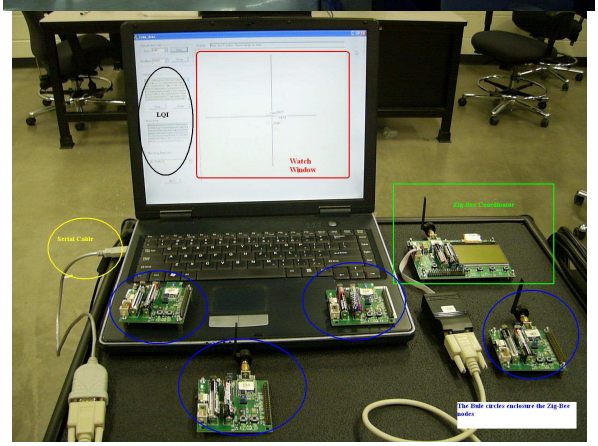
Radio-Frequency Energy Harvesting for Microelectronics -A pervasive "Internet of Things" is quickly spreading, owing to the versatility that wireless sensor networks afford, coupled with the availability of low-cost integrated circuits to perform the sensing, signal processing, communication, and data collection functions. One drawback to moving toward a practical installation is the poor reliability and limited useful life of batteries needed to supply the energy to the untethered sensor nodes. The batteries require intermittent replacement, necessitating ongoing battery monitoring and maintenance. Battery changing is often an expensive proposition. This limitation has to some extent curtailed the proliferation of the Internet of Things.

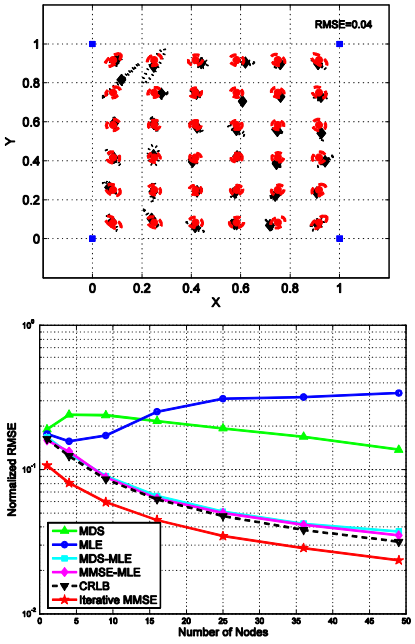
This research develops radio-frequency energy harvesting technique that can alleviate the dependence on batteries for microelectronics systems. As the technologies of low-power sensor, processors and radio-transceivers mature, micropower (power measured in milliwatts or microwatts) energy harvesting plays an important role in implementations of the Internet of Things, and in effect may enable perpetual sensors. There are researches on energy harvesting transducers including photovoltaic cells that convert solar light energy, thermoelectric devices that convert thermal energy (temperature differential), and piezoelectric devices that convert vibration energy (mechanical movements). However, little research is devoted to RF energy harvesting that converts electromagnetic energy to electrical energy. The ambient RF sources can be radio, television and mobile base station transmitters, wireless networks, cell phones, and mobile radio devices. Our research develops microelectronics systems with radio-frequency energy harvesting capability for ubiquitous and perpetual wireless sensor networks. This work is supported by the Faculty Scholars Award of Western Michigan University. (**Liang Dong**)

Neural Network Algorithms for Power Electronics-Based Active Filters on Power Transmission Systems-The main object is to develop neural network algorithms to improve the control of active power and reactive power flow in power transmission systems. Instantaneous active and reactive power theory ("*p-q* Theory") has been applied in controller of compensators that are generally used as active power line conditioners. Most problems on power transmission systems are related to nonlinear loads, harmonics, and voltage distortions which show up in the reactive power. Reactive power control and minimization improve power factor, voltage regulation, and stability. Eyad Almaita, PhD student under **Johnson Asumadu**, ECE Professor supervision is working on this.

Location- and Mobility-Aware Wireless Ad Hoc Networks - Wireless local area networks are connecting home computers and provide access in cooperate and public hotspots. Yet we are expecting wireless ad hoc networks to connect a myriad of terminals that range from small sensors, large appliances, to huge machinery and vehicles in the near future. An "Internet of Things" will emerge and eventually connect seamlessly with the "Internet of People". Compared with human users, the end terminals in the internet-of-things are required to reveal more complete physical information, such as locations and movements, in order to achieve better networking and data processing and provide meaningful monitoring and control.

This research is to develop location- and mobility-aware wireless ad hoc networks from a practical perspective. Toward this goal, there are four research objectives: (1) Develop antennas and hybrid positioning scheme for cooperative localization and tracking of wireless ad hoc networks in complex channels; (2) Develop distributed extended Kalman filter algorithm and distributed convex optimization for cooperative localization and tracking; (3) Establish a new framework for cross-layer design of location- and mobility-aware wireless ad hoc networks; and (4) Implement the location- and mobility-aware wireless ad hoc network and evaluate the system performance in real scenarios. The research results will be distributed algorithms for localization and tracking of large-scale ad hoc networks, a theoretical framework of communication architecture across physical, medium access control, and network layers, and a prototype of the practical location- and mobility-aware wireless ad hoc network. (**Liang Dong**)





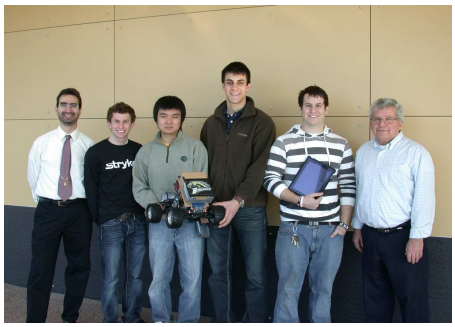
Kalman Filtering-Based Active Power Filters for Power Transmission Systems-The main object is to develop algorithms based on Kalman Filtering algorithms to improve the control of active power and reactive power flow in power transmission systems. Most problems on power transmission systems are related to nonlinear loads, harmonics, and voltage distortions which show up in the reactive power. Reactive power control and minimization improve power factor, voltage regulation, and stability. Hisham Alshawawreh, PhD student under **Johnson Asumadu**, ECE Professor supervision is working on this.

Smart Grid-The main objective is to design and implement smart active distributed measurement architecture for sensing and monitoring, with greater accuracy and in real-time, grid apparatus to ensure reliability of the grid operations, to provide self-healing (re-calibration of apparatus parameters and properties ….), and to manage and control information coming from the grid apparatus and electrical quantities. The proposed intelligent monitoring, sensing, analysis, data management system (DMS) that can anticipate contingencies and prevent grid failures with very high likelihood of success, and "optimally manage of distributed resource." Ahmad Alshawawreh, PhD student under **Johnson Asumadu**, ECE Professor supervision is working on this.

Judith (Judy) Seymour – Judy took the position of Office Associate for the ECE Department office in December. She brings an extensive knowledge of the community and is a wonderful addition to the department. Please join us in welcoming Judy.

CEAS Students Win Stryker Challenge!

Congratulations to the engineering team that won the first annual Stryker challenge. They include: ECE student **Wei Chiu**, MAE students Luke Burley, Kevin Thompson and, Colin Haire. Their faculty adviser is **Dr. Damon Miller** and Professor Fred Sitkins is their team organizer. The CEAS team coming in at first place beat the University of Michigan, Michigan State, Notre Dame and, Purdue University. Each team had to construct a vehicle and run it on a timed course. WMU performed flawlessly achieving the best time. Stryker Corporation used this event to narrow down the field of engineering schools that it will be recruiting from. This will be an annual event with a different competition each year. (Pictured left to right Dr. Miller, Colin Haire, Wei Chiu, Luke Burkey, Kevin Thompson, and Fred Sitkins)



Frank Severance Retired: Frank retired in June after being with our department for 26 years. Frank's major academic interest is in control systems where he specialized in nonlinear stochastic optimal control. He was a co-founder (with {Professor Fred Sitkins) of the American Institute for Motion Engineering (AIME) where he taught a number of controls courses to industrial clients. He has published one text book – System Modeling and Simulation (John Wiley & Sons) and is the author of numerous professional papers, primarily in nonlinear engineering mathematics. Most recently, Frank is the co-director (with Dr. Damon Miller) of the Neurobiology Engineering Laboratory housed in the engineering building on WMU's Parkview campus. He is also one of the initial directors of the Michigan Space Grant Consortium (MSGC), of which Western Michigan University is an affiliate member.

Upon retirement, Frank has decided to follow his more academic interests in mathematics. That is to say, he is currently enrolled in the Ph.D. program in mathematics here at WMU. He maintains his research lab responsibilities and continues his work with the MSGC as a founding board member. He is also active with the American Association for the Advancement of Science, where he holds a research affiliation. He expects to continue living the in Kalamazoo area with his wife Sandie.

WMU IEEE Student Branch- Faculty advisor Johnson Asumadu and students have been active throughout 2010-2011 academic year. Students enhanced study experience and research knowledge by attending seminar presentations hosted by the WMU Student Chapter of IEEE. Seminars included presentations by PhD candidate Mike Ellinger on "EE Opportunities on Neurobiology" and PhD candidate Vincent Krause on "Ground Penetrating Radar for Nondestructive Testing". IEEE welcomed guest speakers such as SSgt Ryan Ballard of the U.S Air Force to discuss, Scholarships, Career Opportunities and Co-Op Internships available, Abdullah Marta, Cummins Inc. "Working for a High Tech Company" and Kim DeVries and Chris Sell from WMU/CEAS Advising Office to talk about "Preparing for Graduation and Beyond", just to name a few. Membership drives and rummage sales were also held throughout the year to raise for the IEEE Student Branch.

Pictured Dr. Johnson Asumadu, FacultyAdvisor; John Gesink, Chair ECE, Abdullah Marta, Guest Speaker; and Joseph Kelemen, Emerti ECE Faculty,

Kappa Omega Chapter of ETA KAPPA NU is renewing itself under the new leadership. The honor society of Electrical and Computer Engineers recently joined IEEE professional society. This past fall the WMU chapter inducted 35 new members. The 2011 officers are, *front row*: John Veenkant, Corresponding Secretary; Akliseya Nahusenaye, Recording Secretary *back row*: Brian Miars, Treasurer; Wei Jian Chiu, President; Erik Boettcher, Vice President and Liang Dong, Faculty Advisor.

Earth Today iPhone Application for JPL's Earth Sciences Directorate

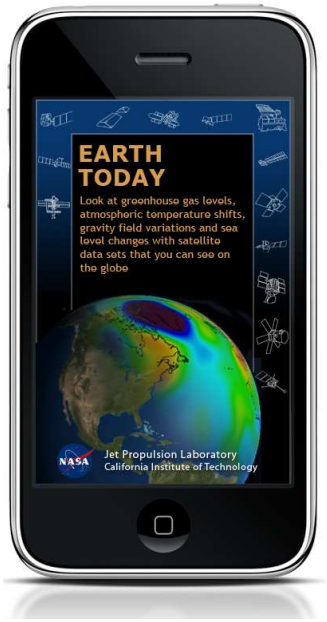
Dean R. Johnson, Summer Faculty Fellow, 2010
Western Michigan University
Visualization Technology Applications and Development

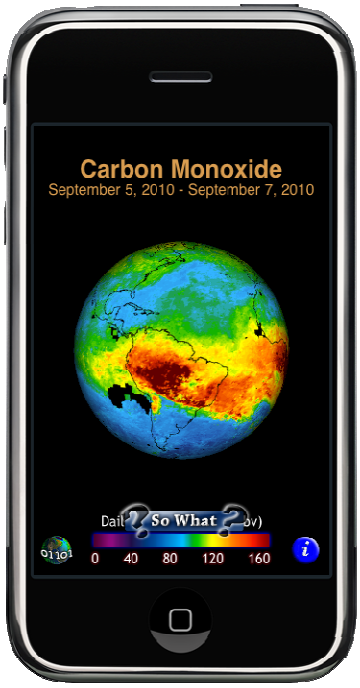
Introducton

An application that will help people visualize important physical and environmental characteristics of the Earth has been designed for the Apple iPhone. The app is called *Earth Today (ET)*, and is capable of displaying such important satellite–derived data sets as air temperatures, Ozone/CO/CO_2 levels and gravity fields on a 3D model of the Earth. The app is sponsored by JPL's Earth Sciences Directorate and should be a useful tool to help demonstrate results of climatic change to the general public.

Design

Approximately 10 pieces of art were designed to storyboard the *ET* app sequence of events, which included a splash page (see below), various datasets (see right) and an information page. Much of the artwork that was be utilized in this project was developed as a variation of last year's iPhone application, and utilized Photoshop templates provided by the design firm teehan+lax. The software design attempted to mix traditional UIKit Xcode with OpenGL code from a SiO2 game engine that was employed in this project. C++ code was added to the game engine's template routine to rotate or scale a 3D Earth model using finger touches on the iPhone screen. Most of this was done by my student Kris Clark. After this, a user interface consisting of 2 buttons (designed by Clark) was written in Xcode that provided the capability of bringing up a dataset menu or an information page that would transition over the 3D interface. Much of this software development, including linkages to JPL servers by which various data sets could be textured over the earth 3D model, were performed by JPL's Paul Doronila. A final feature, involving popping up relevancy statements whenever a "So What" button was pushed over the dataset legend, (see above) was added in the last 2 weeks of development.





Results

ET was implemented and successfully downloaded and displayed various datasets, information and "So What?" statements. Informational items were collected over a period of several weeks from Earth Science contacts Sharon Ray, Margaret Srinivasan and Karen Yuen. We thank Jason Hyon (Chief Technologist, Earth Sciences Directorate) and Kevin Hussey (Manager, Visualization Technology Applications & Development) for this worthwhile project.