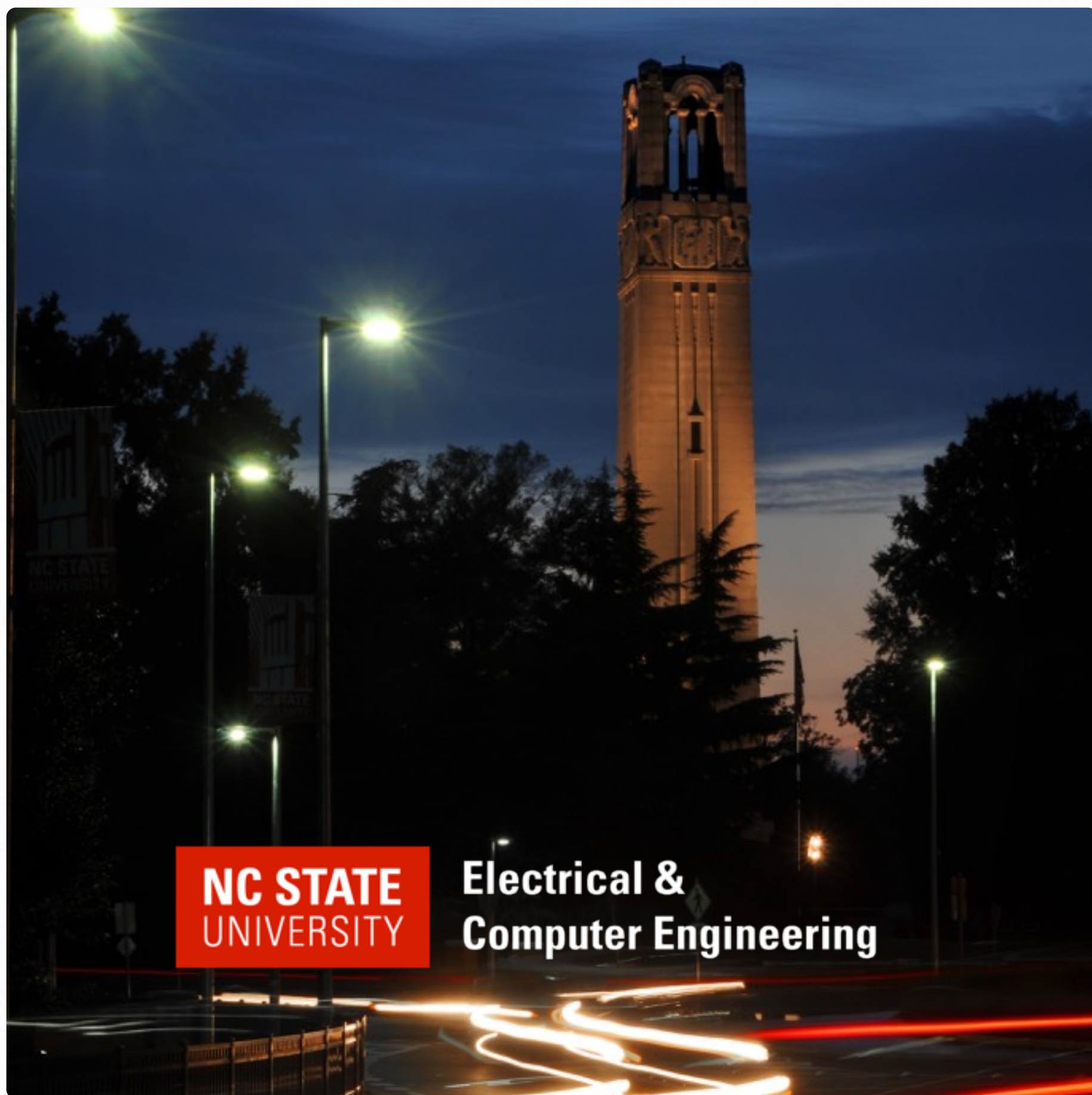


NC State Department of Electrical & Computer Engineering

# Cool Things from 1990-2009



**NC STATE**  
UNIVERSITY

**Electrical &  
Computer Engineering**

# Cool Things from 1990 to 2009



# 1

## 1990 to 1999

Priority changes, changes in leadership, and opening new centers





# Overview



The decade of the 90's saw the introduction of two new ECE centers: the Center for Robotics and Intelligent Machines (CRIM) was established on January 1, 1992 with Dr. Ren Luo as director, and shortly thereafter Dr. Jayant Baliga's Power Semiconductor Research Center (PSRC) was established on July 8, 1992. Adding these two centers to the existing Center for Advanced Electronic Materials Processing (AEMP), Center for Advanced Computing and Communications (CACC, formerly CCSP), and the Electric Power Research Center (EPRC), all of which were led by ECE faculty members, increased the number of

centers in the department to five. Also in 1992, the Southeast University and College Coalition for Engineering Education (SUCCEED) was established by NSF as a new initiative in undergraduate engineering education. Dr. M.A. Littlejohn (ECE) was the driving force and founding director of this successful venture which had NC State as the lead institution and involved seven other universities – Clemson, FAMU/FSU, Florida, Georgia Tech, NC A&T SU, UNC-Charlotte, and Virginia Tech.

In addition to the expansion of centers in the department, there were significant changes in



the organizational structure of the department as well as at the College of Engineering level. Dr. Wilbur L. Meier, Jr. resigned as dean of engineering on June 30, 1993 and Dr. Tildon H. Glisson stepped in as interim dean and served in that capacity until Dr. Ralph K. Cavin, head of ECE, was appointed interim dean on July 1, 1994 and permanent dean effective August 1, 1994. Following Dr. Cavin's move into the dean's position, Dr. John R. Hauser was appointed as acting head of ECE and remained in that position until Dr. Robert M. Kolbas was named head of ECE on August 1, 1995.

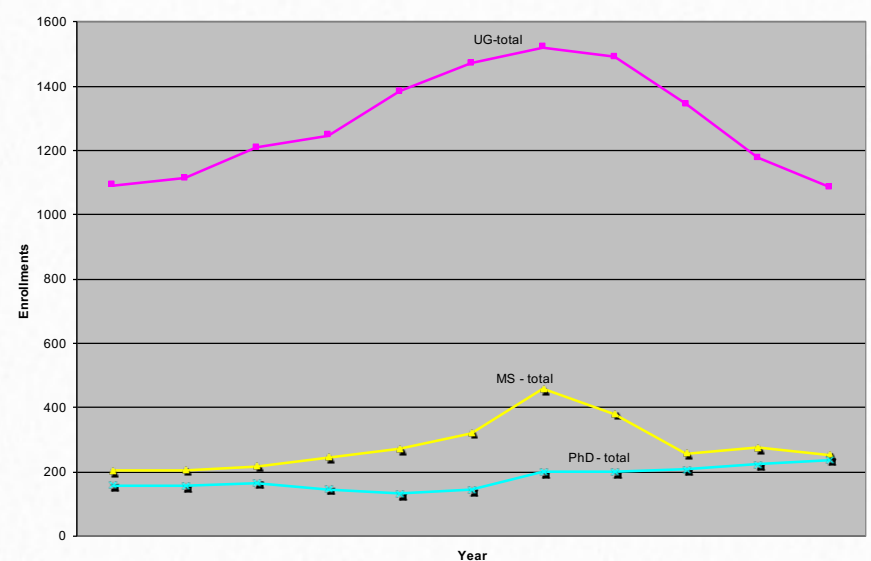
Dr. Cavin served as dean until resigning to accept a position as vice president of the Semiconductor Research Corporation on January 1, 1996. Dr. John G. Gilligan, a faculty member in nuclear engineering and associate dean of research, was appointed as interim dean upon Dr. Cavin's resignation. Also on January 1, 1996, Dr. Sarah A. Rajala, another ECE faculty member and director of CACC, became the first woman to be appointed associate dean of academic affairs in the college of engineering. Dr. Wes Snyder assumed the position of CACC director after Dr. Rajala assumed her new position.

The changes in the dean's office culminated with the appointment of another ECE faculty member, Dr. Nino A. Masnari, as dean on August 1, 1996. Dr. Masnari had served as director of AEMP for eight years and had previously served as ECE department head from 1979 to 1988. Dr. John Hauser was appointed director of AEMP when Dr. Masnari became dean.

Finally, at the University level, Chancellor Larry K. Monteith (also an ECE faculty member, former ECE department head, and dean of engineering) resigned after serving for nine years as interim chancellor and then permanent chancellor beginning in 1989. Dr. Marye Anne Fox, who had a long and distinguished career as a faculty member and vice president of research at the University of Texas, succeeded Dr. Monteith in 1999 as chancellor.

Early in 1990 the college of engineering made a decision to halt the rapid growth of undergraduate enrollments by imposing restriction on the number of new students coming into the various departments, especially ECE students. Since state funding for the university depended on enrollments, the college and all of the departments committed to increasing the MS and PhD graduate enrollments to compensate for the decreased UG numbers that were expected. Unfortunately, as indicated in Figure X.1, it was much easier to decrease the UG enrollment than to increase the number of graduate students.

Figure X.1. ECE Enrollments - UG, MS, PhD



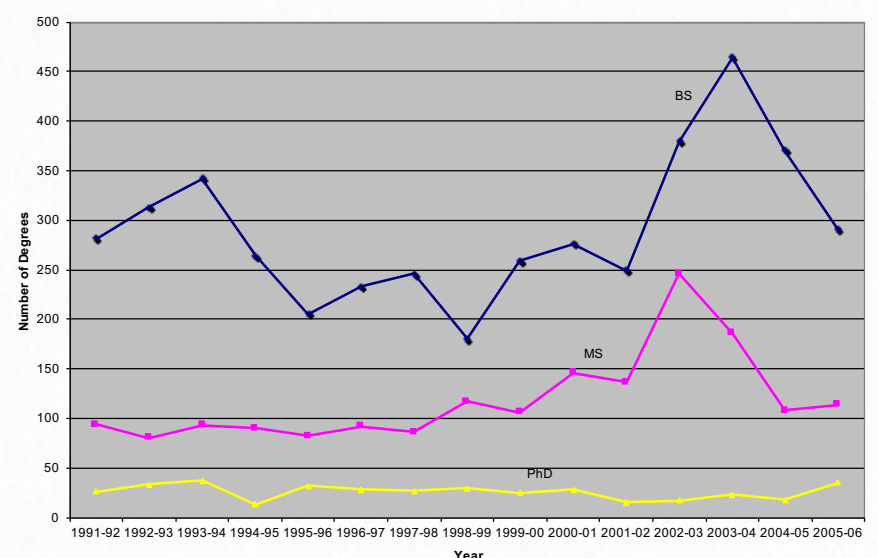
Over the period from Fall 1991 to Fall 1995 the UG enrollment in the college as well as in the ECE department decreased by ~ 22% while the total MS and PhD enrollments remained about the same. Consequently beginning in 1996 the college committed to increasing the UG enrollment but to do so without compromising the quality of the incoming freshmen students. Among the individual departments, ECE experienced the largest growth from 1996 to 2001 not only in UG enrollment but also in graduate enrollments (see Figure X.1). This proved to be especially beneficial to the college and to the ECE department as a result of the new state funding algorithm that was based on a nine-cell matrix that provided more funds to engineering than to other less expensive programs. This significant increase in funding to the university resulted in allocation of an additional 15 faculty positions over the next five years leading to the tenured/tenure-track ECE faculty complement increasing from 38 in 1999-2000 to 53 in 2005-06. (Unfortunately, the economic downturn in the early 2000 era resulted in precipitous declines in UG and MS enrollments over the next five years).

Figure X.2 shows the ECE degree productivity over the time span from 1991 to 2005-06. BS ECE degrees dropped to a minimum of ~180 in 1998-99 and then increased to a maximum of ~464 in 2003-04. It should be noted that the numbers starting in 2000-01 are somewhat misleading since about 30% of the BS degrees awarded in 2001 through 2005 were dual EE/CpE degrees. Thus the number of individuals

receiving degrees was about 30% less than the total degrees awarded.

The decrease in BS degrees likewise was accompanied by a correspondingly large decrease in MS graduates between 2002-03 and 2004-05 (~56%), another consequence of the ongoing economic downturn resulting from the dot-com bubble burst during that period.

Figure X.2. ECE Degrees - BS, MS, PhD



# Academic Program Changes

A revised EE curriculum involving a reduction in credit hours from 132 to 120 was prepared by the faculty and submitted to the university, but was rejected. The proposal was resubmitted and approved in 1992-93, and then further modified to require 125 credit hours for freshmen coming in F'93. Specific changes to the EE curriculum included:

- addition of a course on probability and statistics to replace the former probability course,
- addition of a course on C++,
- addition of a course in humanities and social science,
- elimination of the CSC Pascal course,
- elimination of one ECE junior-level course.

Similarly, in recognition of changes in the NC State General Education Requirements, the CpE curriculum was increased from 122 to 124 hours effective F'94.

The CpE program itself underwent a successful ABET accreditation visit in 1991-92. The review resulted in a favorable three-year accreditation which placed the program in alignment with the upcoming review of all COE programs in 1994-95. As a result of that review both ECE programs received full six-year accreditation.

The department suffered a major setback in May, 1993 when a serious fire destroyed the DAN 444/445 research laboratories of Drs. Bedair and Kolbas. This also resulted in the decision by the university to relocate those two laboratories elsewhere because of safety concerns in the Daniels Hall facility.

During the next several years the department was scattered among numerous buildings all across campus as planning evolved to relocate the department on Centennial Campus. Fortunately, funding for the Engineering Graduate Research Center (EGRC), which had been under consideration since 1987, was approved by the State Legislature. Groundbreaking for the EGRC took place in October 1994 and the building was completed and ready for occupancy by 1996. The Grand Opening Ceremony for the building took place on October 14, 1997. On a further note, the EGRC was later renamed the Monteith Research Center (MRC) in honor of former Chancellor Larry K. Monteith.

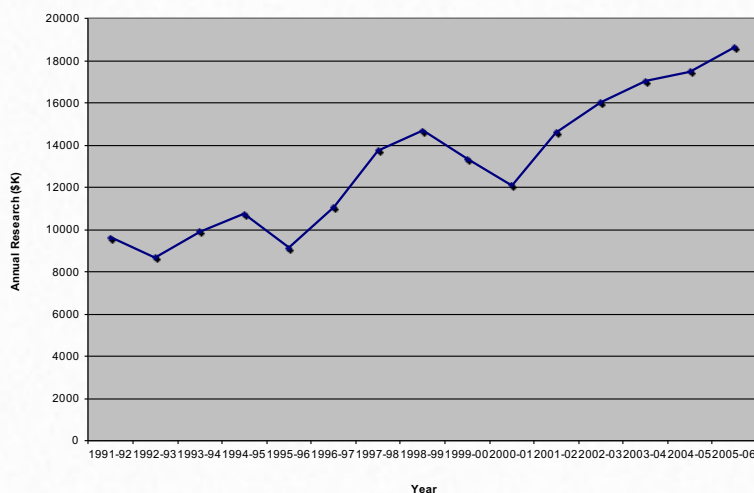


# Research Activities

After relatively flat research funding over the period 1991 to 1996, the ECE research programs resumed the strong growth pattern experienced in the 1980's. The annual total research expenditures for the department during the 1990's and slightly beyond is illustrated in **Fig. X.**

3.

Figure X.3. ECE Total Annual Research \$ Expenditures (\$K)



Total external research expenditures grew steadily during that period reaching a maximum of ~\$14.8 M in 1998-99, declining over the next two years, and then increasing annually thereafter. To put things in perspective, the department total research expenditures in 1998-99 represented a 1380% increase over the ~\$1M total reported in 1980-81.

Much of the research funding during the 1990 decade was a result of the establishment of successful research centers as alluded to previously. AEMP, CCSP (later CACC), PSRC, CRIM, and EPRC all contributed in their own way

to the increased research productivity of the faculty. CCSP was among the first (perhaps the very first) of the NSF Industry/University Cooperative Research Centers in the US and continued to operate successfully throughout the 1990's and beyond.

NC State, along with faculty and students from more than 20 other universities, was the recipient of one of the first Engineering Research Centers established by NSF in the 1980's. The NSF ERC program quickly evolved into the Center for Advanced Electronic Material Processing (AEMP). AEMP was quite unique in that it integrated research programs supported by industry into the core research activity of the NSF ERC program. The industry support was in the form of several SRC semiconductor research programs, a SEMATECH Center of Excellence (SCOE) on Advanced Single Wafer Processing, and various other company research activities. AEMP received support from NSF for the full 11-year cycle associated with the ERC initiative. During that time it received over \$45M of overall external support and \$14M of matching university/state support, but more significantly, more than 300 students who were involved in AEMP ended up receiving degrees from NC State. Likewise, many other AEMP undergraduate research scholars went on to receive advanced degrees from other institutions.



# Faculty Accomplishments & Recognitions

Departmental faculty continued to receive significant recognition for their accomplishments in research and teaching. For example, the total number of IEEE Fellow recognitions awarded to ECE faculty for its entire history up to 1980 was 10. Since then, 7 more were added in the 1980's, 7 in the 1990's, and 13 more between 2000 and 2009.

A complete listing of tenured or tenure track ECE faculty member who have been recognized as IEEE Fellows over the years is recorded in Table T.1.

Numerous other awards and special recognitions that were received by ECE faculty, either from NC State itself or from external organizations or agencies, are included in Table T.2. Of special note are the numerous recognitions received by Dr. Jayant Baliga (National Technology Medal, National Academy of Engineering, O. Max Gardner Award, NC State Distinguished University Professor, IEEE J.J. Ebers Award, IEEE Lamme Medal, IEEE Morris N. Liebman Award, Alexander Quarles Holladay Medal for Excellence, along with many other recognitions). Likewise, as listed in Table T.2, four ECE personnel have received the Alexander Quarles Holladay Medal, which is the highest faculty award given in recognition of an individual's contributions to the University through research, teaching, or service.

Nagle, H. Troy	1983
Baliga, B. Jayant	1983
<b>Hauser, J.R.</b>	<b>1986-87</b>
Grainger, John J.	1987-88
<b>Reisman, Arnold</b>	<b>1988</b>
<b>O'Neal, J. Ben</b>	<b>1989</b>
Masnari, Nino A.	1989-90
Trew, Robert J.	1990-91
Bedair, Salah	1992
<b>Monteith, Larry K.</b>	<b>1992</b>
<b>Iafrate, Gerald J.</b>	<b>1993</b>
Trussell, Joel	1993-94
<b>Osburn, Carlton M.</b>	<b>1998</b>
Steer, Michael B.	1999
Kolbas, Robert M.	2000
<b>Rajala, Sarah</b>	<b>2001</b>
Lunardi, Leda	2002
Stancil, Daniel	2004
<b>Conte, Thomas M.</b>	<b>2005</b>
Franzon, Paul D.	2006
Huang, Alex Q.	2006
Chow, Mo-yuen	2007
Krim, Hamid	2008
Lazzi, Gianluca	2008
Ozturk, Mehmet	2009
Snyder, Wesley	2009
Husain, Iqbal	2009
Baran, Mesut	2010
Misra, Veena	2012
Duel-Hallen, Alexandra	2012
Devetsitkiotis, Michael	2012

**\*Resigned or Retired**

Some of the prestigious external recognitions include that of H.T. Nagle who was elected as president of IEEE in 1999, and Dr. S.A. Rajala who was elected president of ASEE (American

Society for Engineering Education) in 2007. In addition, several ECE faculty members (S.T. Alexander, H.T. Nagle, R.J. Trew, J. B. O'Neal) were awarded IEEE Third Millennium Medals in 2000.

Four ECE faculty members were recognized as professors of distinction during the 1990 decade and were joined by an additional six faculty members in the 2000-2010 decade (see Table T. 2).

Other notable achievements in the department included the establishment of the Engineering Entrepreneurs Program by Dr. T. K. Miller. This program was successful in producing a number of outstanding alumni who went on to play leading roles in the creation of new companies both in North Carolina and elsewhere. The list includes such companies as Red Hat, Da Vinci Systems, Accipter, Stingray Software, Auction Rover, and many others.

In addition to administrative changes mentioned previously, 1991 saw the departure of Professor William T. Easter from his position as associate department head. He was widely recognized as an outstanding administrator and served in that capacity for eleven years before stepping down to return to full-time teaching.



# 2

## 2000 to 2009

New buildings, centers, and initiatives propelling ECE well-into the 21st century





# Overview



The program of the ECE department during this period was driven by its current mission statement:

The Department of Electrical and Computer Engineering has as its mission the accumulation, generation, and dissemination of knowledge in Electrical and Computer Engineering. Central to the mission is a high quality research and educational program that benefits our students, the State of North Carolina, the nation and the

world. The Department acts as a focal point for development, growth and entrepreneurship. The national and international reputation of the Department facilitates future growth in areas of fundamental economic importance to the State.

The first decade of the twenty-first century was a momentous one for the ECE department. The department moved from its early home in Daniels Hall, which it had occupied since 1938, to Engineering Building





2 on the Centennial Campus in 2006. In July 2000, Dr. Robert Kolbas, having served as ECE Department Head since 1995, was reappointed to that position for a further five years by Dean Masnari but indicated his wish to revert to his professorial position within the department. Dr. John Grainger was appointed in August 2000 to serve as Interim Head of ECE while a search for a replacement Department Head proceeded. He was succeeded by Dr. John Hauser who agreed to continue as Interim Head. Eventually in January 2003, Dr. Robert Trew, then ECE Head at Virginia Tech University, agreed to return to NCSU and served as Head of ECE for the next five years. Dr. Trew resigned his position as ECE Department Head in 2008 and Dr. Robert Kolbas was appointed Interim Head of ECE until a new national search brought Dr. Daniel Stancil from Carnegie-Mellon University to serve as

ECE Department Head, a position he has now occupied since July, 2009.

Students continued a head start in their profession by participating in student organizations such as an award winning chapter of Eta Kappa Nu, the student chapter of the IEEE, the NCSU co-op program, undergraduate research programs and in many national engineering competitions. The university continues to host career huge fairs twice a year to link students to more than 140 employers who hire computer and electrical engineering students. And it's not all about science and technology. The ECE Department continues to provide well-rounded education that includes courses in the liberal arts and social sciences and many formal and informal programs encourage students to have an active social life, interact with people



from other disciplines and pursue their artistic interests.

The IT environment, so essential for teaching and research, took a giant leap forward in 2001 in when Mr. Daniel J. Green (MS Information Science, UNC-Chapel Hill), arrived on campus. In 2003 he was appointed Director of Information Technology and soon formed WolfTech, the first Information Technology Group within the ECE department. WolfTech's computer and network support of faculty, graduate students, and undergraduates is, without doubt, second to none (see [ECE IT](#)).

By the end of the decade, the ECE department had 125 faculty members, more than 500 graduate students, and over 2000 undergraduates.



# Academic Programs

Instruction of ECE has always followed the trajectory of electrical science and technology as it developed over the years. In 1917 when the electrical engineering department was established, the course of study focused primarily on the science and applications of machinery, power generation and distribution, and illumination. In the period of 2000 to the present, the UG program focused on circuit design, nanoelectronics; efficient power generation, use and distribution; communications systems of all kinds; control; and medical applications.

Undergraduate students in this decade studied under a curriculum which began with freshmen entering the department in 1999. The new curriculum emphasized specializations and followed a multi-layer approach to achieve the necessary breadth and depth and intermediate level of electives covering seven major ECE specializations which were inserted between core curriculum and specialization electives. The flagship course of the new curriculum was ECE 200: Introduction to Signals, Circuits and Systems, which was developed under the direction of Mehmet Öztürk. The activity was supported by a generous grant from the National Science Foundation. To prepare the students for the mathematical skill set they would need in their specialized electives another course,

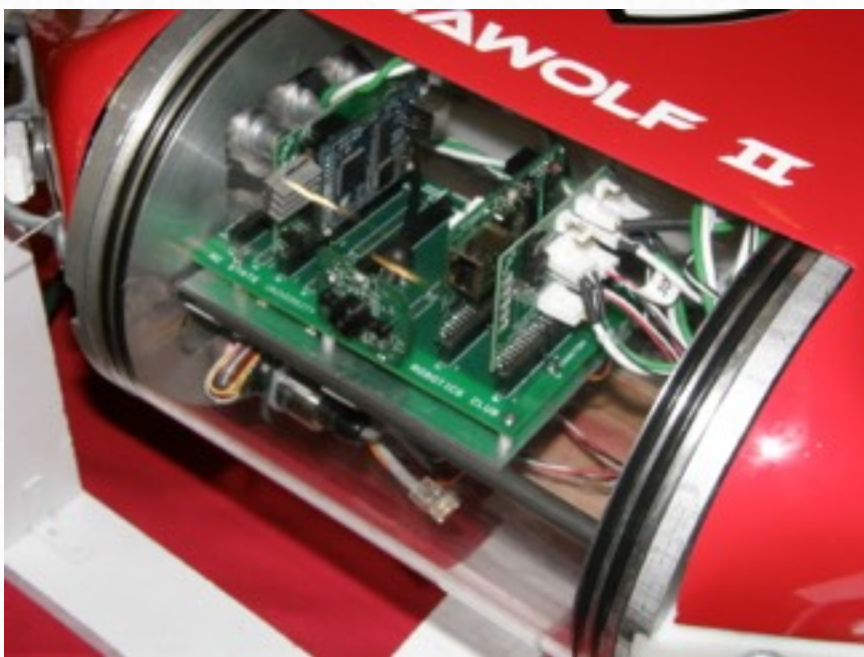
ECE220: Analytical foundations of Electrical and Computer Engineering was developed under the direction of Joel Trussell and replaced the one-semester course on differential equations taught by the math department. In 2006, the computer engineering faculty achieved another milestone and created a course sequence to teach programming in alignment with the progression of the curriculum.



The first ECE undergraduate research program solely for ECE students was established in 2006 under the direction of Dr. Mehmet Öztürk and attracts about 25 students annually. The program includes oral presentations by students and a poster session. Winners receive a cash award. The program received additional support from NSF to bring students from other institutions to NC State. The NSF also provided support for students from across the country to spend a

summer doing research under the supervision of an NCSU professor.

Throughout this decade students took a required “capstone” senior design course under the direction of Dr. Bart Green. The course represents the culmination of students engineering education as it calls on them to employ their engineering skills in designing solutions to real-world problems. Projects are sponsored by established companies, start-ups, entrepreneurs, and ECE faculty. The course culminates in Design Day, an event in which students present the results of their design work.



Starting in the 2009-2010 academic school year, the Electrical and Computer Engineering Department offered a new undergraduate concentration in Renewable Electric Energy Systems (REES) within the Bachelor of Science Electrical Engineering degree program. The new concentration evolved to address the need to create a national power system capable of integrating geographically distributed renewable

energy and advanced storage systems that will interface with the existing electric utility systems to serve the country's future electric energy demands.

Students get a head start in their profession by participating in student organizations such as an award winning chapter of Eta Kappa Nu, the student chapter of the IEEE, the NCSU co-op program, undergraduate research programs and in many national engineering competitions. The university hosts career huge fairs twice a year to link students to more than 140 employers who hire computer and electrical engineering students. And it's not all about science and technology- many formal and informal programs encourage students to have an active social life, interact with people from other disciplines and pursue their artistic interests.

Undergraduate and graduate enrollments and degrees awarded in ECE are always effected by economic conditions. Figures 1 and 2 illustrate changing enrollment patterns.

In 2005 Dr. Robert E. Troxler of Raleigh has endowed a gift of \$250,000 to the College of Engineering at NC State University. Troxler's gift will establish the William F. Troxler Design Center Support Endowment and the William F. Troxler Enhancement Fund. Funds from the support endowment will be used by the ECE Department to furnish and maintain the William F. Troxler Design Center



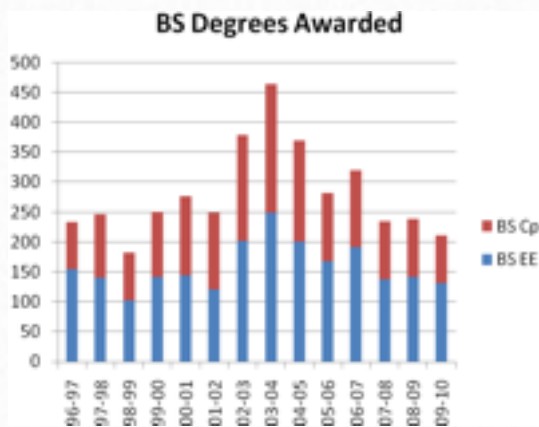
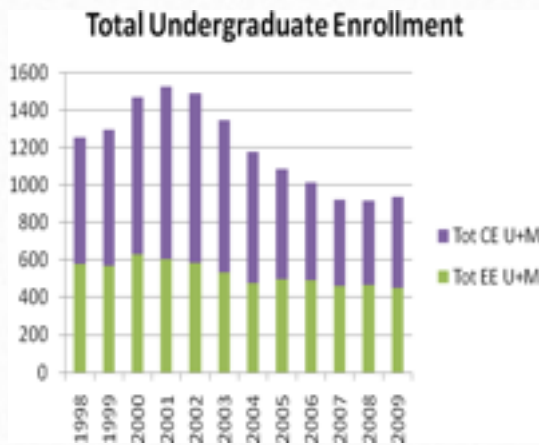


Figure 1. Total undergraduate students (matriculated + unmatriculated), and total BS Degrees Awarded.

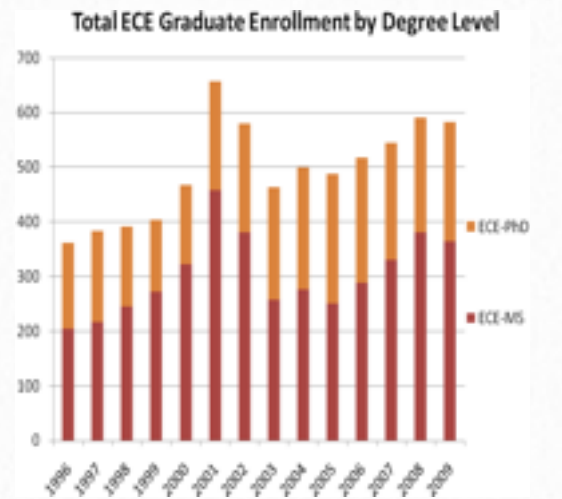
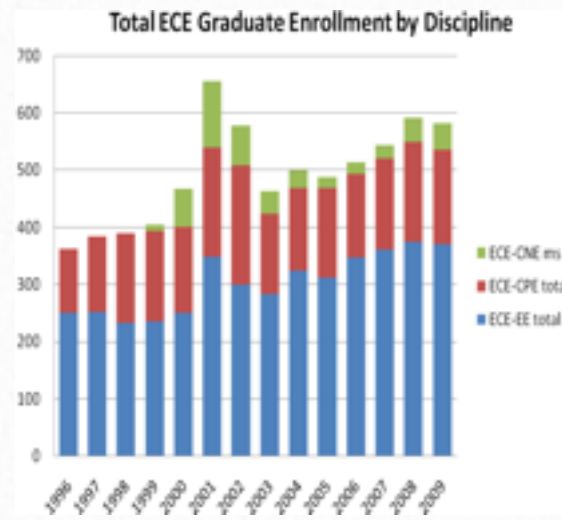


Figure 2. Total ECE Graduate student enrollment trends by discipline and degree level.

# Research Programs

ECE research and graduate programs are central to the department's mission of generating and disseminating knowledge. The ECE department now has distance-education options that match the on-campus programs for all three masters programs in Electrical Engineering, Computer Engineering and Computer Networking. Four of the most significant new research thrusts impacting the ECE research and graduate program initiated in this decade concern (a) Biomedical Engineering and (b) Semiconductor Power Electronics and (c) Advanced Transportation Energy Center (ATEC) (d) Future Renewable Electric Energy Delivery and Management (FREEDM).

Biomedical Engineering (BME) has a long history at North Carolina State University. goes back a long way in ECE history. As far back as 1968, then Chancellor John Caldwell and College of Engineering Dean Ralph Fadum were exploring BME programs with the medical school at UNC. In 1987 the Center for Communications and Signal Processing in the ECE Department worked with the Bowman Gray medical school at Wake Forest University in Winston Salem to establish Biomedical Engineering Program. Dr. Wesley Snyder spent three years there and one of our PhD graduates, Pete Santago became director of this program. When H. Troy Nagle, PhD, MD, joined ECE at NCSU in 1984 he began

fostering BME collaborations with professors at UNC and from 1992 to 2009 ECE faculty and students from NCSU, Duke, and UNC-CH collaborated on a number of BME research projects. For example, Roy Propst (NCSU-ECE PhD graduate and BME professor at UNC-CH), Wentai Liu (PhD, ECE professor at NCSU), Mark Humayun (MD, BME PhD student at UNC and Medical Resident at Duke Eye Center), and Gene de Juan (MD, Professor, Duke Eye Center) conducted retinal stimulation experiments in rabbits and humans. This early work led to the current retinal implants commercially available from Second Sight, Inc. Over the years, the retinal implant project team expanded to include Johns Hopkins University and the University of Southern California. Dr. Gianluca Lazzi, newly arrived at NCSU ECE department, used his expertise in RF/tissue interaction measurement and modeling to make made important contributions to the retinal project. In 2009, this retinal implant project appeared on R&D Magazine's highly-selective top-100 R&D list.

In 2003 a Joint Department of Biomedical Engineering (BME) was established and co-located at the NC State University and the University of North Carolina at Chapel Hill with ECE Professor Dr. Troy Nagle as Founding Chair. This department links the School of Medicine at UNC-CH to the College of

Engineering at NC State. NC State currently offers a BS in Biomedical Engineering and joint MS and PhD degrees in Biomedical Engineering.

In 2006, collaboration between ECE Professor Dr. Maysam Ghovanloo and UNC-CH professors Oleg Favorov and Mark Tommerdahl aimed to develop an implantable microsystem for treating Parkinson's disease. This device uses wireless technologies to eliminate electrical cables and energy-efficient switched-capacitor circuits, making the device more biocompatible and effective with brain tissue. Dr. Ghovanloo also developed two magnetic medical devices. The first is an assistive technology unit called the Tongue-Drive System; it allows individuals with severe spinal cord injuries to interact with electronic devices (computers, televisions, telephones, wheelchairs, etc.) by means of a special mouthpiece and a small magnet affixed to the tongue. The second is a drug compliance system that incorporates polymer-coated, tiny, round magnets into pills and capsules. As the magnets move through the patient's digestive tract, a necklace-based sensor system detects their passing and builds an electronic compliance record.

ECE Professor Dr. John Muth and Textiles Professor Dr. Tushar Ghosh, who developed plastic tube structures that can mimic human muscle fibers. Bundles of these fibers can be included into textile structures to build electronically controlled actuators for many varied applications. More recently, Dr. Muth and ECE Professor Dr. Leda Lunardi have teamed

with Valencell, Inc., a small local start-up company, to build blue-to-infrared optical biomedical diagnostics with funding from the federal STTP program; facilities within the ECE department are used to support this research. In 2010, ECE Professor Dr. Paul Franzon, Textiles Professor Tushar Ghosh, and their colleagues developed a hydraulic and latching mechanism for a multi-line (full screen) Braille display for the blind. ECE faculty pursue a wide variety of other BME research projects as well.

The Semiconductor Power Electronics Center (SPEC) was established in 2005 as an NCSU center of excellence under the leadership of Professor Alex Huang, founding Director. SPEC's research programs in power and energy are directed towards battery-life extension, next-generation microprocessor powering, grid-blackout prevention, enablement of faster power electronics systems exploiting new materials and processes, innovative methods and enhanced protection of electric power distribution systems, and integration of renewable energy sources into future grid configurations. SPEC, with laboratories and offices housed initially in the Partner 1 Building on NCSU's Centennial Campus, began in April 2005 with two ECE faculty members, Dr. Huang and Dr. Mesut Baran. New faculty positions created within the ECE Department by Dr. Robert Trew, then Head of the ECE Department, facilitated the addition of Dr. Subhashish Bhattacharya (2005) and Dr. Srdjan Lukic (2008) to SPEC's expanding research and educational programs. Cognizant of the needs and interests



of industry, the Power Management Consortium was launched within SPEC and garnered support from Texas Instruments, Fairchild, Vishay Siliconix, I R, Intel, and Pyramis. As part of its outreach activities, SPEC arranged a series of seminars and provided laboratory demonstrations of great interest to industry and academia. Closer industry-university relationships were forged when Progress Energy and ABB joined the SPEC Consortium for Advanced Power Electronics and Energy Storage (CAPES).

Advanced Transportation Energy Center (ATEC). The state of North Carolina funded the this center in February 2008. Investor-owned utilities Duke Energy and Progress Energy also pledged additional funding for ATEC with the mission to promote development and deployment of plug-in electric vehicles and plug-in hybrid electric vehicles (PHEV). In recognition of NCSU's excellence in power electronics and energy-related research, and the suitability of SPEC's research-laboratory facilities, SPEC became the home of ATEC with Dr. Alex Huang as Director. Newly-arrived SPEC faculty members with motor-drive background and connections to major industrial players (such as ABB, Ford, GM, Toyota, Progress Energy and Duke Energy) would ensure success of the venture. The funding commitments from Duke Energy, Progress Energy, and the State of North Carolina allowed ATEC to support a multidisciplinary team of faculty from ECE, MAE and Textiles to work on several important research topics related to PHEV; these included wired and wireless

charging stations, advanced battery energy storage subsystems, motor drive and drive train optimization. Several PHEV were purchased for R&D and outreach purposes while charging stations were installed for use by ATEC and other university users.

Future Renewable Electric Energy Delivery and Management (FREEDM): In September 2008, The National Science Foundation (NSF) announced support for establishing the (FREEDM) Systems Center with Dr. Alex Huang, Progress Energy Distinguished Professor of Electrical and Computer Engineering as Center Director and lead Principal Investigator. The new NSF FREEDM Systems Center was able to draw upon and exploit the strengths of NCSU's two pre-existing centers, SPEC and ATEC. Today, all three centers with their separate but complementing missions are located in the brand new Keystone Science Center on the NCSU Centennial Campus. Five new faculty additions to the NCSU ECE Department support the research, education, and industry collaboration programs of the three centers. The Keystone Science Center building, specifically designed to house the centers' testing and demonstration facilities, now also houses many of the nearly one-hundred graduate and undergraduate students involved in the centers' research and education programs.

Important aspects of FREEDM Center involve its education programs, which have the goal to produce a diversity of graduate students empowered to advance fundamental knowledge,

enabling technologies, and engineering systems for renewable electric delivery and management systems in a globally interconnected economy. The overall program, long in vision and compass, has a comprehensive College Program and an ongoing Pre-College Program.

Under the leadership of NCSU-ECE faculty members, Dr. Mesut Baran and Dr. Leda Lunardi, the College Program contains an undergraduate concentration in Renewable Electric Energy Systems (REES) culminating in the award of a REES certificate. This certificate program typically reaches about sixty students.

Undergraduate students are encouraged to participate in the research experience for undergraduates program which promotes undergraduate involvement in FREEDM research and laboratory activities. Graduate students take a customized portfolio of courses designed to ensure requisite knowledge, skills, and experience for success in an innovation/technology-driven global society. Classroom courses are prepared with distance education in mind and for sharing with students at FREEDM partner institutions.

The Pre-College Program led by Dr. Sharon Schulze and Dr. Lisa Grable aims at engaging pre-college administrators, teachers, and students in fourteen (14) middle- and high-schools. This is accomplished by a variety of activities, including classroom visits by FREEDM graduate students, a Young Scholars program, workshops on curriculum development and research experiences for teachers, and summer

campus in renewable energy for girls and minorities. With these activities, the FREEDM educational outreach aims to impact over 13,000 middle- and high-school students and teachers.

In 2010, to complement the FREEDM educational thrust, Dr. Mesut Baran established a new professional MS program in Electric Power Systems Engineering (MS-EPSE); funding was provided by a Department of Energy program which encourages universities to enrich/develop power engineering programs for workforce training for the electric power industry. The new NCSU program aims to graduate thirty (30) MS students annually by offering a comprehensive educational program in power engineering, consisting of core power-system engineering topics and professional skill components. MS-EPSE is now accredited as one of the first professionals master programs in power engineering in the nation. This carries additional professional preparation through cooperation with industry, an advisory board, mandatory co-ops, increased hands-on exposure and an industrial "e-mentoring" activity.



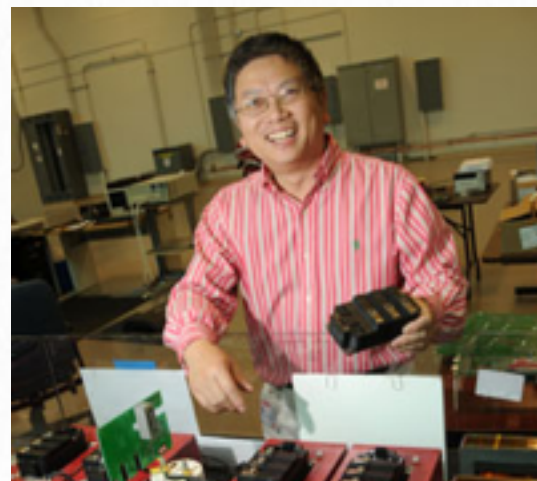
# Faculty Accomplishments and Recognitions

There have been too many accomplishments and recognitions during the period to mention them all here. For a more complete list see the ECE Annual Reports for 2000-1009. In what follows we discuss only a few of the most salient.



In 2002, Dr. John R. Hauser won the Semiconductor Industry Associations University Research Award for outstanding contributions to semiconductor technology. A year later he received the prestigious Holladay Medal. John retired in 2006 after giving 37 years of outstanding service in teaching, research and administration to NC State.

Dr. Alex Huang was named the new Progress Energy Distinguished Professor in Electrical and Computer Engineering at North Carolina State University. The endowed professorship was established as part of Progress Energy's \$1.2



million gift to the College of Engineering. The gift, announced in 2006, is the largest in the history of the

Progress Energy Foundation. Alex is currently the director of FREEEDM research center and the Advanced Transportation Energy Center.

Dr. Tom Miller, North Carolina State University Vice Provost for Distance Education and Learning Technology Applications (DELTA), was honored by the United States Distance Learning Association (USDLA) with its award for Outstanding Leadership by an Individual in the field of Distance Learning. Miller had previously



received the state award from the North Carolina Distance Learning Association. Dr.

Miller is also the McPherson Family Distinguished Professor in Engineering Entrepreneurship, a position created by 2009 by Tom McPherson a 1977 NCSU graduate and entrepreneur.

The North Carolina State University Board of Trustees awarded the Alexander Quarles Holladay Medal for Excellence to three faculty members in recognition of their outstanding careers at NC State. The Holladay Medal is the highest honor bestowed on a faculty member by the trustees and the university. This year's honorees are Drs. Nino A. Masnari, Distinguished Professor of Electrical and Computer Engineering and Troy Nagle, professor of Biomedical Engineering and Electrical and Computer Engineering, and Dr. John Hauser. Dr. Michael Littlejohn won this award in in 1998.



Dr. Jayant Baliga has been named one of the eight heroes of the semiconductor revolution by Scientific American and is the recipient of the O. Max Gardner award, which

recognizes "the greatest contribution to the welfare of the human race" among all faculty members of the UNC system. Additionally, he is a fellow of the IEEE and the youngest man to ever be elected to the National Academy of Engineering. Dr. Baliga invented the insulated gate bipolar transistor, a device now in thousands of consumer products including efficient light bulbs. Because this

device reduces the amount of electricity needed, it reduces the amount of carbon dioxide from being released into the atmosphere by, literally, trillions of pounds. Prof. Baliga has authored/edited 18 books and over 500 scientific articles. He has been granted 120 U.S. Patents. The IEEE has recognized him numerous times - most recently with the 'Lamme Medal'.

Dr. Gianluca Lazzi was rewarded for his outstanding contributions in the field of electrical and computer engineering with the 2009 ALCOA Foundation Engineering Research Achievement Award. Through his research in retinal prosthesis, he has pushed the boundaries of engineering development beyond traditional limits and has had an obvious impact on the 10 million people worldwide coping with blindness. His leadership and groundbreaking research in implantable devices and the field of bioelectromagenetics have had a substantial impact on engineering, science and society.

The Institute of Electrical and Computer Engineers (IEEE), the largest technical society in the world, fully sponsors only one international conference in the area of robotics, The International Conference on Robotics and Automation fully sponsored by the IEEE, and the Intelligent Robotics Systems Conference (IROS), co-sponsored by the IEEE and the Japanese Robotics Society. This conference attracts over a thousand researchers from all over the world. In 2007, the general chair of IROS was Dr. Eddie Grant, director of the Center for Robotics and Intelligent Machines in the ECE Department. In



2010, the general chair of this conference will be Dr. Wesley Snyder. To have two general chairs from the same department is unprecedented.



Dr. Michael Steer received the U.S. Army Commander's Award for Public Service for research that has helped American forces remotely counter roadside bombs - research that has saved hundreds of soldiers' lives. Steer's work, funded by the Army, has applications in electronic warfare and countering improvised explosive devices, commonly referred to as roadside bombs, that have killed U.S. soldiers in Iraq and Afghanistan. The work helped the Army learn how these explosive devices worked. The Army is honoring Steer not only for his research, but also for his efforts communicating the work to Army scientists and engineers and pushing the research results from the laboratory into the battlefield. He also received the 2010 Microwave Prize from the IEEE Microwave Theory and Techniques. Prof. Michael Steer was also named the Lampe Professor of ECE and received the 2010 Microwave Prize from the IEEE Microwave Theory and Techniques.

Dr. Salah Bedair was named Distinguished Professor of Electrical and Computer Engineering. This is a significant honor bestowed by the university and recognizes Dr. Bedair's cutting-edge research over multiple decades. Among his many accomplishments, the first multi-junction solar cell was fabricated in his lab in 1979, and he and his collaborators recently demonstrated ground-breaking room-temperature magneto-electric materials.

Fifteen faculty members were promoted to the rank of Fellow in the IEEE:

Lunardi, Leda	2002
Stancil, Daniel	2004
Conte, Thomas	2005
Franzon, Paul D.	2006
Huang, Alex Q.	2006
Chow, Mo-yuen	2007
Krim, Hamid	2008
Lazzi, Gianluca	2008
Ozturk, Mehmet	2009
Snyder, Wesley	2009
Husain, Iqbal	2009

# Entrepreneurship

NCSU is located in the heart of the research triangle park, home to more than **170 global companies**, including IBM, GSK, Syngenta, RTI International, Credit Suisse, and Cisco, that foster a culture of scientific advancement and entrepreneurship, especially in the area of electrical and computer engineering.



During the first decade of the twenty-first century, the entrepreneurship programs at NCSU increased dramatically under the direction of an ECE professor, Dr. Tom Miller. Dr. Miller initiated the **Engineering Entrepreneurs Program** in 1993 to help students develop skills in management, finance, marketing, product development and entrepreneurship - all essential in forming an idea

into a successful business. This program has been a key to NC State's entrepreneurial success. By 2007, the university had launched more than 60 companies and holds more than 500 active patents. The Engineering Entrepreneurs Program sponsors a speakers program which attracts speakers which, to name just a few, include Jim Goodnight, CEO of SAS, Neal Hunter, founder of Cree, Inc. and Barbara Mulkey, president and CEO of Mulkey Engineers & Consultants, and Steve Yauch, founder of a number of companies, - all NC State graduates.

In 2008, the engineering entrepreneurship program was expanded to a campus wide program called the **Entrepreneurship Initiative** at NC State. This Initiative includes a number of campus E. organizations on campus. Tom is currently executive director of this Initiative. Tom is also vice-provost for Distance Education and Learning Technology Applications (DELTA). He is a member of the Academy of Outstanding Teachers at NC State, and a recipient of the Joseph M. Biedenbach Outstanding Engineering Educator award from IEEE. In



2009, Dr. Miller was named the McPherson Family Distinguished Professor in Engineering Entrepreneurship at NC State. This endowed professorship was established by Thomas R. McPherson Jr., an entrepreneur, NC State Distinguished Engineering Alumnus and a member of the Engineering Foundation Board of Directors.

The Garage, a facility sponsored by the NC State Entrepreneurship Initiative and Red Hat (a company established by NCSU graduates), is a 2000 sq. ft. facility complete with meeting rooms, lounge space, basic laboratory space, shops, and prototyping area. The intent of the Garage is to provide a meeting space for students to foster new ideas and work on entrepreneurial endeavors.

Since so many ECE students and faculty have become entrepreneurs, it is difficult to find and identify them all. At the risk of missing some of our students who have started companies we list the following (if we've left you out, forgive us and **let us know** about you):

- Jim Collins – Applied Signal Technologies
- Jerry Neal – RF Micro Devices
- Tom McPherson – Rapid City and several others
- Nick England – Okonis and several others

- Bill Nussey – DaVinci, iXL, Silverpop
- Chris Evans – DaVinci, Accipiter
- Brian Harry – One Tree Software
- Scot Wingo – ChannelAdvisor and others
- Aris Buinevicius – ChannelAdvisor and others
- Donnie Barnes – Red Hat
- Erik Troan – Red Hat, rPath
- David Anderson – PeopleClick
- Bill Troxler- Troxler Electronic Laboratories
- Steve Yauch – Carolina Electronic Assemblers
- Joe Forbes - Consert
- Joe Britt – Software for Danger and others
- J. Turner Whitted- Numerical Design Limited

More information is located here: [ECE Department Alumni Entrepreneurs](#).

Although we have listed only some of our students, many faculty members have also founded companies.



# 3

## Alumni Entrepreneurs

The ECE department has a rich history of successful entrepreneurs. Below are a few notable examples. Many more have started small companies that are too numerous to mention, but collectively have provided thousands of jobs.



### **James Collins (BSEE)**

Jim Collins founded Applied Signal Technology in Sunnyvale, CA, in 1984, along with John Treichler and Gary Yancey. All were previously employed with ARGOSystems, a defense contractor. Jim

and his co-founders saw the transformational opportunities that digital signal processing were bringing to the industry, and AST was a pioneer in that space. AST went public in 1993, and in 2011 was acquired by Raytheon to become part



of Raytheon's Space and Airborne Systems business.

### **Jerry D. Neal (ASEE)**

Jerry Neal earned his Associate's degree in Electrical Engineering through a joint program of Gaston Technical Institute and North Carolina State University. He founded RF Micro Devices in Greensboro, NC, in 1991, along with co-founders Bill Pratt and Powell Seymour. RFMD developed the gallium arsenide power amplifiers that revolutionized the cellular telephone industry. The company went public in 1997, and in 2012 has 4,000 employees world-wide and is valued at just over \$1B. Jerry teamed with co-author Jerry Bledsoe to write the book *Fire in the belly: building a world-leading high-tech company from scratch in tumultuous times, chronicling the story of RFMD*, in 2005.

### **Thomas R. McPherson (BSEE 1976, MSEE 1977)**

Tom McPherson founded and led several successful high tech companies resulting in one IPO and two mergers. Some of the companies that Tom helped establish and make successful include Picture Element Limited, Network Equipment Technologies, Rapid City Communications, Hatteras Networks Inc. and most recently Cognio, Inc. which he sold in 2011 to Cisco Systems. Tom established the McPherson Family Distinguished Professorship for Engineering Entrepreneurship in 2009, and was honored as a Distinguished Engineering Alumnus in 2004.

### **Nick England and Mary C. Whitton (MSEE 1984)**

Nick England and Mary Whitton were graduate students working in Professor John Staudhammer's graphics lab in Daniels Hall from 1972 to 1978. In 1978 they founded Ikonas Graphics Systems, pioneering the world's first programmable raster graphics display technology. Ikonas was acquired by Adage in 1982. In 1986 Nick and Mary founded Trancept Systems, along with co-founder Tim Van Hook. The company produced the TAAC-1, the first high performance graphics accelerator for Sun Microsystems workstations. The company was acquired by Sun Microsystems for \$5M a year later. Nick served as Director of Visualization Products for Sun from 1987 to 1993. In 1999 he founded 3rdTech, a company which produces advanced imaging and 3D products for the law enforcement and security industries. 3rdTech's DeltaSphere-3000 3D capture system for preserving and reconstructing crime scenes was featured in an episode of the hit television series, CSI.

### **Bill Nussey (BSEE 1987)**

Bill Nussey founded DaVinci Systems, along with co-founders Chris Evans, Matt Ocko, and Paul Ramsey, in 1985 while he and Evans were undergraduates in ECE. Da Vinci was a pioneering company in email for the IBM PC, and the company grew to be the 3rd largest email company in the world when it was sold to ON Technology in 1994. After Da Vinci, Bill attended Harvard and earned an MBA. After

Harvard, he worked for the top-tier venture capital firm Greylock Ventures. He left Greylock to become the CEO of iXL in Atlanta. In 2000, while at iXL, Bill was named the most influential consultant in the world by Consulting Magazine. He currently serves as President and CEO of Silverpop in Atlanta, a leading email marketing firm. He has also authored a book on email marketing: *The Quiet Revolution in Email Marketing*.

grew to \$500M over the next year during the dot-com boom. It has been said that the Accipiter deal was the largest return on investment in the history of Intersouth Partners, North Carolina's premier venture capital firm. Today, Chris is actively involved in mentoring student-led start-ups from NC State and serves on the advisory board of the NC State Entrepreneurship Initiative.

## Brian Harry (ECE)

Brian Harry learned C programming while an undergrad in ECE, working in the Computer Systems Lab under Dr. Tom Miller. Miller recognized that Brian had an extraordinary ability, and introduced him to Bill Nussey and Chris Evans, who had recently founded Da Vinci Systems. Brian joined Da Vinci in 1988 and was the lead developer behind their very successful Da Vinci Email product. Brian left Da Vinci to found his own company, One Tree Software, along with co-founders Kenny Felder and Larry Iverson in 1991. One Tree's source code management software was recognized as the best in the world, and the company was acquired by Microsoft in 1994. Brian's talents were recognized by the Microsoft leadership as he became one of the most respected technology experts in the company, and was responsible for conceiving and implementing the core technology of Microsoft's .NET framework, the technology that moved the company to the web. He was named a Microsoft Technical Fellow, one of only 22 people awarded that level of recognition. Brian was so highly valued within



*Matt Ocko, Bill Nussey, and Chris Evans (from INFO WORLD magazine, August 20, 1990)*

## Chris Evans (ECE 1983-87)

After Da Vinci Systems (see above) Chris Evans founded Hotlinx, a publishing company specializing in the computing industry with magazines driven by ad revenue. When he moved Hotlinx online, he recognized the need for better advertising technologies on the web. That led him to found Accipiter, which was the pioneer of web banner advertising. Chris sold Accipiter to technology conglomerate CMGI in 1998 for \$35M in stock. The value of the stock



the company that when he turned in his resignation, planning to move back to North Carolina to raise his family, Bill Gates asked him what it would take for him to stay. Brian grinned and said, "You'd have to let me open a development branch in North Carolina," knowing that Microsoft adamantly kept all of its development groups clustered in Redmond. To his surprise, Gates agreed to open Microsoft's first software group outside of Redmond, in Morrisville, North Carolina. Today, Brian continues to lead this division, which employs 120 developers.

# 4

## ECE IT: The Birth of WolfTech

Spearheading computing technology in ECE and across the University



Over the 2000-2012 span of time, the ECE Department and the entire NCSU campus has been riding the wave of technology associated with the new Information Age. Information Technology (IT) was changing

the world and the ECE Department would have to put together the building blocks underlying and enabling the new IT infrastructure requirements.



In 2001, there was no formal Information Technology group within the ECE department. Throughout the late 1990's the department had computer support from a system administrator, Mr. Andrew Burnett, who was part of a centralized help desk maintained by the NCSU College of Engineering. Other part-time staff members at that time were Micah Colon, a Unix Administrator (who shared his time equally between the ECE department and the Computer Science department) and a teaching assistant, Mark Hamrick (under the direction of Associate Department Head, Dr. Jack Brickley, then responsible for the management of computers in three ECE teaching labs).

The ECE department's first (embryonic) website was established by ECE Professor, Dr. Tom Conte. In August 1996, Dr. Robert Kolbas, then ECE Department Head, added the task of redesigning the site's look and feel to the duties of Ms. Margaret E. H. Hudacko, the only programming support in the department. The first fully-graphical website was released in November of that year. Internet commercialization began to boom in 1999 and demand for skilled "technology workers" skyrocketed. The university experienced a severe "brain drain" and ECE was no exception. Mr. Burnett left the university and for

nearly two years, computer support in the ECE department was sporadic, often depending on a mixture of graduate assistants passing on their knowledge to undergraduates likely to continue in post-baccalaureate study. At that time, the ECE department was geographically spread over two campuses, thus making service calls to ECE faculty in the Engineering Graduate Research Center (now the Monteith Graduate Research Center) on Centennial Campus nearly impossible. By the beginning of the new century, the web was in the midst of its "dot-com" boom and was becoming firmly established as the new medium. ECE Professor, Dr. H. Joel Trussell, had volunteered to oversee the department's online presence and Ms. Hudacko had grown into the role of departmental webmaster; two work-study students, supported by departmental funding, helped to further website development

Early in 2001, Drs. Paul Franzon and Michael Steer funded a Systems Programmer I position to provide computer support for their research programs and in March of that year, Mr. Daniel J. Green (MS Information Science, UNC-Chapel Hill), arrived on campus. Before too long, Dan could see that a coordinated IT group was needed in the department and spent his first few months simply trying to create a compre-

hensive inventory of resources. The need for innovation and a vision of how things should be was agreed among the IT staff and WolfTech, the first Information Technology Group within the ECE department, was formed. Assuming the leadership role, Dan sought funding to hire student workers to assist with support on both campuses; over the next two years Dan continued to advocate and plan for a more formal Information Technology structure. Ms. Hudacko's web group was eventually merged into WolfTech, and in July 2003, new ECE Department Head Dr. Robert J. Trew Jr. appointed Mr. Green as Director of Information Technology (IT).

WolfTech adopted the practice of developing its own talent from the student population on campus. Student workers -- both part-time and work-study -- were used for computer support, web design, and programming. For a few years, ECE IT even maintained its own EOS ("Engineering Operating System") Lab Operators program under the supervision of Ashley Chadwick. This program hired ECE students as Lab Operators to manage the EOS labs in Daniels Hall on Main Campus. The program was retired when ECE moved to Engineering Building II (EB2) on Centennial Campus, where the sole EOS lab became managed by ITECS, the College of Engineering

IT group. While it lasted, the EOS Lab Operators program hired a total of twenty-eight (28) ECE students.

In 2004, Patrick Murphy and Brian Carty, both NCSU graduates, became the first full-time staff hires for the computer-support side of the new WolfTech organization. In 2007, Daniel Martin succeeded Patrick who is now a Systems Specialist at UNC-Chapel Hill; Brian is still with the ECE department as Windows Systems Administrator. Eventually, Micah Colon ceased to report to the CSC department and, when Solaris began to fade, became full-time Linux Administrator (Solaris was replaced entirely by Red Hat Enterprise Linux in 2010) for WolfTech. Mike Belangia succeeded Micah in 2011.

On the web side of the WolfTech house, the concept for a new graduate-student management database led to the hiring of Web Programmer, Jeremy Leipzig, in early 2004. Jeremy was followed in succession by Peter Nyberg in 2005, Andrew Stein in 2006, and finally Richard Hodson in 2012 as the primary developers of GradWatch. Richard had previously replaced Margaret Hudacko as ECE Media Developer in 2007. Both Andrew and Richard continued the WolfTech tradition of hiring internal part-time student workers to full-time staff



positions within ECE. The popularity of GradWatch led to its growth and expansion to the entire NCSU College of Engineering -- and to another programmer position within WolfTech thereby allowing the hiring of Mitch Amiano in 2012. A little while later, Allen Moore was added to fill the Web Designer position left vacant as a result of Richard's promotion to Web Programmer.

The ECE department's success in creating two active National Science Foundation research centers has now resulted in two additional full time positions for WolfTech. Indeed, in the decade since its creation, WolfTech has expanded to become the largest departmental IT support group on the NCSU campus -- now comprised of its Director, two server administrators (Windows and Linux), two desktop support administrators, three programmers, one web designer, and a small force of part-time and work-study student workers.

In 2012, Dan Green was named Director of Information Technology & Operations to officially reflect his expanding responsibilities within the ECE department; he now has supervision of Electronics Engineer, Rudy Salas, and Building Liaison, David Lassiter (who retired in late 2012 after many years of loyal service). Besides supporting all of

the ECE department's IT needs, WolfTech manages the departmental Educational Technology Fee (ETF) fund, all teaching labs, an electronics shop, two mechanical shops, card access authorization, security cameras, the departmental capital asset inventory, and most student seating assignments within the ECE department.



The ECE department won the NCSU College of Engineering Award of Excellence in 1991, 1999, and 2001 (Electronics Engineer Rudy Salas). However, since 2004 all ECE department winners have been members of the WolfTech IT group: namely, Dan Green (2004), Margaret Hudacko (2005), Brian Carty (2009), and Andrew Stein (2011).

Over the years, the WolfTech IT division of the Department of Electrical and Computer Engineering has produced a portfolio of on-line tools now widely used across the entire NCSU campus -- including the campus digital signage system, Billboard, which currently powers over 300 digital signs displaying almost 3000 unique slides for 34 units across NC State's campus. In addition, the WolfTech Active Directory domain, created to support the Windows computing needs of the department in May 2005, grew to support multiple colleges, and finally in March 2009, was adopted as the campus standard -- it currently supports over 16,000 computers on campus.

It is generally agreed that WolfTech's computer and network support of faculty, graduate students, and undergraduates is, without doubt, second to none.