

Annual  
Report

2009-

2010

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Electrical and Computer Engineering

Department of Electrical and Computer Engineering  
North Carolina State University

# Annual Report 2009-2010

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## I. Overview

This has been a very productive year for the faculty and staff of the ECE department. Several professors have received major national awards, ECE research has been featured multiple times in the national media, and partial figures as of April 2010 show the dollar value of submitted proposals up 70% over the previous year.

We were pleased to have Dr. John Muth return to the faculty after a tour of duty in Iraq with the U.S. Navy Reserve. For 12 months, he negotiated Iraq's violence and sticky politics as he led a team of 30 civilians, military personnel and translators that provided advice and support to the nation's Ministry of the Interior. The ministry will eventually take charge of all internal security in Iraq, allowing the Iraqi army to focus on external threats.

His efforts did not go unnoticed. In the spring of 2009, Muth received a Bronze Star for his service, which included performing more than 100 missions in dangerous situations, installing a system of human rights inspections at pre-trial detention centers and setting up the ministry's court systems.

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.

The award is the fourth highest honor the United States Department of the Army can bestow upon a civilian, given to recognize civilian service or achievements that contribute significantly to the accomplishment of the mission of an Army activity, command or staff agency. The Commander's Award for Public Service consists of a bronze medal, lapel button, and citation certificate.

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.

Also, Dr. Mo-Yuen Chow was selected as Zhejiang Chang Jiang Scholar Visiting Professor of Zhejiang University in China. Zhejiang University is ranked as the number 2 engineering school in China. The scholarship is viewed as one of the most prestigious scholarships to be awarded in China.

In other news, Dr. Paul Franzon's group's research on refreshable Braille displays was featured on websites by *Scientific American*, *Wired*, and *Tech News Daily*. Dr. Wes Snyder's research on image processing for autonomous vehicles has been covered by *Tech News Daily*, *Gizmag*, the *BBC*, and *Reuters*. New memory management techniques for parallel computing developed by Dr. Yan Solihin were reported by *Gizmag*, *Science Daily*, and *Ars Technica*, among others. The FREEDM Center was featured by *National Public Radio*, and Dr. Huiyang Zhou's research on software for graphics processing units (GPUs) was featured on the NSF website *Science360*.

The undergraduate enrollment was 938, up slightly from the previous year (915). The graduate enrollment was 583, down slightly from the previous year (591).

Finally, Dr. Mesut Baran led a team that received a \$3.4M grant from the Department of Defense to develop a new accelerated Professional Master's Degree program in Electric Power Systems. This exciting program will help us prepare the next generation of engineers and leaders for careers in the electric power industry. The goal of the program is to provide a comprehensive professional graduate degree that encompasses a broad treatment of the engineering, management, and profession skills needed in the electric utility industry.

### **A. 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. Major investments have been made in laser equipment for an undergraduate optics laboratory, measurement equipment for research in millimeter waves, reconfigurable hardware for computer architecture research, and a nitrogen generating capability for the NCSU Nanofabrication Facility.

Also, the FREEDM Systems Center will be moving to the new Keystone Science Center in June, 2010. The new building is located next to the RedHat building on NCSU's Centennial Campus.

### **B. Compact Plan**

### **C. Diversity**

- There are 59 tenure track and teaching faculty, 7 of whom are female, and 3 of whom are African American males.
- There are 20 permanent SPA employees in the department: 8 are white female, 3 are African American females, 8 are white males, and 1 is an African American male.

Identifying qualified faculty candidates in under-represented groups and getting them to apply for open faculty positions is a continuing challenge. The department took several actions during the year attempting to address the "pipeline" issue associated with this difficulty:

- The Department participated in the Building Future Faculty program at NCSU by sponsoring 3 participants interested in future faculty positions. One was a black female, and one was a Hispanic male.
- The Department Head attended the Minority Leaders Spring Review at the Air Force Research Laboratory in Dayton, Ohio. The purpose of this program is to enhance the involvement of undergraduate and graduate students from under-represented groups in engineering-related research, with specific emphasis on mentoring students from HBCUs.
- The Director of Graduate Programs met with the NCAT ECE Department Head and Interim Dean of Engineering to discuss recruitment of graduate students and the possible sharing of courses via online delivery.

- The Director of Graduate Programs, assisted by the IT staff, has been active in developing a new online tool that will be made available nationally, the Graduate Recruiting Initiative in ECE (GRIECE). Using this tool, we hope to increase our pool of applicants from under-represented groups as well as US Citizens. The site is being constructed (GradExchange.org), and we plan to promote it nationally during the next academic year.

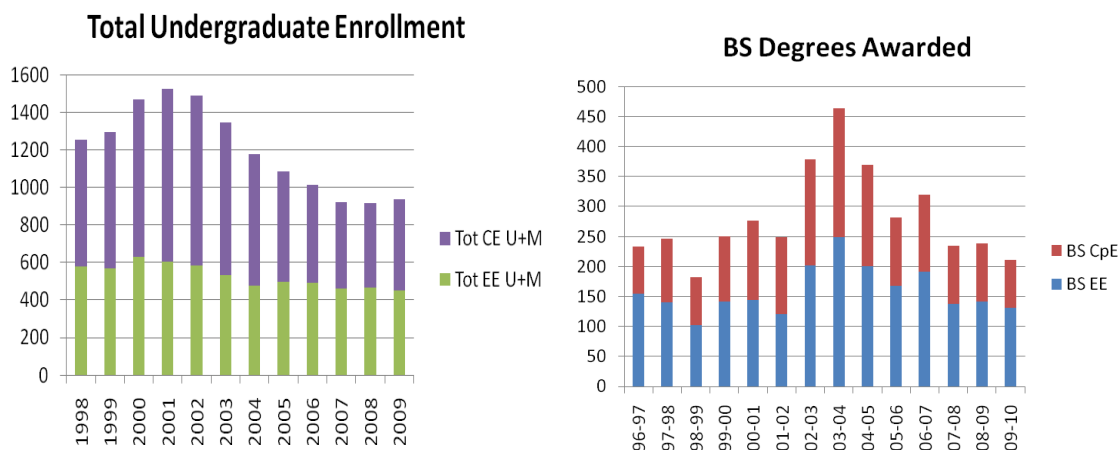
## II. Undergraduate program

### A. Enrollment, degrees awarded, trends

Following a number of years of declining enrollment in ECE—a trend that has been observed nationally—the enrollment in ECE has stabilized during the last several years. Likewise, the number of degrees granted has remained relatively constant during the past 3 years. For the 09-10 academic year, there were 131 BSEE degrees and 80 BSCpE degrees awarded (some of these were double majors). The enrollment statistics for the 09-10 year and the multi-year trends are given in Table 1 and Figure 1.

**Table 1. Enrollment as of the F09 semester**

	EE	CpE
Unmatriculated	94	185
Matriculated	358	301
Total each degree	452	486
Total undergrad students	938	



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

### B. Instructional program advances

- We introduced a new *Renewable Energy* concentration for undergraduates.
- *Two new special topics courses* were offered for the 1st time this year - Electric Motor Drives and an undergrad version of ECE506, Architectures of Parallel Computers.
- *More summer course offerings*- two extra courses over previous years.

### C. Highlight student honors, measures of quality

**Priyadarshini Asokan**, Outstanding Senior Award  
**Stephane B.L. Henrion**, Outstanding Senior Award  
**Dusty Wayne Mabe**, Outstanding Senior Award  
**Steven Christopher Mills**, Outstanding Senior Award  
**Stephen Michael Shuford**, Outstanding Senior Award  
**Adam Michael Studebaker**, Outstanding Senior Award

**Stephane Bernard Louis Henrion**, Faculty Senior Scholar  
**Stephane Bernard Louis Henrion**, Leadership Award  
**Curtis Graham Hamilton**, Humanities Award  
**Meredith Thompson**, Scholarly Achievement Award  
**Joshua M. Thompson**, Service and Citizenship Award  
**Andrew and Spencer Williams**, ECE nominees for the College of Engineering Faculty Senior Scholarship Award

**Patrick Bowen**, Barry M. Goldwater Scholarship

#### **D. Degree recipients list (optional)**

#### **E. Scholarships**

In 2010 we awarded 75 scholarships from 29 different donors for a total of \$157,620.

#### **F. 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**

In the Southeastcon2010 conference student competition, teams from NC State ECE placed 12<sup>th</sup> in the Software Competition, and tied for 3<sup>rd</sup> in the Ethics Competition.

The IEEE student chapter also sponsored numerous tech-talks and information sessions with companies such as Seneca5, Mathworks, and Netapp.

### **Underwater Robotics Club**

Seawolf 3 took 16th place among 30 teams at the 2009 AUVSI Autonomous Underwater Vehicle competition in San Diego during the summer of 2009.



### **OpenHardware Design Lab**

Several students approached the department with the desire to start an electronics club where they could work on projects and build circuits and systems for fun (i.e., not in connection with any class). In response, the department cleaned out a room on the ground level of Engineering Building II that had been used for storage, and equipped it with two lab benches. We are in the process of equipping it with instruments donated from local industry.

#### **G. Cooperative education program**

There were 47 coops in the fall 2009, and 44 in the spring for a total of 91 coops this last year. They were employed by 34 different companies.

#### **H. Career placement**

Working with the NCSU Career Center, ECE rolled out a new online job board that is integrated with the campus ePACK tool.

## **III. Graduate program**

#### **A. Enrollment, degrees awarded, trends**

The total graduate student enrollment in the fall of 09 was 583. The number of PhD students was 218 (up slightly from 211 last year), and the number of MS students was 364 (down slightly from 380 last year). The figures for the current year as well as multi-year trends are shown in Table 2 and Figures 2 and 3 below.

**Table 2. Graduate enrollment and degrees granted in 09-10.**

	F09 Enrollment	09-10 Degrees
EE MS	204	85

CpE MS	114	90
CNe MS	46	32
<b>Total MS</b>	<b>364</b>	<b>207</b>
EE PhD	167	33
CpE PhD	51	9
<b>Total PhD</b>	<b>218</b>	<b>42</b>
<b>Total Students</b>	<b>582</b>	

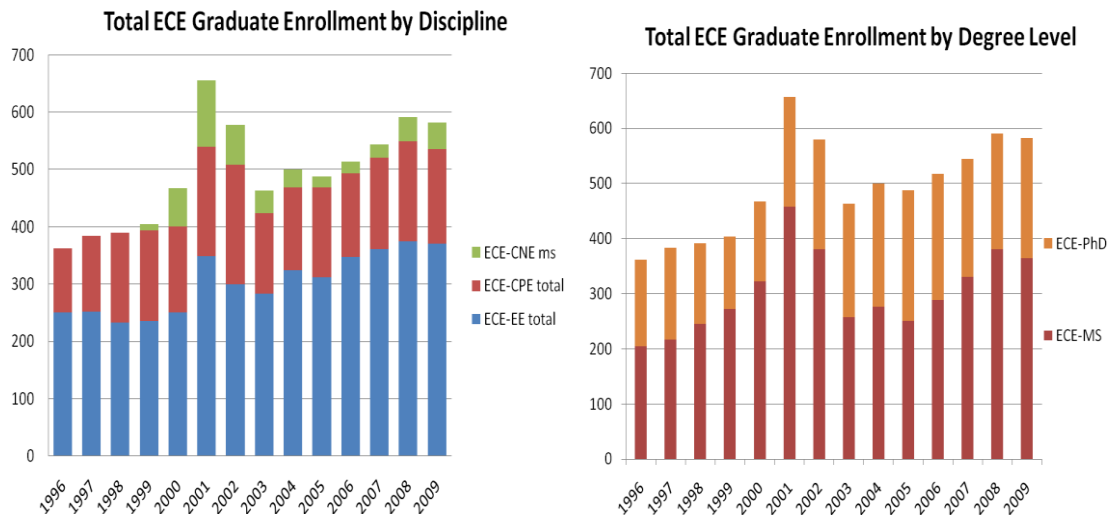


Figure 2. Total ECE Graduate student enrollment trends by discipline and degree level.

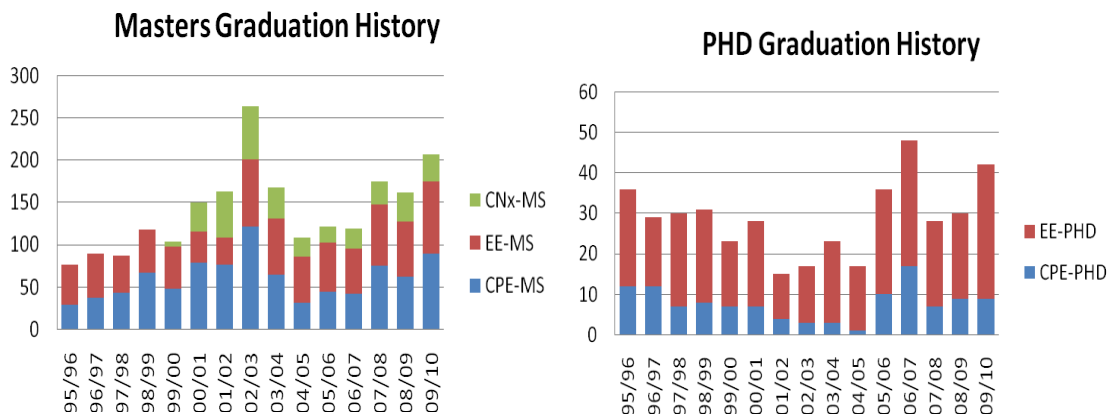


Figure 3. Trends in MS and PhD degrees granted.

**B. Instructional program advances, including curriculum development**

Key developments during the past year were in the areas of electric power and renewable energy:

- A new Renewable Energy graduate concentration was introduced.
- As mentioned previously, a team led by Prof. Mesut Baran received a \$3.4M grant from the Department of Defense to develop a new accelerated Professional Master's Degree program in Electric Power Systems.

#### **C. Graduate Students, current list (optional)**

#### **D. Degree recipients list (optional)**

#### **E. Fellowships and awards**

Twenty five graduate students received fellowships, totaling \$226,740. In addition, the following students received best paper and thesis awards:

**Vineet Kulkarni** (advisor: Devetsikiotis) Best Paper Award, IEEE Global Communications 2009 Conference (14 out of 1204 papers selected).

**Jiwei Fan** (advisor: A.Q. Huang) Best Poster Paper Award, Custom Integrated Circuits Conference (CICC) 2009.

**Jaehoon Park** (advisors: Barlage, Johnson) Best Presentation Award, International Semiconductor Device Research Symposium.

**Harish Chintakunta** (advisor: Krim), Certificate of Merit for Winning Poster, Defense Threat Reduction Agency Basic Research Program Technical Review.

**Samson Melamed** (advisors: Franzon, Davis), Best Student Paper Award, IEEE 3DIC Conference (2009).

**Fei Xing** (advisor: Wang) 2009 Nancy G. Pollock Dissertation Award, NC State University Graduate School.

**Shravan Chintapatla** (advisors: Lunardi, Muth) 2009 Nancy G. Pollock Thesis Award, NC State University Graduate School.

**Mursalim Habib** (advisors: Viniotis, Callaway) Best Paper Award at the 4<sup>th</sup> Annual International Conference on Software and Data Technologies.

#### **F. Career placement**

### **IV. Faculty and staff**

#### **A. Administrative achievements and staff changes**

There were several changes in the departmental administrative and technical staff:

**Catherine Lull** joined as Contracts and Grants Manager

**Tenille Naumann** joined as Post-Award Contract Specialist

**Siobhan Strange** was promoted to Financial Manager

**Katy Wilson** was promoted to Personnel Specialist

**Nicole Hedges** joined as NNF Process Engineer

The following new faculty joined the ECE Department during 2009-10:

#### **Brian Floyd**

Dr. Floyd joined NC State in January 2010. His research interests include RF and millimeter-wave circuits and systems for wireless communications, imaging, and radar applications. Specific research topics include 3-D RF, digitally assisted/digitally-replaced RF systems, mmWave passive and active imagers, multi-Gb/s silicon phased-array transceivers for 60 GHz, and manufacturable mmWave antenna-in-package approaches.



Prior to 2010, Dr. Floyd worked at IBM Research in Yorktown Heights, NY as a research staff member (2001-2007) and as the manager of the RF and wireless circuits and systems group (2007-2009). His work at IBM included the demonstration of some of the world's first 60-GHz transceivers in silicon and the development of 60-GHz phased-array transceivers, antennas, and packages.

### **Zhenhua Jiang**

Dr. Jiang worked on various problems towards a sustainable energy infrastructure. The goal of his research is to explore new ways to develop a smart electric grid of the future that would replace the nation's current aging, vulnerable, and inefficient system. One of the current research focuses is to explore new approaches to integrate environmentally clean, distributed energy resources into existing electric power distribution systems via smart microgrids by employing advanced sensing, communications, computing, control, power electronics and intelligent technologies.

### **Huiyang Zhou**

Huiyang Zhou received the bachelor's degree in electrical engineering from Xian Jiaotong University, China, in 1992 and the Ph.D. degree in computer engineering from North Carolina State University in 2003. He is currently an associate professor in the Department of Electrical and Computer Engineering at North Carolina State University. Between 2003 and 2009, he was an assistant professor at the School of Electrical Engineering and Computer Science, University of Central Florida. His research focuses on high performance microarchitecture, low-power design, GPU Computing (General Purpose computing on Graphics Processing Units or GPGPU), architecture support for system dependability, and backend compiler optimization. He is a recipient of NSF CAREER award and a senior member of the IEEE.

The following faculty were reappointed or promoted:

**David Schurig**, reappointed to Assistant Professor

**James Tuck**, reappointed to Assistant Professor

**Michael Escuti**, promoted to Associate Professor with Tenure

**Eric Rotenberg**, promoted to Full Professor

#### **B. Activities**

#### **C. Awards and Honors**

**Mo-Yuen Chow** (Professor) was selected as Zhejiang Chang Jiang Scholar Visiting Professor of Zhejiang University, China.

**Michael Steer** (Professor) and **Kevin Gard** (Adjunct Assistant Professor) received the 2010 Microwave Prize from the IEEE Microwave Theory and Techniques Society.

**Michael Escuti** (Assistant Professor) received a Faculty Early Career Development (CAREER) Award from the National Science Foundation.

**Michael Steer** (Professor) received the U.S. Army Commander's Award for Public Service.

**Neeraj Nepal** (Postdoctoral Researcher) received a best poster award from the Material Research Society's Fall Meeting (2009).

**Nino Masnari** (Distinguished Professor) received the Electrical and Computer Engineering Alumni society Merit Award from the college of Engineering at the University of Michigan.

**John Muth** (Associate Professor) received a Bronze Star for his service during a recent tour of duty as a U.S. Navy reservist in Iraq.

#### **D. Courses taught**

#### **E. Seminars, visitors**

The Department has continued its Interdisciplinary Distinguished Seminar Series, coordinated by Dr. Hamid Krim.

In addition, during the last year we introduced a new ECE Distinguished Speaker Colloquium, featuring presentations from distinguished speakers drawn from both academia and industry who will address 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.

## F. Staff

During August of 2009, three ECE staff were recognized with Pride of the WolfPack Awards. The Pride of the Wolfpack is an award designed to recognize NC State employees for a special or unique contribution to their college/unit or the University. ECE Department winners were **Brian Carty**, **Richard Hodson**, and **Joe Matthews**.

## V. Research programs

### A. Highlights, including volume of activity and achievements of significance

After several years of decline, the dollar value of submitted proposals from ECE is up substantially for 09-10. With partial data through April 2010, the value of submitted proposals is up 70% over the previous year. The dollar value of research awards is expected to decrease somewhat, reflecting the low volume of submitted proposals in FY 08-09.

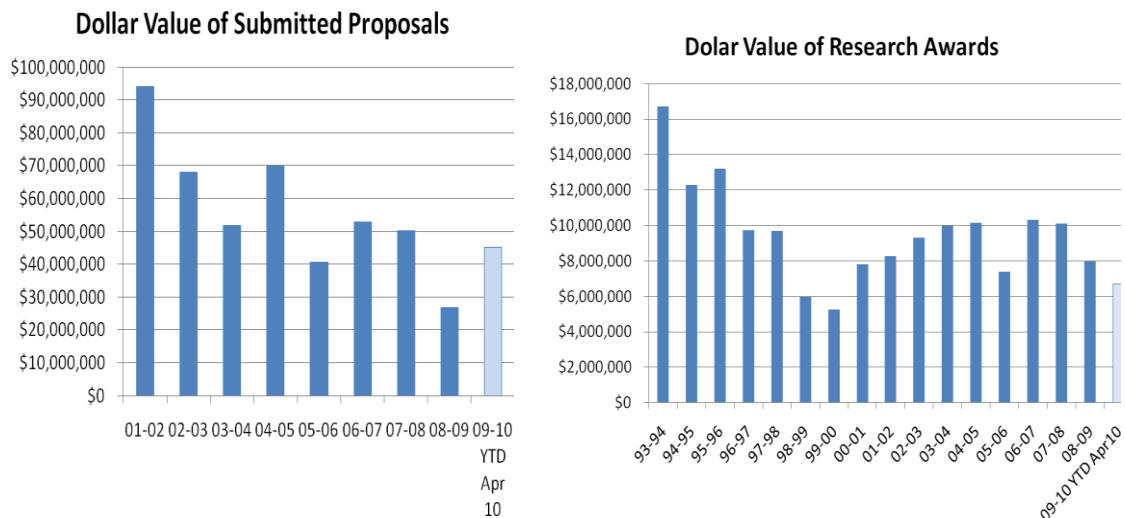
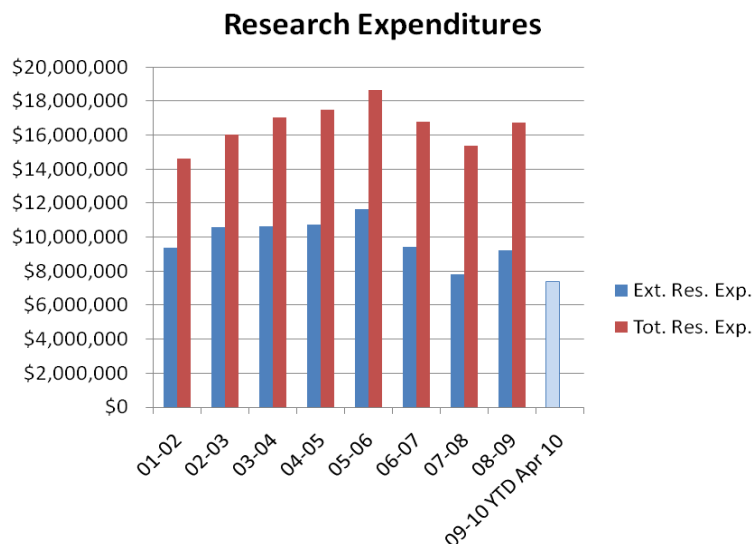


Figure 4. Dollar value of submitted proposals and research awards by year.

## D. Expenditures

Historical trends for research expenditures are shown in Figure 5. External research expenditures are expected to be comparable to, or slightly below, last year's figures.



**Figure 5. Research Expenditures.**

## **VI. Extension activities, including initiatives and public service activities**

## **VII. Financial summary**

## **VIII. Departmental sponsors (optional)**

As of March, 2010, the department has received \$314,640.50 in foundation donations from 35 different people/organizations.

## **IX. Recommendations and concerns for the future**

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

- *Developing a strategic plan.* The plan will be a guide for resource allocations as we move forward in building the department.
- *Emphasis on Development.* Increased emphasis will be placed on both individual and corporate gifts.
- *Increased Faculty-student mixer opportunities.* Both students and faculty have expressed the desire to interact more outside of class.
- *Reorganized Advisory Board.* Input and support from the advisory board are critical to moving the department forward.
- *Increased Public Relations.* Attention will be given to newsletters and mailings that will help 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.