

Students Get Charged Up about Battery Technology

Erik Adolfsson '11 and fellow ECE students present the results of their senior design project.



THIS PAST YEAR, the electrical and computer engineering department continued its ongoing work in sustainable energy technology. The senior design project focused on state-of-the-art battery technology, which is “a key aspect of today’s ‘green technology,’ such as wind and solar power generation, ‘smart grid’ power distribution, and electric vehicles,” explains **Chris Nadovich**, electrical & computer engineering lab director who served as one of the project’s faculty advisers.

Last year’s graduating seniors added an independent cell management capability to the Lafayette Photovoltaic Research and Development System (LPRDS). This new feature coordinates the charging and discharging of an array of Lithium Iron Phosphate (LiFePO₄) cells on an individual cell-by-cell basis. Control of individual cells maximizes battery capacity as it increases service life. The end result is a cheaper, better battery for energy storage and management.

“Basically, all batteries are different and they charge at different rates,” says

Erik Adolfsson ’11. “Some are fast, some are slow. We built a circuit to balance four cells so that they are all full of charge instead of some overcharging and some not charging enough.”

According to Nadovich, the project work involves a wide variety of multidisciplinary engineering design tasks. “System level requirements are not the only electrical design constraints, but mechanical, chemical, and thermal considerations as well. The students are conducting a wide range of analysis and design tasks, including multi-physics modeling, reliability and manufacturability studies, and regulatory determinations,” he says.

There was also significant collaboration with the chemical engineering department on this project. Chemical engineering graduate **Robert Lovelett ’11** and his thesis adviser **Javad Tavakoli**, professor of chemical engineering, worked in parallel to this project on the detailed chemical aspects of multi-physics LiFePO₄ cell modeling and analysis.

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JUNIORS KINECT ON VIDEO GAME DESIGN PROJECTS

As part of the junior level Solid State Electronics course taught by Todd Wey, assistant professor, students developed an interactive video game. Eight, two-student teams independently designed a game system that combined live video from a TV camera with a moving game object synthesized by the electronics. The electronic game “puck” can be controlled by body motions of the live players in the scene, much like the XBOX 360 Kinect. An interesting aspect of this project was that technical constraints prevented the use of digital computers in the design. Students engaged in active learning as they dreamt up schemes to implement their video game in non-traditional, creative ways.

STUDENTS PRESENT RESEARCH AT CONFERENCES AND RECEIVE AWARDS

Three seniors presented their theses and senior design projects at student paper competitions. Frank Stinner ’11 presented his thesis work, guided by Todd Wey, assistant professor, and Chris Nadovich, lab director, at the IEEE Region II conference and won second place. Shailesh Shrestha ’11 and Gregory Earle ’11 participated in the Walter B. Morton Student Paper Contest sponsored by the Lehigh Valley section of the IEEE. Earle’s presentation, based on his senior design project, was awarded third place. In fall 2010, Shrestha received the Charles F. Homewood Memorial Scholarship from the International Society for Automation-Lehigh Valley Section for his thesis work, guided by Yih-Choung Yu, associate professor.

Justin Bunnel ’11 presented a paper at the 2011 Northeast Bioengineering Conference.

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From the Department Head



Welcome to our ninth annual newsletter. We are pleased to share with you our students' accomplishments and faculty activities in-and-out of the classroom. I am pleased to report

that the electrical and computer engineering department remains steadfast in its effort to improve the curriculum, maintain and enhance facilities, and help students achieve their academic goals that often go far beyond the minimum curricular requirements. Please feel free to contact us should you have any concerns or questions. It is our privilege to stay in touch with all our constituents and peers.

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John Nestor
Professor of Electrical and
Computer Engineering

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The ECE senior project team was comprised of Adolffson, **Justin Bunnell '11**, **Gregory Earle '11**, **Samuel Friedman '11**, **Ricardo Quan '11**, and **William Kiewicz-Schlansker '11**. **John Greco**, professor of electrical & computer engineering, also served as a faculty adviser.

For Adolffson, this project has taught him a large range of skills. "I have learned about scheduling

tasks, delegating work, and how difficult it is to design a system from the ground up. This project has definitely given me a better understanding of how projects are developed and some of the unique challenges of working with a team of engineers," he says. After graduation, Adolffson will begin work at Texas Instruments in Dallas as a technical sales associate.

Faculty News

Professor **William Hornfeck** led Lafayette's semester-long program in German culture and engineering at Jacobs University Bremen in Germany. This is his third semester in Germany and his fourth abroad.

Professor **John Nestor** co-chaired the IEEE microelectronics education conference held in San Diego this June. Nestor also assumed the

role of department head July 1, taking over for **Ismail Jouny**, Dana Professor, who served as department head for nine years.

Todd Wey will be promoted to associate professor with tenure effective fall 2011.

A Look at the Graduating Class of 2011

Three students from the Class of 2011 are attending graduate school at Cornell, University of Pennsylvania, and Jacobs University, Bremen. Others found employment with Intel, Texas Instruments, PMC Sierra, and International Battery. The following are a few profiles of promising alumni.

SAM FRIEDMAN '11

Excels in the Lab and on the Stage

This May, I graduated with degrees in electrical & computer engineering and music with honors. Throughout my four years, I was provided with the resources to excel academically, athletically, and socially due to the small liberal arts environment and many opportunities. Some of these opportunities included the performance by College and professional groups of two orchestral pieces that I composed during my senior year. I was also a member of the College's Division I soccer team, the orchestra, Hillel Society, Delta Upsilon Fraternity, and president of the Soccer Club.

The department has helped prepare me academically and provided me with the means to successfully pursue internships and a career path. During the summer of my sophomore year, I was accepted into the Research Experience for Undergraduates program at the University of Rochester where I developed a program to monitor the operation of a chain of dark matter detectors. In the summer after my junior year, I obtained an internship in Lausanne, Switzerland, working at Ecole Polytechnique Fédérale de Lausanne where I wrote and tested code for a GALS system on chip design.

The variety of projects and the skills I learned during my courses helped provide me with a strong résumé and interviewing abilities during my job search. Due to the range and depth of topics covered within the curriculum, I was always able to discuss a project that was extremely relevant to the job that I was pursuing. Next year, I will be working at Intel Corporation in Hillsboro, Ore., as a network software engineer. The department's combination of teaching a variety of engineering topics while also emphasizing a deep focus within specific subjects has helped prepare me for a career in engineering.

ERIK ADOLFFSSON '11

Learns Life Lessons through Golf and Engineering

As I stepped onto Lafayette's campus freshman year I had no idea what an arduous journey lay ahead of me. I thought it would be easy to pursue both of my passions: engineering and golf. Experience proved otherwise but the struggles and triumphs I went through along the way provided me with a better college experience than I could have ever imagined.

Golf has been my passion for more than a decade. My parents introduced me to golf when I was nine-years-old and once I hit my first pure shot, I was hooked. Golf draws some parallels to engineering for me and I believe this is why I have a proclivity for both. It requires a keen intellect and expert problem solving skills. One must assess many factors before rendering a solution. Golf requires intense focus and determination in order to be successful. Engineering demands a similar commitment.

I have grown by leaps and bounds since freshman year. My mathematical skills, teamwork skills, and problem solving skills are much stronger because of the curriculum Lafayette offers. The small class sizes for engineering make it so easy to become close to your professors. Their doors are always open if you need to talk or if you need extra help. This is something you won't find at a bigger school. The biggest asset Lafayette has is its faculty.

Each year, I was challenged and pushed to expand my knowledge of electrical engineering. The projects and labs associated with class help to teach things you can't learn in a book.

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Students demonstrate how to use the brain-computer interface device.

PROFESSOR YIH-CHOUNG YU WORKS WITH STUDENTS ON NUMEROUS RESEARCH PROJECTS

Yih-Choung Yu, associate professor, received research funding from Richard Koplin '64, clinical associate professor at New York Eye and Ear Infirmary, to develop a cost effective eye-scanning device, invented by Koplin, for use in ophthalmic ultrasound. The device has a simple actuator for oscillation and a feedback control scheme for precision. Ahsan Nawroj '12 and Shailesh Shrestha '11 were involved with the project since summer 2010. The project not only provides students with a research opportunity but also a unique industrial design experience.

During summer 2011, Yu is collaborating with Lisa Gabel, assistant professor of psychology, to develop a brain-computer interface device. This multidisciplinary design project is sponsored by a Faculty Innovation Grant from the Provost's Office. Neuroscience majors Christopher Angeloni '12 and Victoria Corbit '13 and electrical and computer engineering majors Anthony Lorence '13 and David Salter '12 are working on the project. Yu is also mentoring two grand challenges scholars Felix Hutchison '12, an electrical and computer engineering major, and Yue Yuan '12, a mechanical engineering and policy studies dual major, in developing a neuron emulator.

Yu was invited to lecture on his cardiovascular modeling and ventricular assist device development at the Federal University of Maranhão in Brazil in July 2011. He also was invited to present a paper at the IEEE conference in Macau, China.

ECE is produced annually by the Communications Division for the Electrical and Computer Engineering Department and distributed to Lafayette engineering alumni and students. The department welcomes your comments and letters. Send to: John Nestor, ECE Department, Acopian Engineering Center, Lafayette College, Easton, PA 18042; (610) 330-5411, nestorj@lafayette.edu, www.lafayette.edu.

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MISSION

Our mission is to be one of the nation's premier undergraduate ECE departments. We are dedicated to providing students a thorough technical preparation, the continuous development of professional awareness, and a heightened sense of social responsibility.

This mission statement leads to three major goals: (1) to bring together students of high ability and a faculty composed of teacher-scholars in the major fields of electrical and computer engineering for the purpose of learning through study, inquiry, discourse, and discovery—our people. (2) to maintain a continuous evolution of curriculum, pedagogical practices, and resources to educate students in the guiding principles of the engineering profession and the best practices in both electrical and computer engineering—our program. (3) to create an interactive environment between students and faculty that fosters a dedication to learning and an appreciation of both the history and future of the discipline—our learning environment.

OBJECTIVES

Graduates will have the ability to:

- educate themselves continually;
- adapt to changing job assignments/challenges;
- function in a team and provide leadership;
- apply their engineering education in solving a broad range of problems;
- be involved in professional/public/community service;

- excel in their chosen area of professional activity;
- communicate in a mature and effective manner;
- appreciate business enterprise, technology management, and social and legal issues.

PROGRAM OUTCOMES

Upon graduation, students will have:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in lifelong learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- (l) understand microscopic material properties and how they are used to develop modern electronic devices





DEPARTMENTAL AWARDS AND HONORS

Shrutarshi Basu '11 won the J.J. Ebers Memorial Award, given to a student based on high academic achievement and noteworthy professional interest in the field.

Gregory Earle '11 is the recipient Lawrence J. Conover '24 Electrical Engineering Prize, presented each year to a senior upon recommendation of the faculty.

Frank Stinner '11 is the recipient of the Finley W. and Ethelwyne H. Smith Electronic Engineering Prize, awarded annually to the senior who has earned, at the end of the junior year, the highest cumulative average and is working toward departmental honors with a project in the electronics or communications field.

Basu, Shailesh Shrestha '11, and Stinner also successfully defended their theses and graduated with departmental honors. Their topics included eye scanning, wireless power, and a new multi-core development language.

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Bunnel's paper was a summary of his summer EXCEL research project focusing on controlling a robotic arm with electrical impulses with Ismail Jouny, Dana Professor. Work by Zhao Xin Yin '13 on a computerized, wearable glove that studies human grasping behavior, was also presented at the same conference, as well as the IEEE Conference on Industrial Electronics and Applications in Beijing, China. Yin worked with Luis Schettino, assistant professor of psychology, and Yih-Choung Yu, associate professor.

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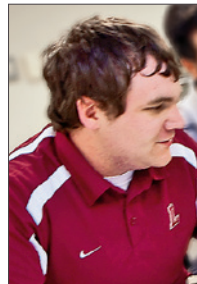
Hands-on experience is the best way to learn to be an engineer. I learned about NTSC TV signals when building an artificial groundhog. I learned about control systems when I built a music controlled water fountain. I learned about WiFi when building a wireless communication system between PC's. And most recently I learned about Lithium ion cells and how to efficiently store energy. I have enjoyed every single project I've worked on at Lafayette. They are fantastic learning experiences and you are given freedom to design what you want and how you want it.

As I look back on my Lafayette career, it is certainly bittersweet. I learned so much, met so many great people, and played a lot of golf. I am sad to leave, but as I have grown older and have now finally graduated I feel ready to take on the world.

FRANK STINNER '11 Uses Rockets, Lasers, and Wireless Power to Get Into Grad School

My Lafayette experience was very diverse. During my four years, I tried to involve myself in everything I could—from shooting rockets into the sky to lasers across the Quad. There was never a dull moment. There was always a new and exciting challenge awaiting.

As I was not only interested in engineering, I also pursued a minor in physics. One of the



physics department's most popular activities was a semi-annual rocket launch. I enjoyed testing my skills trying to engineer a model rocket that would fly as high as possible. Although I was not always successful, each failure led to a more refined design.

As a summer EXCEL project for the ECE department, I worked on a system for transmitting and receiving analog audio over a laser. The goal of the project was to produce an independent system that could be simply and automatically operated. The project was an intriguing challenge. When it was complete, as a final extreme test of the system, I successfully set up a laser and receiver and broadcast music from the library across the Quad to Farinon.

I continued on to my honors thesis which was a wireless power transmission system. This was an exciting and challenging project which required me to draw from all my engineering knowledge. The theoretical portion of my project was published as part of an IEEE student activities conference in which I took second place in the paper competition. My final project produced a fully operational system which could charge a battery wirelessly directly and efficiently from an independent supply.

This fall, I will be going on to the University of Pennsylvania to continue studying electrical engineering. My research focus will combine my interests in engineering and physics. Specifically, I will be studying an alternative to pure semiconductor logic in the form of piezoelectric nano-switches.