

Annual
Report

2010-

2011

Electrical and Computer Engineering

Department of Electrical and Computer Engineering
North Carolina State University

Annual Report 2010-2011

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I. Overview

This has been a very positive and productive year for the faculty and staff of the ECE department. We have several faculty and staff in new leadership positions, we have increased opportunities for faculty and staff to interact, the Advisory Board has been reactivated, we have begun a bi-monthly e-newsletter, several professors have received major awards, and ECE research has been featured multiple times in the national and international media.

During the past year, we have had several leadership changes. Brian Hughes agreed to serve as our Associate Department Head, replacing Yannis Viniotis. Mike Devetsikiotis agreed to serve as our Director of Graduate Programs, replacing Joel Trussell. These are both very capable professors with the full respect of the faculty and add significant strength to our leadership team. In addition, Bart Greene has taken on the role of Director of Industrial relations. This has provided us with a single point of contact for our industrial partners, and oversight to make sure we use contributions appropriately. He has also assisted with the interaction with the COE Foundation Office, and helped to formulate “asks” when appropriate. Finally, Pete Strongoli joined the department as Director of Administration and Finance.

In an effort to increase the opportunities for faculty and students to interact, we began a “Blue Sky Pizza Lunch” for faculty, and have met about 3 times/semester during the past year. This has provided additional opportunities for faculty to meet and informally discuss ideas. We also introduced a welcome dinner for sophomores entering the department and faculty.

With the assistance of Bart Greene in his new role of Director of Industrial Relations, we re-organized and revived our advisory board. We appointed 2/3 of the final board with staggered 2 and 3 year terms, and will appoint the final third in January 2012. The board is primarily made up of CEO/VP level graduates and supporters, and includes small entrepreneurial companies, large companies, and another ECE department head (Ga Tech, although he has just been promoted to Dean!). We held the first meeting in February of this year, and we have already begun to benefit from the feedback and interactions.

With Dan Green’s help, we have introduced a bi-monthly e-newsletter using Bronto. The first issue was sent in December of 2010. We have also begun construction and use of an “ece-friends” listserve that can be used to keep local friends up to date with activities such as colloquia and picnics.

In other news, Dr. Tom Miller was named the 2010 NC State Entrepreneur of the Year, Dr. Mesut Baran was named IEEE Fellow, Dr. Bob Trew was named AAAS Fellow, Dr. Alex Huang was named the QiuShi Chair Professor at Zhejiang University, Dr. Jay Baliga was named to the *Electronic Design* Engineering Hall of Fame and also received the Holladay Medal for Excellence by the NC State Board of Trustees, and smart solid-state transformers being developed by the NSF FREEDM Systems Center have been named to MIT Technology Review’s 2011 list of the world’s 10 most important emerging technologies. Research involving faculty in ECE has been featured in numerous regional, national, and international media venues, including *msnbc.com*, *Popsci*, *IEEE Spectrum*, *syfy news*, *cnet news*, *News & Observer*, *cbsnews.com*, *Science*, *MIT Technology Review*, *EE Times*, *BBC*, *ECN*, *Tech Journal South*, *Triangle Business Journal*, *R&D*, *gizmag*, *engadget*, *azoptics.com*, and *US News and World Reports*.

The Department of Electrical and Computer Engineering also received a “Supporting Friend of IEEE member and Geographic Activities Award” for supporting and promoting IEEE Eastern North Carolina Section activities by hosting events on campus since 2002.

Finally, the Electrical Engineering and Computer Engineering undergraduate programs were reviewed by ABET during the Fall 2010 semester, along with other programs in the college. Although the final results of this review are not yet available, it is significant to note that ABET requested permission to put the Computer Engineering Self-Study on display as an example of a well-written Self-Study at the April 2011 ABET Symposium.

Changes in Service Environment

Although the economic conditions of the state have been challenging, with the support of the dean and the university, the department has continued to move forward. The most significant change in our environment was that the FREEDM Systems Center moved to the new Keystone Science Center in June, 2010.

A. Diversity

- There are 56 tenure track and teaching faculty, 7 of whom are female, and 3 of whom are African American males.
- There are 22 permanent SPA employees in the department: 13 are white female, 1 is an African American female, 7 are white males, and 1 is an African American male.

In recruiting for the position of Director of Administration and Finance, we interviewed four top candidates. Although not hired in the end, three were women, two of whom were African American.

In advertising for faculty this year, several changes suggested by the university were made in the position description and process with the goal of making the position more attractive for under-represented groups. These changes included making a statement about the importance of diversity near the beginning rather than relying on the stock legal statement at the end, and appointing a woman (Veena Misra) as the Chair of the search committee. It's difficult to say to what extent these changes were responsible, but we ended up interviewing 3 women and an Hispanic male. I am pleased that with the addition of Edgar Lobaton, we now have our first Hispanic faculty member. The department took several actions during the year attempting to address the "pipeline" issue:

- The Department participated in the Building Future Faculty program at NCSU by sponsoring an Hispanic male participant interested in a future faculty position.
- The Interim Director of Graduate Programs spoke with the NCAT ECE Department Head to discuss recruitment of graduate students and the possible sharing of courses via online delivery.

II. Undergraduate program

A. Enrollment, degrees awarded, trends

During the 2010-2011 academic year, ECE awarded 151 BS EE degrees and 90 BS CpE degrees, including double majors. The total undergraduate enrollment is given in Table 1. While enrollment declined in the first half of the last decade—a trend that has been observed nationally—it has stabilized during the second half. Similarly, the number of degrees awarded has remained relatively constant over the past four years.

Table 1. Total Undergraduate Enrollment in F10

Degree Program	BS EE	BS CPE	BS EE&CPE
Unmatriculated	91	135	0
Matriculated	323*	183	203
Total Each Degree	414	318	203
Total ECE Undergrad Students	935		

* includes 17 REES concentration EE majors

B. Instructional program advances

The new concentration in Renewable Electric Energy Systems (REES) is gaining in popularity. We presently have 17 matriculated REES concentration EE students.

C. Highlight student honors, measures of quality

Of 190 ECE students who earned the BS degree during the 2010-2011 academic year, 25 graduated *Cum Laude*, 21 *Magna Cum Laude*, and 29 *Summa Cum Laude*.

John Eldon Stout, a senior majoring in electrical engineering, computer engineering and physics, was one of only 20 students nationwide to receive a scholarship from the Astronaut Scholarship Foundation, a non-profit organization established by the Mercury Astronauts. The Astronaut Scholarships are awarded annually to students who show exceptional performance in the fields of science, engineering or mathematics.

A team of NCSU students led by Patrick Carroll, a junior majoring in electrical engineering and computer engineering, has placed among the top three finalists in the 2011 Disney ImagiNations competition.

In addition, 20 seniors received ECE departmental awards this year:

John Robert Matthew Cohen, Outstanding Senior Award	Logan P. Vinesett, Outstanding Senior Award
Mark Theodore Draelos, Outstanding Senior Award	Andrew N. Williams, Outstanding Senior Award
David Kenneth Haupt, Outstanding Senior Award	Spencer Ellis Williams, Outstanding Senior Award
Shawn Michael Humber, Outstanding Senior Award	Brandee Nicole Woolard, Outstanding Senior Award
Megan Leigh Matthews, Outstanding Senior Award	Andrew N. Williams, Faculty Senior Scholar Award
Troy Zachary Muma, Outstanding Senior Award	Spencer Ellis Williams, Faculty Senior Scholar Award
Kyle P. Roberts, Outstanding Senior Award	Andrew N. Williams, Leadership Award
Ramandeep Singh Sahota, Outstanding Senior Award	Rachel M. Kurtz, Humanities Award
Kirk Thomas Stallings, Outstanding Senior Award	Mark Theodore Draelos, Scholarly Achievement Award
John Eldon Stout, Outstanding Senior Award	Brandee Nicole Woolard, Service and Citizenship Award

D. Scholarships

In Spring 2011, we awarded 92 scholarships from 42 different donors for a total of \$189,570.

E. Student organizations and activities

Eta Kappa Nu

The Beta Eta Chapter is involved in many activities that benefit scholarly, professional, and community activities of ECE students here at NC State. Activities during the past year included:

Scholarship

Members volunteered their free time to help the department with Fall and Spring Open House, department tours to prospective students, and the annual ECE Picnic. The Beta Eta Chapter also offered free tutoring services for undergraduate ECE classes each semester. Members also assisted in advising students during registration.

Profession

Since the Spring of 2006, the Beta Eta Chapter has sponsored the GO (Golden Opportunity) Social. This event gives members the chance to speak with various companies who hire ECE graduates before the Fall and Spring campus career fairs. A wide variety of companies are invited to give presentations to students, participate in an open question-answer session, and conclude with a catered dinner. The Chapter also works very closely with the NC State IEEE branch in presenting company presentations throughout the semester. These events give members a number of chances to develop close contacts with both locally owned enterprises as well as international corporations.

Community

Beta Eta members are actively involved in the NC State community as well as their communities at home. The Chapter often lends a hand to various volunteer events and programs such as Habitat for Humanity, Service Raleigh, and Science Olympiad to name a few. Members have also assisted the College of Engineering's Outreach program by visiting local elementary and middle schools talking with students about careers in engineering.

Institute of Electrical and Electronics Engineers (IEEE)

The IEEE Student Branch sponsored 7 Technical Talks by corporations that included Cisco, Eaton, Mathworks and National Instruments. One talk was a presentation of an NCSU graduate research project in the area of solar power.

The student branch hosted 6, three-person teams that competed in the IEEEExtreme programming competition. Over 1000 teams participated world-wide in the 24-hour, on-line programming event.

Again this year, the student branch actively participated in the IEEE SoutheastCon Student Program with entries in the hardware, software, T-shirt and ethics competitions. 16 students attended the event in Nashville and over 25 participated in preparation for the competitions.

IEEE officers attended leadership training in Atlanta sponsored by IEEE Region 3, and a leadership conference in Nashville as part of SoutheastCon 2011.

Underwater Robotics Club (URC)

The URC competed in the 2011 RoboSub Competition sponsored by the Office of Naval Research and the Autonomous Underwater Vehicle Systems International (AUVSI) Foundation. The competition requires an autonomous underwater vehicle to navigate a course using vision, sound and environmental sensing while performing mechanical and electronic tasks. This was the sixth year the URC has competed and they placed 9th out of 21 universities entered.

The URC has made concerted efforts to expand beyond the ECE department in recruiting members. This year students from CSC and MAE were active in the design of the vehicle for the 2011 competition and there has been interest from students in the School of Design.

Open Hardware Design Lab (ODL)

The ODL has been established as an official student organization with NCSU and has received funding from Student Government this year. The ODL has established bylaws and procedures for operation, and the lab has been actively in operation for most of the semester.

The goal of the organization is to provide a laboratory for students to experiment, build projects and learn outside their formal classroom activities. The club has established a number of projects that students can work on and provides mentoring to students interested in expanding their skills in design.

Analog Devices is actively working with the ODL to provide parts and mentoring to the organization.

F. Cooperative education program

In Fall 2010, a total of 36 students participated in cooperative education programs at 21 different companies. In Spring 2011, 43 students participated in cooperative education programs at 20 different companies.

G. Career placement

Last year ECE and the NCSU Career Center created a new online job board that is integrated with the campus ePACK tool. By June 2011, a total of 359 ECE undergraduates had logged onto the job board, and 269 had uploaded resumes, which is roughly 40% of all matriculated students. The placement statistics as of 9/1/2010 for our May 2010 graduates are given in Table 2 below.

Table 2. Placement statistics for May 2010 graduates as of 1 September, 2010.

BS Curriculum	Graduates	Reported Status	Grad School	Employed	Reported Salary	25th Percentile	Average Salary	75th Percentile
Computer	46	44	10	17	14	52,500	58,768	66,938
Electrical	73	66	17	27	25	50,000	59,507	65,000

III. Graduate program

A. Enrollment, degrees awarded, trends

The total graduate student enrollment in the fall of 2010 was 513. The number of PhD students was 202 (down slightly from 208 last year), and the number of MS students was 311 (significantly down from 364 last year). The figures for the current year are shown in Table 2.

Table 2. Graduate enrollment and degrees granted in Fall 2010 – Spring 2011.

	F10 Enrollment	F10-Sp11 Degrees
EE MS	204	55
CpE MS	69	57
CNe MS	38	10
Total MS	311	122
EE PhD	152	22
CpE PhD	50	8
Total PhD	202	30
Total	513	152

**Source for Enrollments: UPA

*Source for Degrees: SIS/Graduation Lists (estimated values)

B. Instructional program advances, including curriculum development

Our new accelerated Professional Master's Degree program in Electric Power Systems funded by a \$3.4M grant from the Department of Defense will enroll its first students this summer. Proposal for the degree program is with the Board of Governors for final approval.

C. Fellowships and Awards

Twenty seven graduate students received fellowships, totaling \$322,450. In addition, the following students received best paper and thesis awards and patents:

Niket K. Choudhary won 1st Place in the ACM Student Research Competition for his work titled "FabScalar: Composing Synthesizable RTL Designs of Arbitrary Cores within a Canonical Superscalar Template".

Wenbo Zhang was a part of the Award winning BME-ECE graduate Design Team "Patient Link" spin out company (Augment Medical) just admitted to the Carolina Launch Pad.

ECE Graduate Student, Jeffrey Harmon, and 2010 FREEDM REU student Michele Bustamante, mentored by ATEC Program Manager Ewan Pritchard and ECE Professor Dr.Subhashish Bhattacharya, was one of three groups to win the Grand Challenge Poster Competition at the 2011 Engineering Day at the NC Legislature.

Ioannis Papapanagiotou (PhD-CpE) and his thesis advisor, **Prof. Michael Devetsikiotis**, received the best paper award for the year 2010 from the IEEE Technical Committee on Communications Systems Integration and Modeling, for their paper "Flow Classification Using Clustering and Association Rule Mining".

B. Pourdeyhimi, B. Karaguzel, **C.R. Merritt**,* **T. Kang**,* **J.M. Wilson**,* H.T. Nagle, and E. Grant, received the Research Publication Award of the Textile Institute for their publication, "Flexible, durable, printed electrical circuits," In: Journal of the Textile Institute, 100, 1, pp 1-9, 2000.

H. Troy Nagle, **Tae-Ho Kang***, **Carey Merritt***, Burcak Karaguzel, Behnam Pourdeyhimi, and Edward Grant were awarded **US Patent 7.712.373.B2, issued 5/11/2010**, "Sensor Device for Real-Time Monitoring or Relative Movement Using Capacitive Fabric Sensors."

***Carey Merritt** (Chair: E. Grant) and **Tae-Ho Kang** (Chair: H. T. Nagle) were students in the ECE department. **John Wilson** was a Postdoc of P. Franzon's.

IV. Faculty and staff

A. Administrative achievements and staff changes

There were several changes in the departmental administrative staff:

Pete Strongoli joined as Director of Administration and Finance
Siobhan Strange transferred to Center Specialist

Kendall Del Rio Graduate Administrative Secretary
Amy Schwab joined as Financial Manager

The following new faculty joined the ECE Department during 2010-11:

Dror Baron

Dr. Baron joined NC State in August of 2010. He received his PhD from the University of Illinois at Urbana-Champaign in 2003. He has also held positions as a postdoctoral research associate at Rice University (2003-2006), a Quantitative Research Analyst with Menta Capital (2007-2008), and a Visiting Scientist at the Technion (2008-2010). Generally speaking, Dr. Baron's research lies on the intersection of fast algorithms, signal processing, and information theory. He is particularly interested in developing systems that extract as much information as possible from data in a computationally timely manner.

Alper Bozkurt

Dr. Bozkurt joined NCSU in August 2010. His research interests include development of microscale sensors, actuators and methodologies to unlock the mysteries of biological systems with an aim of engineering these systems directly or developing new engineering approaches by learning from these systems. Prior to joining to NC State, Dr.Bozkurt received his PhD in 2010 from Cornell University where he performed research to interface microtechnologies with metamorphic development of insects for building remotely controlled biobotic organisms (insect cyborgs). His previous research at Drexel University (2002-2004) included the development of functional near infrared spectroscopy systems for brain-machine interfaces to augment cognition and for clinical monitoring of the newborn brain in neonatal intensive care units.

Aranya Chakraborty

Dr. Chakraborty joined NCSU in August 2010. He received his Ph.D. from Rensselaer Polytechnic Institute in 2008, and also held positions as a Postdoctoral Research Associate at the University of Seattle and as an Assistant Professor at Texas Tech prior to joining NC State. His research interests span all branches of control system theory with applications to large-scale electric power systems. He is a part of the FREEDM Systems Center, currently researching several system and control-theoretic problems for the US power grid using Synchrophasor (WAMS) technology, and its integration with renewable energy sources such as wind energy.

The following faculty were reappointed or promoted:

Srdjan Lukic, reappointed to Assistant Professor

Cranos Williams, reappointed to Assistant Professor

Subhashish Bhattacharya, promoted to Associate Professor with Tenure

John Muth, promoted to Full Professor

B. Awards and Honors

Aranya Chakraborty (Assistant Professor) received an NSF CAREER Award.

Tom Miller (McPherson Family Distinguished Professor) was named 2010 NC State Entrepreneur of the Year.

Mesut Baran (Professor) was named IEEE Fellow.

Bob Trew (Alton and Mildred Lancaster Distinguished Professor) was named an AAAS Fellow.

Eddie Grant (Professor) was appointed a Senior Researcher in the Department of Advanced Robotics at the Italian Institute of Technology in Genoa, Italy.

Alex Huang (Progress Energy Distinguished Professor) was named Zhejiang University's QiuShi Chair Professor

Alex Huang (Progress Energy Distinguished Professor), **Subhashish Bhattacharya** (Assistant Professor), and the FREEDM Center: The smart solid-state transformers being developed by the NSF FREEDM Systems Center at North Carolina State University have been named to MIT Technology Review's 2011 list of the world's 10 most important emerging technologies.

Jay Baliga (Distinguished University Professor)

- Inducted into the 2010 class of the *Electronic Design Engineering* Hall of Fame.

- Received the Alexander Quarles Holladay Medal for Excellence by the North Carolina State University Board of Trustees in recognition of his outstanding career at NC State.

C. Seminars, visitors

The Department has continued its Interdisciplinary Distinguished Seminar Series, coordinated by Dr. Hamid Krim, and the ECE Distinguished Speaker Colloquium. The Colloquium featured presentations from distinguished speakers drawn from both academia and industry who addressed a wide variety of topics of interest to our community. The seminar is directed to everyone, from undergraduates on up to faculty and industry friends—the level of the presentations is for non-specialists and accessible to students. The Distinguished Speaker Colloquium is sponsored by our friends at Fluor. Colloquium speakers for 2010-11 were:

Earl Swartzlander, Professor, University of Texas, Austin, “Fused Floating-Point Arithmetic for DSP Application”

Marshall Brain, Founder, HowStuffWorks, “The Meaning of Life and the Role of Robots”

Abbas Jamalipour, Distinguished Lecturer, IEEE Communications Society, “Current and Future Wireless communications Networks”

Joseph DeSimone, Chancellor’s Eminent Professor of Chemistry, UNC-CH, “Co-opting Moore’s Law: Vaccines, medicines and Interfacially-Active Particles Made on a Wafer”

P.R. Kumar, Franklin W. Woeltge Professor, UIUC, “ Cyberphysical Systems”

D. Staff

Andrew Stein received a College of Engineering Award for Excellence.

V. Research programs

Because such a large fraction of research activity by ECE faculty is associated with the FREEDM Center and is not captured in the ECE ledger 5 account information provided by the college, no accurate data about ECE research trends is presently available.

VI. Departmental sponsors

A. Donations

Sponsorship by Corporations, Alumni and Friends of the Department increased significantly in fiscal year 2010/2011. As of the end of April 2011, we received \$844,092 in donations. This is an increase of \$468,787 over the twelve month total of last fiscal year and more than double last year’s donations. Of this year’s sponsorships, 62 % were gifts to faculty in support of their activities, 27 % were for scholarships and fellowships, and 11 % were donations to support the department and student groups. Approximately 90 % of the sponsorships were from corporations and 10 % from alumni and other individuals. The majority of this increase was from the new partnership with ABB accounting for \$215,000. However, giving remained strong from existing corporate partners including Progress Energy, Duke Energy, IBM, Analog Devices, Fluor, Tekelec and Mentor Graphics; each contributing over \$30,000. We also have laid the groundwork for expanded partnerships with Cisco, Analog Devices, Siemens, Northrop-Grumman and Qualcomm. Our corporate support is dominated by companies in the power industry due to the attraction of the FREEDM Center and we hope that the groundwork with these other corporations in the electronics and communications industry will give us returns in the future.

Donations from Alumni and Individuals remained strong also. This fiscal year we collected \$86,926 in the first ten months, up from \$58,186 last fiscal year. Most donations are for scholarships, fellowships and department support of activities.

We have made a conscience effort to integrate Alumni and Corporation Partners in the ECE Department activities including social events, seminars and student based activities. We are sending bi-monthly newsletters to alumni to keep apprised of department achievements and have encouraged them to follow the department on *Facebook*, *Twitter*, *LinkedIn*, and *YouTube*.

B. Strategic Advisory Board

Our industrial advisory activities were reignited this year with our first meeting of the newly formed Strategic Advisory Board on Feb 4, 2011. The main focus of this meeting was organization and introduction. Members introduced themselves and their backgrounds while the ECE department gave an overview of the curriculum, research and planning activities. The charge to the board was in three areas:

- Give us advice regarding directions of the industry
- Give us feedback on education directions and trend important to industry
- Help us expand our corporate and alumni relationships

To fulfill the charter, we picked board members at the executive level who regularly interact with other industry leaders and will have the broad industry visibility required. We also were able to attract Gary May, recently appointed Dean of the College of Engineering at Georgia Tech, to provide an academic perspective. Members of the board are:

<i>Name</i>	<i>Title</i>	<i>Company</i>
Andy Rindos	Head, CAS and World-Wide CAS Strategist	IBM
Caren Anders	Vice President	Progress Energy Carolinas
Dean Hering	Chief Innovator	NetCentrics
Eric Pearson	Director	Northrop Grumman Corp
Gary May	Dean of Engineering	Georgia Institute of Technology
Jan van Dokkum	Operating Partner	Kleiner, Perkins, Caufield & Byers
Laura Schoppe	President	Fuentek
Nelson Peeler	Vice President	Duke Energy Corp.
Robbie Troxler	Director; Advanced Technology	Troxler Electronic Laboratories
Serge Leef	Vice President	Mentor Graphics Corporation
Tony Montalvo	Vice President	Analog Devices
Wes Covell	President	Harris Corporation, GCSD

We plan to expand the board from 12 to 18 in the next year. Actions by board members this year include feedback on ABET Program Educational Objectives and recommendations on technology transfer and working with industry. We also have leveraged Market Communications contacts with board members to rewrite our departmental brochures and web pages.

VII. Recommendations and concerns for the future

Specific challenges that the department will focus attention on during the next year include:

- *Implementing the strategic plan.* We expect the plan to be completed by early Fall, and will be a guide for resource allocations as we move forward in building the department.
- *Emphasis on development.* We will continue our increased emphasis on both individual and corporate gifts. A particular goal will be to devise a plan for regularly generating discretionary funds that can be used for moving expenses for new faculty.
- *Continue development of faculty-student mixer opportunities.* We plan to continue our sophomore welcome dinner and grad/student ice cream socials as well as look for additional opportunities for students and faculty to interact.
- *Continue increased emphasis on public relations.* We will continue our efforts to rethink our public and alumni relations through e-newsletters, web site updates, social media, and mailings to increase the visibility of the department.
- *Improved staff support environment.* With increasing research activity and simultaneously tightening state budgets, it will be a continuing challenge to do more with less, while maintaining a sustainable work load on our administrative staff, and providing exemplary support for our faculty.