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A Word from the Department Chair

Welcome to the 2013-2014 academic year newsletter of the Department of Electrical and Computer Engineering at Western Michigan University. It has been a great year for us, and I’m very happy to be able to share some of the top highlights with you. In particular, we were very fortunate to welcome two new assistant professors in January, Lina Sawalha and Fahad Saeed, both in the Computer Engineering area. We also hired a new lab coordinator, Bob Makin, who joins David Florida in running the department’s many lab facilities. Bob comes to us having recently completed his master’s degree in physics from the University at Buffalo, and has considerable expertise in embedded microcontrollers, electronics, and programming.

In this issue, you will also read about an exciting new company venture started by several of our doctoral students, recent upgrades to several teaching laboratories, a new outreach initiative called the Raspberry Pi Club, as well as a number of other stories about recent activities of our undergraduate and graduate students’ (as well as faculty) — including Sunseeker, WMU’s famous solar powered vehicle.

As always, if you’re a former student, we’re always very glad to hear from you.: simply send email to

steven.durbin@wmich.edu

You can find other highlights and updates on our website:

www.wmich.edu/ece

Steven M. Durbin, Ph.D. is Professor and Chair of the Department of Electrical and Computer Engineering at Western Michigan University. He joined WMU in July 2013, having previously taught at the University at Buffalo (SUNY), the University of Canterbury (New Zealand), and Florida State University. His research interests include novel semiconductor materials, molecular beam epitaxy thin film growth, and optoelectronic devices.
Lina Sawalha is an assistant professor in the Department of Electrical and Computer Engineering at Western Michigan University. She also holds an adjunct assistant professor position in the Computer Science Department at WMU. She received her MS and PhD degrees in Electrical & Computer Engineering from the University of Oklahoma in 2009 and 2012 respectively, and her BS degree in Computer Engineering from Jordan University of Science and Technology in 2006. Her research interests include computer architecture, parallel architectures, microarchitecture, hardware/software co-design, high performance computing, energy efficient computing and 3D displays. She is currently investigating new and novel solutions to the daunting challenges introduced by the move to heterogeneous multi-/many core processors (HMPs), and providing users/programmers with transparent solutions to the problems of HMP design and scheduling.

Dr. Sawalha is the founder and director of the Computer Architecture and Systems Laboratory at Western Michigan University. She served as a committee member for IEEE International Conference on Computer Design 2013, the First International Workshop on Hardware-Software Co-design for High Performance Computing (Co-HPC) associated with SC 2014, and the 4th annual conference XSEDE 2015. She also served as a reviewer for several journals and conference proceedings in computer architecture, high-performance computing, and 3D displays. She is a member of IEEE, IEEE Computer Society, ACM, ACM SigArch, Eta Kappa Nu, Golden Key International Honour Society, Technical Committee on Computer Architecture (TCCA), and Women in Computer Architecture (WiCArch).

You can find out more about Dr Sawalha on her website:

https://www.wmich.edu/ece/directory/faculty/sawalha.html
Dr. Saeed holds a joint position between the Department of Computer Science and the Department of Electrical and Computer Engineering. Prior to joining WMU in January 2014, he was with the National Institutes of Health (NIH), where he was a Research Fellow from June 2011 to January 2014 and a Postdoctoral Fellow from Aug 2010 to June 2011. He received his Ph.D. in the Department of Electrical and Computer Engineering at the University of Illinois at Chicago (UIC) in 2010.

He has served as visiting scientist in the Department of Bio-Systems Science and Engineering (D-BSSE), ETH Zürich and Swiss Institute of Bioinformatics (SIB), and was the recipient of ThinkSwiss Fellowship by the government of Switzerland. He was nominated for the best dissertation award at the University of Illinois in the year 2010. Due to his exceptional research performance at the National Institutes of Health (NIH) he was awarded the Fellows Award for Research Excellence (FARE).

Dr. Saeed has served as the program co-chair of the Bioinformatics and Computational Biology conference (BICOB) and IEEE International Conference on Bioinformatics and Biomedicine (BIBM). He has also served as a program committee member for IEEE HI-BI-BI, IEEE/ACM IPDPS, ACM-BCB and BIOKDD. He has been named as an associate editor for Springer Journal of Network Modeling Analysis in Health Informatics and Bioinformatics in 2014.

His research interests include parallel and distributed algorithms & architectures, computational biology and big-data analytics. Dr. Saeed is a member of IEEE and ACM.

You can learn more about him by visiting his website: http://www.saeedfahad.com/
Exploring the Intersection of Biology and ECE

A WMU College of Arts and Sciences Interdisciplinary Research Initiative Award is supporting work to apply an optimal control technique pioneered by members of the Neurobiology Engineering Laboratory to biological neurons. This project is a joint effort between Biological Sciences (Drs. Jellies and Linn), Mathematics (Dr. Koelling), and Electrical and Computer Engineering (Dr. Miller and Michael Ellinger). Neurons use voltages developed across their cell membranes to encode and process information and to communicate with target tissue. The technique allows researchers to find reduced energy current stimuli that force neurons to produce a desired membrane voltage. Recent papers by Drs. Koelling, Miller, Severance, and doctoral students Michael Ellinger and John Stahl have successfully demonstrated the effectiveness of this method in simulation of conductance-based neuron models. Current work is focused on demonstrating the feasibility of applying this technique to biological neurons. A poster presented at the Annual Meeting of the Michigan Chapter of the Society for Neuroscience demonstrated the functionality of a custom-built electrophysiology rig to support this research. A paper by doctoral student Jason Anyalebechi and Drs. Koelling and Miller extending this technique to neuron phase models has been accepted by the 2014 IEEE Engineering in Medicine and Biology Society conference.

Neurobiology Engineering Laboratory members Jason Anyalebechi, John Stahl, Dr. Frank Severance, Alexandra Ferguson, Dr. Melinda Koelling, Michael Ellinger, and Dr. Damon Miller.
Lab Upgrades

Electronics and Circuits Labs

Both the circuit and electronics labs are being revamped this summer for the upcoming academic year. Before, students were using oscilloscopes to capture waveforms, printing them locally and then attaching them to their reports. There was no capability to interface the oscilloscope to the computer. With the new equipment purchased, that is no longer the case. Both B-215 and B-216 have new PCs operating on Windows 8.1 and running one of the latest editions of LabVIEW software from National Instruments (NI). In addition, a USB data acquisition card allows the user to interface with not only the oscilloscope but other electronic sensors and equipment. By providing these new tools, the curriculum will now be able to include data acquisition topics in these entry level classes (ECE 2100, 2210, 3200) such as sampling rate and resolution. The students will also gain experience using LabVIEW, a software package for interfacing with electronic instruments.

Microcontroller Laboratory

Following a recent relocation to B210, this lab has been extensively renovated to include larger benches and double the number of stations. New test equipment includes programmable triple output DC supplies and Agilent MSOX3034A mixed signal oscilloscopes. The oscilloscopes feature 350 MHz bandwidth, 4+16 channels, built-in 20 MHz arbitrary function generators, decoding for CAN/LIN & SPI/I2C protocols and on-screen voltmeter display. Instructional systems are the Digilent Nexys and ST Microelectronics STM32F4 Discovery development boards. The latter is based on the Arm® Cortex®-M4 core. So far, the new facility has proven extremely popular with our students, and with swipe-card access, is frequently used after hours for a variety of projects.
New Initiatives

Raspberry Pi Club

The Raspberry Pi, show below, is a Linux-based, credit-card / cell-phone sized computer. It is capable of many tasks that a standard desktop PC can perform, such as word processing, spreadsheets and watching high definition videos. Additionally, it has a series of digital I/O ports which make it extremely useful in electronics projects.

The Raspberry Pi

The Raspberry Pi Club is a joint initiative of the Department of Electrical and Computer Engineering and the Department of Computer Science, and is designed to give undecided engineering majors some hands-on experience with concepts relevant to our degree programs—for free! Students will learn the basics of using, programming, and interfacing the Pi during free weekly meetings.

For more information about the Raspberry Pi Club, check out wmich.edu/ece/rpi/index

More information about the Raspberry Pi can be found at their official website,

Fun in the Sun Camp

This summer, the Department of Electrical and Computer Engineering hosted a new half-day summer camp designed to introduce middle school kids to solar cells and basic electrical circuits. Seven youngsters took part this summer.

Top: Graduate student Brian Durant instructs the Fun in the Sun campers on series circuit connection. Bottom right: what visit can’t include a stop by Sunseeker? Bottom left: WMU students help explain circuits and LEDs to middle school students.

Soft Circuits

When Mattawan Middle School life skills teacher Ann Pierluissi contacted us about a project involving electronics and sewing, we weren’t sure what to think! In reality, it turned out better than we had hoped, sewing circuits using conductive thread, and using LEDs and coin batteries to create a final product.
Student Highlight: Alexandra Ferguson

My name is Alex Ferguson, and I have been active in the CEAS since my first year here at WMU. I am a member of the Society of Women Engineers, serving as the Girl Scout Coordinator for the past year. I plan events for Girl Scouts in order to promote an interest in science and engineering in girls from a young age. For SWE, I attended the regional conference in Houghton to network and meet other female engineers, both students and professionals.

In my second year, I was a First Year Seminar Instructor, helping new CEAS students to adjust to the vigorous demands of the college engineering curriculum. I also became a research assistant in the Neurobiology Laboratory, working with Dr. Damon Miller. For that, I applied and was awarded a grant from the Michigan Space Grant Consortium Undergraduate Fellowship Program to research the optimal control of biological neurons.

Outside of WMU, I have had many interesting opportunities. In my first summer, I was an intern in the Facilities Services building of Ford Motor Company, in their Research and Engineering Center. I helped compile data to assess energy savings possibilities in the Dynamometer building. This summer I am working in a NSF funded program that provides research experience for undergraduates (REU) at the University of Colorado Boulder. I am involved in the Photoemission Spectroscopy Laboratory, where I am currently working on interfacing picomotors and LabVIEW to move the optical stage for the ultrafast lasers.

I have also recently applied to the Accelerated Master’s Program for Electrical Engineering. I know that this program will be very beneficial for me, adding only a year onto my time here, but allowing me to graduate with a master’s degree as well. At this point, I am unsure what my plans will be after I graduate. I may continue schooling and research, or I may look for opportunities in industry. I am very fortunate to attend WMU where the professors are very interested in me personally, and care about my growth and learning in engineering. By being involved, I have made many connections and made my experience at WMU and in the CEAS very enjoyable.
Students Create New Startup Company

SafeSense Technologies L.L.C. is a startup dedicated to the development of sensing systems using printed electronics. The team has been working towards developing a flexible sensor to detect and measure impacts received in the sports field. Once a player is hit, the information from the sensor will be sent to a smartphone based application that will use multiple variables to provide information used to determine whether or not an athletic trainer should check for a concussion. The smartphone application will provide a long-term and permanent record of past impacts and concussion assessments. The impact monitoring in helmets, using a printed impact sensor along with the free smartphone application, is our first use case of this platform technology, and our team plans to incorporate printed sensing technology for other applications in the future.

The main advantages of this system over competing systems are its flexibility/conformability, lightweight characteristics, and cost-effectiveness. The sensor system can conformably adhere to and completely cover almost any surface, creating a capability that no other product on the market provides. The ability to integrate the sensor around the entire helmet interior enables complete "point-of-impact" mapping of head trauma around the skull. Others can only report the magnitude of the force incurred to the helmet. Another benefit of the product is its ability to gather data from multiple devices and wirelessly send the data to a cloud based storage system, through the use of a smartphone based application. This would enable data access for researchers and physicians to better understand the different types of impacts that may cause a concussion. Further, this device can be produced at a much lower cost than current impact sensing devices due to the use of print manufacturing technologies.

The team (Binu Baby Narakathu, Sai Guruva Reddy Avuthu, Ali Eshkeiti and Michael Joyce) from the Electrical and Computer Engineering Department and the Chemical and Paper Engineering Department, led by Dr. Massood Atashbar and Dr. Margaret Joyce, from the Center for Advancement of Smart Sensing Structures (CASSS) and the Center for Advancement of Printed Electronics (CAPE) in the College of Engineering and Applied Sciences (CEAS), participated in the Michigan Collegiate Innovation Prize (MCIP) competition held on February 13th and 14th at the University of Michigan at Ann Arbor, Michigan. After competing with 300 other teams, through presentations of their work from both an engineering and business plausibility standpoint, they were selected as one of the top 8 final teams in the competition.
Senior Design Highlights

Miniature Golf with Automatic Scoring System

An automatic scoring miniature golf system was developed by a senior design project group over the past year. The purpose: simplify the computational scoring to eliminate creative scoring by players. The system works by using a piezoelectric sensor to detect club contact with the ball. This information is transmitted to a microcontroller attached to the club and then wirelessly communicated to the score board. Several small infrared motion sensors were attached to different parts of the course to detect where the ball went, whether it was in the “hole,” “sand trap”, or “water hazard.” The team enjoyed working on the project saying, “It allowed us to showcase what our education at WMU could do.” For a video demonstration, check out:

https://wmich.edu/ece/about/news/2014/mini_gulf_senior_design.html

Collision Avoidance on RC Blimp

In order to create a “hands-on” activity for prospective electrical and computer engineering students that show cases what our graduates are capable of, a senior design team designed, built (and flew) their own semi-automated helium blimp. The team developed a remote control using a microcontroller that reads in two user inputs from analog joysticks and sends them wirelessly to the flight vehicle. A separate microcontroller inside the blimp then receives the user input control and runs the motors. Six strategically placed ultrasonic sensors monitor the surroundings, and enable course adjustments using the motors to avoid collisions with the walls, floor and ceiling. Weight was a constant concern, leading to the students designing their own gondola, which was then created with a 3D printer. The vehicle flew well and did a commendable job of avoiding collisions at low speeds. It was noticed that as the vehicle’s speed increased, the larger momentum made it too difficult for the vehicle to change its heading in a reasonable amount of time. Future work for the project hopes to solve these issues.
Student Organizations

Tau Beta Pi

Tau Beta Pi is an engineering honor society founded at Lehigh University in 1885, and represents all engineering disciplines. The Michigan Kappa chapter is located at Western Michigan University. The members of Tau Beta Pi are marked by their excellence in their academic career and outstanding character.

For the 2013-2014 academic year Tau Beta Pi inducted in 36 new members. This year, Tau Beta Pi was involved with “Pi Day” (March 14th, or 3.14) by having a competition on who could name the most digits of Pi. The winning student received a t-shirt and $20 gift card (editors note: at least it wasn’t $3.14!).

Student members of the organization volunteered with the Engineering Expos, Senior Open House/Parkview Tours, Spring Blood Drive, and Science Olympiad regionals hosted at WMU over this past academic year.

Sunseeker

The WMU Sunrayce Project, now known as Sunseeker, began in 1990. Run by students with support from faculty, alumni and industry partners, they have competed in all 11 cross country solar racing events. This project allows students to apply their classroom skills in a real world setting, where they are responsible for designing, specifying, building and testing everything from the composite structure to the circuits that connect the solar cells to the motor.

The student organization has a long history of outreach activities in the local community. The group has participated in the Kalamazoo holiday parade this past year, and has one of their vehicles on display in the Kalamazoo Air Zoo. They have even journeyed all the way to the east side of Michigan to be part of the Woodward Dream Cruise this past August.

This summer, Sunseeker will be competing in the American Solar Challenge in the 1700+ mile journey from Austin, Texas to Minneapolis, Minnesota. For more information visit www.wmich.edu/sunseeker and follow them on Twitter @WMUSunSeeker
Student Highlight: Robert Galman

Cars and Circuitry are two things that I have really enjoyed. Coming to Western in the fall of 2010, my friend and I heard about the solar car project called Sunseeker. We both went to one of the early meetings that year, and ever since then I have been hooked. When I first started, there was a technical gap, but over time I learned from upperclassmen and from our faculty advisor Dr. Brad Bazuin and I am now the Electrical Team lead. There are a lot of beneficial skills developed as a part of Sunseeker that are not taught in the lecture classes, such as practical circuit design, using printed circuit board (PCB) software, cooling of electrical systems, vibrations, and current battery technology. Most important is learning how to work as a team and to communicate ideas to others. Communication between system leads is very important, as not everyone understands what exactly is going on in the individual system and learning how to simply explain the concepts to students who have limited experience becomes important in making designs. Compromising is involved a lot with our team’s design decisions, with our main goals making the vehicle the most efficient it can be.

Being a member of Sunseeker also has its other benefits outside of the technical aspects. This summer is the 2014 American Solar Challenge and we are going to race from Austin, TX to St. Paul, MN. This trip will be on the highways and the team is going to be camping along the way to save money for future cars.

I am also involved with the Computer Club at WMU, a group of students whose passion lies within computer technology, whether it is building and understanding the latest computer gadgets or writing software algorithms to make complex tasks easier. The students that I have worked with in this organization have a large knowledge and skill base that can help you with homework or projects that you may be working on.

Being a member of both Sunseeker and Computer Club, I have created strong bonds with fellow classmates that have resulted in new friendships and experiences, and a network of individuals that is helping me achieve the goals I set for myself.
Benjamin VanDyken, a graduate student in mechanical engineering, is working to complete the design of a modular printed circuit board to support experiments with discrete-time chaotic circuits. Even though such circuits are described by deterministic difference equations, their behavior rapidly becomes unpredictable, resulting in interesting and complex phenomena. Breadboard implementations of these circuits are prone to a number of problems; the developed printed circuit board will greatly improve the efficiency of experimental work.

Benjamin’s design has leveraged work and help from current and previous students, including David Kirklewski, Donovan Squires, and James Truszkowski. Ben was awarded an undergraduate research fellowship from the NASA Michigan Space Grant Consortium (MSGC) to support this project. He recently presented this work at its annual conference in Ann Arbor. The Nonlinear Circuits and Systems Laboratory, directed by Dr. Miller, continues to explore chaotic circuits in collaboration with Dr. Giuseppe Grassi of the University of Salento (Italy).

Printed circuit board developed by Benjamin VanDyken to support research in discrete-time chaotic circuits (left). Ben and Drs. Miller and Grassi at the 2013 NASA Michigan Space Grant Consortium Conference (right).
Recent Publications and Grants

Grants

Lina Sawalha
Title: “Towards effective multicore processing in automotive powertrain control systems”
Source: Ford Motor Company through Oakland University

Fahad Saeed
Sept 2012 – Aug 2014: US $200,000
Title: "High Performance Algorithms and Implementations for Biological Sequence Analysis and Genome Alignment"
Source: National Science Foundation
March 2014 – March 2015: US $5,499
Title: "High Performance Algorithms for Genome Alignments"
Source: NVIDIA
April 2014 – April 2015: US $16,000
Title: "High Performance Algorithms for Genome Alignments and Proteomics Analysis"
Source: Altera Corporation

Steve Durbin
Title: EAGER: Earth Abundant Element Nitride Semiconductors Based on ZnSnN₂
Source: National Science Foundation

Patents


Selected Recent Publications


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