

IEEE – Control Systems Society
Technical Committee on Control Education

Meeting Invitation

Date: Thursday, 12 December 2013
Time: 12:00 pm – 02:00 pm
Venue: Villa Vittorio; Piano Primo 1.6
The CDC Conference Venue
Firenze Fiera Congress and Exhibition Center
Piazza Adua, 1; Florence, Italy

A G E N D A

1. Welcome and Apologies
 - a. Apologies received from (as at 28 Nov 2013):
Angela Schoellig; Dawn Tilbury; Stephen Kahne; Ferri, Bonnie H; Sebastian Trimpe; Daniel Abramovitch; Emmanuel Gonzalez, Floyd Hanson;
2. TCCE Progress Report June 2013 – December 2013 (attached)
3. Strategic Domain Activities
 - a. The Beauty of Controls Workshops for Middle and High School Students and Teachers.
 - b. Annual invited sessions on control education
 - c. A series of workshops on Trends in Controls Education, in partnership with the IEEE Education Society and NSF
4. Other Business Tabled
5. Report from TAB meeting if available at the time of the meeting
6. Next meeting
7. Meeting Close

Attachments:

TCCE Progress Report June 2013 – December 2014

The 2014 ACC Control Education Invited Session flier

The 2014 ACC Control Education Workshop flier

TO: Frank Allgower, VP Technical Activities, CSS
FROM: Ljubo Vlacic, Chair, TC on Control Education, CSS
SUBJECT: Progress Report; June 2013 – December 2013
DATE: 16 November 2013

The following milestones are the main highlights of the reporting period

A).

Under the leadership of the TC Deputy Chair, Professor Bozenna Pasik-Duncan, two educational events were organized jointly with AACC Technical Committee on Education at the ACC'2013 in Washington DC:

1.
High School Workshop on the Beauty of Controls was held on Monday, June 17, 2013. The detailed program, abstracts of the presentations and short bios of the presenters can be found on the workshop web page:

http://www.math.ku.edu/ksacg/workshops/ACC_2013/acc2013workshop.html

2.
Special Session on the History of Workshops was held on Wednesday, June 19, 2013. The detailed program of the session as well as the list of 72 speakers with the titles of 133 presentations from the workshops can be found on the session web page:

http://www.math.ku.edu/ksacg/special_sessions/ACC_2013_Workshops/acc2013history_of_Workshops.html

Both events were very well attended and well received. The events were videotaped by assisting graduate students from the University of Kansas. The professional editing will be done by the University of Kansas. It is planned to write an article on the 13 year history of the workshops for high school teachers and students for the Control Systems Magazine.

The next workshop for high school students is in its preparation for the ACC'2014.

B).

3.
Under the leadership of the TC Deputy Chair, Professor Bonnie H Ferri, the Committee organized and submitted an invited session on Control Education for the 2014 ACC.

The papers included in the Invited Session show cutting edge pedagogies applied to courses in systems and controls. The pedagogies include experiential education and problem-based learning. Some of these papers arose out of work performed for NSF grants on engineering education. Five of the papers exploit experiential learning, where hands-on activities allow students to experience a new perspective on the topic being taught. The sixth

paper shows how a standard senior-level controls course can be taught using a problem-based learning approach. Further details can be obtained from the enclosed workshop flier.

4.

Professor Bonnie H Ferri's leadership has also brought the idea of organising a preconference workshop for the 2014 ACC. The Committee has endorsed the workshop: *Ubiquitous Hands-On Learning: The Future of Engineering Education*, which will be organized by the Center for Mobile Hands-On STEM. For details, please see the enclosed flier.

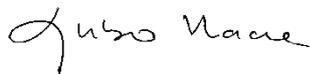
Development of inexpensive and portable USB-powered oscilloscopes, function generators, microcontroller boards, and other portable electronic equipment coupled with software running on laptops has facilitated a new model of engineering education where hands-on experiences can be done ubiquitously anytime anywhere. Students can explore the theoretical concepts introduced in lectures with laboratory-type experiences either immediately in the classroom or at home rather than waiting for a scheduled laboratory time. The submitted workshop will give attendees an overview of the pedagogy and the logistical models for implementing hands-on learning as well as give them basic instruction and experience in operating the various devices.

C).

The Committee membership base has remained unchanged apart from the request received from Emeritus Professor Floyd Hanson seeking the removal of his name from the Committee Membership List due to his retirement.

The Committee's upcoming face-to-face meeting will be held on Thursday, 12 December 2013 in conjunction with CDC 2013 in Florence. The meeting will be hosted by the Committee Chair.

Respectfully submitted



Ljubo Vlacic

TC Chair

2014 ACC Invited Session Proposal

Session Title: Controls Education

Sponsoring Committee: IEEE Control Systems Society Technical Committee on Education
Chair: Ljubo Vlacic; Deputy Chairs: Bonnie Ferri and Bozzena Pasik-Duncan

Session Organizer: Bonnie Ferri, Deputy Chair of the CSS TC on Education

Session Overview:

The CSS Technical Committee on Education plans to organize sessions for future ACCs on the topic of controls education. There are normally very few controls education papers at the ACC, but the topic is of great interest to the attendees. This committee organized a series of sessions like this 10-15 years ago, and the attendance at the sessions was typically 50-60 people. We intend to build interest in such a series of invited sessions by giving out Call for Paper flyers during the ACC Controls Education Invited Session inviting people to submit controls education papers to the 2015 IEEE Conference on Decision and Control and to the 2015 ACC in order to raise awareness of this session and increase submissions.

The papers included in the 2014 ACC Invited Session on Controls Education show cutting edge pedagogies applied to courses in systems and controls. The pedagogies include experiential education and problem-based learning. Some of these papers arose out of work performed for NSF grants on engineering education. Five of the papers exploit experiential learning, where hands-on activities allow students to experience a new perspective on the topic being taught. The sixth paper shows how a standard senior-level controls course can be taught using a problem-based learning approach.

The first three papers address learning enhancement through the addition of hands-on experiences in lecture-based courses. The third paper further addresses the use of a MOOC platform to flip the course in order to facilitate the in-class hands-on activities. The fourth paper has similar goals as the first three papers: it offers the potential to teach controls in a more wide-spread and distributed manner using a low-cost experimental platform. The fifth paper is a lab course that combines embedded computing and controls systems, topics normally taught in two distinct courses and shows how they can be combined to be taught together. The final paper of the session employs a Problem-Based Learning pedagogy to teach a dynamics and controls course.

Paper 1 Title: “Simple Guitar String System for Teaching Fundamental Concepts in a Variety of ECE and ME Courses”

Authors: Al Ferri and Bonnie Ferri

Brief Abstract: This paper presents an inexpensive, mobile experimental platform suitable for courses in circuits and electronics, signals and systems, dynamical systems, acoustics, and vibrations. While being a simple platform, the list of fundamental concepts that can be explored with the platform is very rich, including the relationship between time domain and frequency domain signal characteristics, harmonic content of signals, impulse response, initial condition response, transfer functions, frequency response, resonance, low damping, controllability, observability, filtering, and modes of vibration in strings.

Paper 2 Title: “Integration of Theory and Ubiquitous Experiments in a Signals and Systems Course”

Authors: Aaron Lanterman, Michael Giardino, Jennifer Michaels, Bonnie Ferri, William Hunt, Al Ferri

This paper explores the inclusion of low cost experiments into a lecture-based introductory Systems and Systems course. The experiments are ubiquitous in space and in a curricular sense. Most of the experiments can be completed in a regular lecture room during a lecture period by students working at their desks, and one is completed in any large room by students using only their computers. The experiments are also embedded into a traditionally very theoretical course, thereby giving students an integration of theory and experiments without the use of high cost, centralized laboratory facilities.

Paper 3 Title: “Flipping a Controls Classroom Around a MOOC”

Author: Jean-Pierre de la Croix and Magnus Egerstedt

Abstract: Bridging the theory-practice gap in controls education is a well-known challenge. In this talk, I will discuss how one can approach this divide using a flipped classroom. Based on my recent MOOC (Massive Open Online Course), Control of Mobile Robots, I have flipped the classroom in a senior robotics and controls class at the Georgia Institute of Technology. The students take the MOOC and come to class prepared to program robots. Key to this is not only that the theoretical content is being delivered via the MOOC, but also a hardware/software platform that provides a learning environment where exploratory, practical tinkering is grounded in solid theory. The paper also discusses why the flipped classroom format is ideal for engineering courses in general, as well as report on my flipped classroom findings.

Paper 4 Title: “A Low Cost Experiment to Test Control and Decision Making Strategies.”

Authors: Julián Barreiro-Gómez and Nicanor Quijano.

Abstract: Currently, there are few experiments capable of illustrating new control and decision making strategies. Some of the experiments that we might find are extremely expensive, and they cannot be acquired by third-world countries. In order to overcome these issues, we have developed a balls-in-tubes experiment, which is a low-cost platform for research and educational purposes. In this paper, first, we show how the plant has been designed based on a co-simulation idea, in order to determine the main characteristics of the system (e.g., dimensions, materials, actuator, power supply, etc). Then, in order to illustrate the usefulness of the process, we have done several experiments to show how system identification and other control and decision-making techniques (i.e., classical PD, optimal control, fuzzy logic, and population dynamics) can be implemented and analyzed.

Paper 5 Title: “Teaching Feedback Control and Embedded Design in a Single Course with Lab Projects”

Authors: David G. Taylor and Daniel D. Murdock

Abstract: This paper describes an undergraduate course that has been developed to enable the teaching of feedback control theory and embedded microcontroller implementation in combination, using lab projects to convey the material through exposure to power electronics, electric machines and motion control applications. By incorporating this wide range of topics into a single course, students are better able to grasp connections between concepts more typically taught in separate courses by separate instructors, and they acquire a more comprehensive perspective on the practice of control engineering.

Paper 6 Title: “Applying Problem-Based Learning to Instruction of System Dynamics and Controls”

Authors: Nuno Filipe and Amy Pritchett

Abstract: Problem-Based Learning is a style of active learning where the students learn about a subject through solving authentic, difficult problems in teams. This paper describes the implementation of Problem-Based Learning to the teaching of system dynamics and controls to a third-year undergraduate class of aerospace engineering at the Georgia Institute of Technology. The pros and cons of Problem-Based Learning applied to the teaching of controls are analyzed. The course design and implementation are described. The grade results and student opinions are examined. The paper concludes with a discussion of lessons learned and recommendations for the application of problem-based learning.

Session Organizer Background:

Dr. Ferri is the Associate Chair for Undergraduate Affairs at Georgia Tech, which is one of the largest producers of engineering graduates in the United States. She has won numerous campus-wide teaching awards for her outstanding teaching and for her innovation in the classroom. She is a recipient of the IEEE Harriet B. Rigas Award from the IEEE Education Society. She is a past Chair of the IEEE CSS Technical Committee on Education and was the Program Chair for the 1998 ACC. She currently serves as the Deputy Chair for Invited Sessions for the IEEE CSS Technical Committee on Education.

2014 ACC WORKSHOP PROPOSAL

Ubiquitous Hands-On Learning: The Future of Engineering Education

Organized by the Center for Mobile Hands-On STEM

Endorsed by the IEEE Control Systems Society Technical Committee on Education

Rationale: Studies have demonstrated that concrete experimentation improves student understanding of abstract concepts and motivates students by providing examples of theory in practice. The model of having traditional, centralized laboratories requires expensive equipment and personnel; furthermore, students have limited access to these resources. Development of inexpensive and portable USB-powered oscilloscopes, function generators, microcontroller boards, and other portable electronic equipment has facilitated a new model of engineering education where hands-on experiences can be done ubiquitously anytime anywhere. Students can explore the theoretical concepts introduced in lectures with hands-on activities either immediately in the classroom or at home rather than waiting for a scheduled laboratory time.



Student ownership means that students can work on experiments anytime anywhere.

Benefits to Students: tools immediately and readily available for design projects, design competitions, and to just tinker and follow their own creativity to new areas of discovery. Online and distance learning students have equal access to hands-on activities as do on-campus students.

Benefits to Instructors: new way to facilitate inquiry-based learning through hands-on activities. They can develop course content anywhere and anytime; new ideas for labs, activities, and projects can be easily tried out at home rather than waiting until lab classrooms and technical staff are available. With minimum resources, teachers can easily integrate mobile hands-on activities into their courses.

Benefits to Institutions: new options for incorporating practical lab experiences into their curriculum without the need for expensive equipment and dedicated lab space since students have their own equipment.

Target Audience:

Who should come to the workshop? Engineering administrators, instructors, laboratory staff, graduate students and post-docs interested in academic careers in all engineering disciplines.

Why should you come? Learn different models for the effective implementation of hands-on learning: 1) hands-on experiences in traditional lecture-based courses; 2) lab courses where students own their own equipment and do the labs at home; 3) studio classes; 4) flipped classes; and 5) online lab courses. Experience the use of several different mobile learning platforms for measuring and analyzing physical phenomena, designing circuits, and learning programming. Participants will use a selection of



low-cost electronic boards and portable instruments, which include the **National Instruments** myDAQ, **Digilent's** Analog Discovery board, and **ARM's mbed** microcontroller platform to carry out a number of experiments during the workshop. The experiments will demonstrate the range of hands-on activities and some of the diverse theoretical concepts that can be taught via active hands-on learning. Participants will leave the workshop with a set of tested experimental procedures and other instructional resources.

Presenters:

The presenters of the workshop, **Bonnie Ferri** and **Al Ferri** (TESSAL Center, Georgia Tech) and **Deborah Walter** (Rose-Hulman), have been engaged in pedagogical research on active learning and have designed, implemented, and assessed hands-on activities in numerous courses during their academic careers. In addition, the workshop organizers include Kathleen Meehan (University of Glasgow) and Jim Hamblen (Georgia Tech), who have collaborated as part of the multi-institutional Center for Hands-On STEM, along with colleagues from Howard, Morgan State, and Albany to present this material to facilitate the development of the common themes that have developed from their research. This workshop is partially supported by an NSF TUES Grant (Award 0817102) and technical support from Digilent, with likely support from ARM and National Instruments.



ACTIVE LEARNING: Students working on hands-on activities at their desks during a regular lecture period in a regular lecture room.

Expected Enrollment: A very similar workshop was held at the ASEE Annual Exposition and Conference in 2012 and again in 2013. The attendance was 25 in the first offering and 40 in the second. We can handle up to 50 participants.

This workshop is supported by an NSF TUES Grant (Award 0817102) and technical support from Digilent. We will request similar technical support from ARM and National Instruments (they both gave their support for an earlier version of this workshop presented in conjunction with an American Society of Engineering Education conference). This workshop was also discussed at the last meeting of the IEEE Control Systems Society Technical Committee on Education, where the workshop was endorsed and encouraged to be offered at the ACC.

Half-Day Format Tentative Schedule:

Models of Ubiquitous Hands-On Education (30 Min)

myDAQ Platform Hands-On Activities and Demonstrations (1 hour)

- Hands-on activities showing the time response and frequency response of underdamped and overdamped second-order circuits.
- Demonstration of PID motor control experiment
- Demonstration and presentation of the impulse response, frequency response, and initial condition response of a vibratory system (guitar string)

Break (15 Min)

Mbed microcontroller Platform Hands-On Activities and Demonstrations (45 min)

- Demonstration of a temperature controller built with an mbed kit
- Hands-on activity where participants build a very simple code and implement it on the mbed

Pedagogical Discussion: Models of Learners (15 Minutes)

Discovery Board Platform Hands-On Activities and Demonstrations (1 hour)

- Hands-on activity to run a filtering experiment to remove 60 Hz noise
- Demonstration of the use of MATLAB to control the Discovery Board

Summary and Discussion (15 Minutes)

Logistics

Participants will be given free software ahead of time to download to their computers. The organizers will bring approximately 20 myDAQ boards and breadboard kits, 20 Digilent Discovery Boards and breadboard kits, and 20 mbed kits for the hands-on activities. During those activities, the participants will work in groups of 2-3 on experimental activities that are related to systems and controls topics. This hands-on exposure will give the participants an understanding of the potential impact on student learning from the use of the mobile, student-owned platforms. Additional hardware will be brought for demonstrations of other experiments that students do on their own.

Abstracts:

Models of Ubiquitous Hands-On Education

This section discusses three particular models of implementing hands-on activities in a curriculum: small in-class activities in lecture-based courses, student-owned equipment in lab courses for students to complete at home or at school, and mobile studios where the hands-on activity is fully integrated into a lecture class. These three models use different strategies and take different levels of commitment from universities and from instructors. The first one, in-class experiments on a small-scale level, aims at targeted intervention and has the lowest threshold for instructors, students, and administrations. The mobile studios model has the highest threshold but may have the largest impact by fully integrating classes with hands-on activities. The model where regular, full-scale labs are done by students using student-owned equipment can serve to replace the centralized laboratory model, which is costly to universities, with a mobile version where students have more time to explore the lab activities. Assessment results on how well these methods work will be included in the presentation.

Ref: Kenneth Connor, Bonnie Ferri, and Kathleen Meehan. Models of Mobile Hands-On STEM Education, *proceedings of the ASEE Annual Exposition and Conference*, June 2013, Atlanta.

myDAQ Platform Demonstrations and Hands-On Activities

Hands-On Activity of a Second-Order Response

Demonstration of PID motor control experiment

Demonstration and presentation of the impulse response/frequency response of a vibratory system

Software coupled with the myDAQ board converts a laptop into a suite of instruments including a function generator, oscilloscope, dynamic spectrum analyzer, automated Bode plot generator, and digital I/O interfaces. Georgia Tech now requires all ECE students and all students taking the circuits course for non-majors to purchase the myDAQ board and a small parts kit. The price for this unit is about the same as a textbook. This is a total of 1000 students per term using these devices in one of several lecture-based core courses: ECE2020 Fundamentals of Digital Design, ECE2040 Circuits, ECE 3084 Signals and Systems, ECE 3710 Circuits and Electronics (for nonmajors). The overview of the logistics and the impact on learning of using hands-on activities in lecture-based courses will be presented in the first session (above), but the real impact will be felt here where the participants will see for themselves what students experience.

This session will give a hands-on demo of the platform by having participants experiment with a series RLC circuit where students use a potentiometer to adjust the resistance to get underdamped, critically damped, and overdamped behavior. The participants will see how to use the board for both time domain and frequency domain measurements. The two additional demos will feature a small, inexpensive PID motor control experiment that works with the myDAQ unit and a guitar string experiment. The guitar string is an engaging system for students to use because of the tie to music. The model of the system will be shown along with how that model can be used for students to learn about transfer functions, controllability and observability, light damping, initial condition responses, impulse responses, and frequency responses.

Mbed microcontroller Platform Hands-On Activities and Demonstrations

Demonstration of a temperature controller built with an mbed kit

Hands-on activity to build a simple code and implement it on the mbed

The mbed is a low-cost microcontroller built by ARM that has a very large community providing a large library of online resources and very easy to use support. Embedded computers make up about 90% of all computer applications, so exposure early to these devices is beneficial to all engineering students. Many of the applications of embedded computers include system monitoring and control. Georgia Tech teaches two sophomore-level courses involving programming, both of which require students to purchase an mbed kit (cost of \$95). This session will feature a demonstration of a temperature controller project that was given to students in the C++ programming class. As part of the project, students build the temperature controller from parts in their mbed kit and then program it. This is a nice illustration of crossover technology from the controls domain into a programming class. A hands-on activity is planned for the workshop participants to implement a very simple program on the microcontroller to see how easy it is for students and faculty to use in courses.

Pedagogical Discussion: Models of Learners

Models of Learners

It is commonly accepted that laboratory exercises are a critical component to developing engineering skills. Lab classes represent a significant portion of curricula of all engineering disciplines. Lab exercises in introductory courses are commonly designed to illustrate and demonstrate known concepts or scientific laws. Students also learn practical skills associated with the measurements techniques and experience in the use of modern instrumentation. Other goals of the lab experience are to sharpen observational skills, work in teams, and develop a capacity for independent learning by encouraging students to make self-directed inquiries and explorations. Research in how students learn suggests that when students are actively engaged in the course material they maximize their understanding. Therefore, the laboratory experience is both a critical and a potentially rich learning environment for the development of engineering knowledge and skill. In this session we will document our model of engineering pedagogy that builds on years of experimentation with and without mobile platforms. We will include a review of what the Mobile Hands On STEM team has learned about 1) the depth of learning, 2) short- and long-term retention that results from increased enthusiasm as a result of experiences in active learning, 3) confidence building in engineering skills particularly among underrepresented students, and 3) evidence that engaging in active learning and having the equipment readily available stimulates student creativity and inventiveness.

Discovery Board Platform Hands-On Activities and Demonstrations

Hands-on activity to filter 60-Hz noise from a 600 Hz signal using an active high-pass filter

Demonstration using Matlab to interface with the Discovery Board and generate a custom signal

The Analog Discovery board by Digilent (cost of \$99) functions similarly to the National Instruments myDAQ and the Mobile Studio. Connected to a PC by USB, the Discovery board can analyze both analog and digital signals mimicking the functionality of a digital oscilloscope and logic analyzer. It has a built-in +/-5Volt DC-power supply, waveform generator, digital pattern generator and voltmeter. In this hands-on activity, participants will use the Discovery board to filter noise in a signal processing experiment. The Discovery board will be used to generate a desired signal at 600 Hz corrupted by an equally strong 60-Hz noise signal. Participants will build a high-pass filter using an op-amp and a few components. The noisy signal and filtered signal can be observed using the oscilloscope function, demonstrating the filtering

concept by observing the time-response signal. The network analyzer feature of the Discovery board will be used to sweep the frequency of the input signal, measure the output of the high-pass filter, and create a Bode plot, demonstrating the filter's effect in the frequency domain.

The workshop moderators will also demonstrate the use of Matlab to control the Discovery Board. The Matlab interface gives users the ability to generate, manipulate, and interactively utilize their collected data. This feature can be used to build and test real control systems as a part of a classroom demonstration or an assignment to be completed by the students at home. This activity not only deepens their understanding of the non-ideal effects of their models, but the activity also can reinforce their Matlab skills.

Curriculum Vitae

Bonnie Heck Ferri

Professor and Associate Chair for Undergraduate Affairs
School of Electrical and Computer Engineering
Georgia Institute of Technology
Atlanta, GA 30332

Professional Preparation

B.S., Electrical Engineering, University of Notre Dame, 1981
M.S. Mechanical and Aerospace Engineering, Princeton University, 1984
Ph.D. Electrical Engineering, Georgia Tech, 1988

Professional Appointments

Associate Chair for Undergraduate Affairs, School of ECE, Georgia Tech, Jan. 2013- present
Associate Chair for Graduate Affairs, School of ECE, Georgia Tech, July 2006 – Dec. 2012
Professor, School of ECE, Georgia Tech, September 2002 – present
Associate Professor, School of ECE, Sept. 1995 – Sept. 2002
Assistant Professor, School of EE, Sept. 1988 - Sept. 1995
Engineer Honeywell Inc., Clearwater, FL, August 1983 - June 1985

Related Publications:

1. K. Connor, B. Ferri, K. Meehan, "Models of Mobile Hands-On STEM Education," *Proceedings of the ASEE Annual Conference and Exposition*, Atlanta, GA, June 2013.
2. B. Ferri, A. Ferri, and K. Connor, "BYOE: Mobile Experiment for Signals and Systems Courses: Analysis of a Guitar String," *Proceedings of the ASEE Annual Conference and Exposition*, Atlanta, GA, June 2013.
3. G. Droge, B. Ferri, and O. Chiu, "Distributed Laboratories: Control System Experiments with LabVIEW and the LEGO NXT Platform," *ASEE Annual Conference and Exposition*, San Antonio, June 2012.
4. J. Auerbach and B. Ferri, "Work in Progress - The Costs and Benefits of Using Alternative Approaches in Lecture-Based Courses: Experience in Electrical Engineering," *2010 IEEE Frontiers in Education Conference*, Washington, October 2010.
5. Heck, B.S., Clements, N.S., and Ferri, A.A., "A LEGO Experiment for Embedded Control System Design," *IEEE Control Systems Magazine*, vol. 24, no. 5, October 2004, pp. 61-64.
6. B. Ferri, J. Auerbach, J. Jackson, J. Michaels, D. Williams, "A Program For Distributed Laboratories In The ECE Curriculum," *Proceedings of the 2008 ASEE Annual Conference and Exposition*, Pittsburgh, PA, June 2008.
7. Ferri, B.H, Ahmed, S. Michaels, J., Dean, E., Garvet, C., Shearman, S., "Signal Processing Experiments With LEGO MINDSTORMS NXT Kit for Use in Signals and Systems Courses," *Proceedings of the American Control Conference*, St. Louis, pp. 3787-3792., June 2009.
8. B. Ferri, J. Auerbach, H. Qu, "Distributed Laboratories: A Finite State Machine Module," *Proceedings of the World Congress In Computer Science, Computer Engineering and Applied Computing, International Conference: Frontiers in Education Conference on Computer Science and Computer Engineering*, Las Vegas, NV, July 2010.
9. B. Ferri, J. Auerbach, J. Michaels, and D. Williams, "TESSAL: A Program for Incorporating Experiments into Lecture-Based Courses within the ECE Curriculum," *ASEE Annual Conference and Exposition*, Vancouver, Canada, June 2011.

10. Heck, B.S., Shor, M. and Wadpole, J., "Education that Integrates Computer Science and Control Engineering," *Proc. IEEE Conf. on Decision and Control*, Vol. 3, Dec. 2003, Pages 3005 – 3010.
11. B. Ferri and J. Auerbach, "Work in Progress - A Program to Incorporate Portable Labs Into Lecture-Based Electrical and Computer Engineering Courses," *2010 IEEE Frontiers in Education Conference, Washington, October 2010*.

Selected Honors and Awards:

NSF Presidential Young Investigator Award, 1990;
 Junior Faculty Teaching Excellence Award, 1991;
 IEEE Control Systems Magazine Outstanding Paper Award, 2004;
 Georgia Tech Women's Faculty Distinction Award, 2005;
 Georgia Tech ECE Faculty Outreach Award, 2006;
 IEEE Harriet B. Rigas Award from the IEEE Education Society, 2007
 Georgia Tech Faculty Awards: Class of 1934 Outstanding Use of Innovative Education
 Technology Award, 2012
 Georgia Tech Women in Engineering Excellence in Teaching Award, 2012

Education-Related Grants:

1. A Cohesive Program Of Experimental Modules Distributed Throughout The ECE Curriculum, National Science Foundation CCLI Program; Principle Investigators: B. Ferri (project director), J. Michaels, D. Williams; Amount Funded: \$499,998.00; 08/2006 - 12/2011
2. Manufacturing Experimentation and Outreach (MENTOR); DARPA; Principal Investigators: Drs. Schrage (AE) and Rosen (ME); Amount: \$991,658 (including options for additional years); 9/1/2011-8/31/2012
3. Collaborative Research: Center for Mobile Hands-On STEM, National Science Foundation; Principal Investigators: Drs. Ken Connor (RPI), Kathleen Meehan (VPI), and Bonnie Ferri and Al Ferri; NSF TUES Program, total \$600,000; Georgia Tech portion is \$173,000, 8/2012 -7/2014.
4. Graduate Engineering for **Women, Minorities, and Persons with Disabilities** at Georgia Tech; National Science Foundation; Principal Investigators: Drs. Heck, Llewellyn, Meyers, and Wepfer (project director); Amount Funded: \$1,261,552; 1/1990 -9/1997
5. Graduate Assistance in Areas of National Need; Department of Education; Principal Investigators: Drs. Heck, Ingram, and Jokerst; Amount: \$470,667; 5/1993 – 9/1995

Professional Society Involvement:

IEEE Control Systems Society: Elected member of Board of Governors 1998-2000, 2006-2008;
 Chair of the Technical Committee on Controls Education 1999-2001; Deputy Chair 2013-present
 Program Chair of the American Control Conference, 1998
 Associate Editor of the *IEEE Transactions on Education* 1995-1998
 Chair of the Most Outstanding Paper Award, IEEE Control Systems Magazine, 2007-2012

Outreach Activities:

Faculty mentor and founding member of the Women in ECE organization at Georgia Tech, 2004-2009;
 participation and organization in several summer pre-college camps and workshops 2005-2010;
 judge at local and international competitions for the International Science and Engineering Fair (for high school students) 2008-2011

Aldo A. Ferri, Biosketch
Associate Chair for Undergraduate Studies
George Woodruff School of Mechanical Engineering

Professional Preparation

Lehigh University	Mechanical Engineering	BS, 1981
Princeton University	Mechanical and Aerospace Engr.	Ph.D., 1985

Appointments

Title	Organization	Years
Assoc.Chair for UG Studies	Georgia Institute of Technology	1/10-present
Associate Professor	Georgia Institute of Technology	5/91-present
Assistant Professor	Georgia Institute of Technology	9/85-5/91
Visiting Scholar	Duke University	8/83-9/85
Summer Engineering Employee	RCA Astro Electronics Division	5/81-9/81
Summer Engineering Employee	RCA Astro Electronics Division	5/80-8/80

Most Relevant Publications:

- 1) B. Ferri, A. Ferri, and K. Connor, "BYOE: Mobile Experiment for Signals and Systems Courses: Analysis of a Guitar String," *Proceedings ASEE Annual Conference and Exposition*, Atlanta, GA, June 2013.
- 2) Heck, B.S., Clements, N.S., and Ferri, A.A., "A LEGO Experiment for Embedded Control System Design," *IEEE Control Systems Magazine*, Vol. 24, No. 5, 2004, pp. 61-64.
- 3) Michaux, M.A., Ferri, A.A., and Cunefare, K.A., "Effect of Tangential Dither Signal on Friction Induced Oscillations in an SDOF System," *ASME Journal of Computational and Nonlinear Dynamics*, Vol. 2, No. 3, 2007, pp. 201- 210.
- 4) Ferri, B.H., and Ferri, A.A., "Reconfiguration of IIR Filters in Response to Computer Resource Availability," *ACM Transactions on Embedded Computing Systems*, Vol 9, No. 1, Oct, 2009, pp. 2:1-25.
- 5) Kim, D., Leamy, M.J., and Ferri, A.A., "Dynamic Modeling and Stability Analysis of Flat Belt Drives Using an Elastic/Perfectly-Plastic Friction Law," *ASME Journal of Dynamic Systems, Measurement, and Control*, Vol 133, No. 4, 2011.
- 6) Eicholtz, M.R., Caspall, J., Dao, P.V., Sprigle, S., and Ferri, A.A., "A Test Method for Empirically Determining Inertial Properties of Manual Wheelchairs," to appear, *Journal of Rehabilitation Research and Development*.

5 Other Publications:

- 1) Heck, B.S., and Ferri, A.A., "Model Reduction of Coulomb Friction Damped Systems Using Singular Perturbation Theory," *ASME Journal of Dynamic Systems, Measurement, and Control*, Vol. 118, No. 1, March 1996, pp. 84-91.
- 2) Haroon, M., Adams, D.E., Luk, Y.W., and Ferri, A.A., "A Time and Frequency Domain Approach for Identifying Nonlinear Mechanical System Models in the Absence of an Input Measurement," *Journal of Sound and Vibration*, Vol. 283, 2005, pp. 1137-1155

- 3) Ferri, A.A., and Whiteman, W.E., "Free Response of a System with Negative Viscous Damping and Displacement-Dependent Dry Friction Damping." *Journal of Sound and Vibration*, Vol. 306(3-5), 9 October 2007, pp 400-418.
- 4) Michaux, M.A., Ferri, A.A., and Cunefare, K.A., "Effect of Waveform on the Effectiveness of Tangential Dither Forces to Cancel Friction-Induced Oscillations," *Journal of Sound and Vibration*, Vol. 311, No. 3-5, 2008, pp. 802-823.
- 5) Patrick, R., Ferri, A.A., and Vachtsevanos, G.J., "Effect of Planetary Gear Carrier-Plate Cracks on Vibration Spectrum," to appear, *ASME Journal of Vibration and Acoustics*.

Synergistic Activities

- 1) American Society of Mechanical Engineers (ASME): Fellow, 2007; Chair, ASME Applied Mechanics Division Technical Committee on Dynamics and Control of Structures and Systems, 7/99 – 6/01. Elected Member, Technical Committee on Vibration and Sound, 2008-present. Associate Editor, *ASME Journal of Applied Mechanics*, 7/97 – 6/03 and *ASME Journal of Computational and Nonlinear Mechanics*, (2 terms) 1/05 - 7/11.
- 2) Jack M. Zeigler Woodruff School Outstanding Educator Award, May 2010; Presentation "Mechanical Engineering Education: What Should We Teach and How Should We Teach It?"
- 3) Hesburgh Award Teaching Fellow, 2011. Program where an experienced group of colleagues from various disciplines discuss innovative ways to improve student learning and to strengthen teaching on the Georgia Tech campus.
- 4) Lilly Foundation National Teaching Fellowship, 1990-1991. In addition to weekly meetings and seminars, attended two national teaching conferences where innovative teaching and learning techniques were discussed.
- 5) Together with electrical engineers, helped to develop a LEGO-based, classroom demonstration for closed-loop control. The closed-loop motor controller helped students to visualize the role of controller gain, quantization, nonlinearities, and instability. The demo is used in ME as well as in various ECE classes at GT.
- 6) Collaborative Research: Center for Mobile Hands-On STEM, National Science Foundation; Principal Investigators: Drs. Ken Connor (RPI), Kathleen Meehan (VPI), and Bonnie Ferri and Al Ferri; NSF TUES Program, total \$600,000; Georgia Tech portion is \$173,000, 8/2012 -7/2014.

Collaborators and Other Affiliations

Collaborators

Doug Adams (Purdue), Dr. Olivier Bauchau (Georgia Tech), Dr. Larry Bottomley (Georgia Tech), Dr. Andy Brown (UNC, Charlotte), Jayme Caspall (Georgia Tech), Dr. Ken Cunefare (Georgia Tech), Dr. Steven Hahn (Dynamic Concepts), Dr. Bonnie Heck (Georgia Tech), Dr. Dewey Hodges (Georgia Tech), Due Q. Huynh (Motorola), Dr. Jerry H. Ginsberg (Georgia Tech), Dr. Michael Leamy (Georgia Tech), Jingci Li (Scientific Atlanta), Dr. Peter Rogers (Georgia Tech), Dr. Marilyn Smith (Georgia Tech), Dr. Stephen Spriggle (Georgia Tech), George Vachtsevanos (Georgia Tech), Dr. Wayne Whiteman (Georgia Tech).

DEBORAH O WALTER

CURRICULUM VITAE

EDUCATION

The Pennsylvania State University, University Park, PA Dissertation Title: <i>Parameterization of the Zeeman effect to retrieve Mesospheric temperatures from a limb-scanning microwave radiometer</i>	Ph.D	Electrical Engineering	1999
The Pennsylvania State University, University Park, PA Thesis Title: <i>A data reduction and analysis system for rocket probe measurements</i>	M.S.	Electrical Engineering	1994
The University of Maryland, College Park, MD	B.S.	Electrical Engineering	1990

APPOINTMENTS

2012 – present	Rose-Hulman Institute of Technology Associate Professor Taught courses in electrical engineering including electromagnetics, electrical circuits, and medical imaging	Terre Haute, IN
2006 – 2012	Rose-Hulman Institute of Technology Assistant Professor Taught courses in electrical engineering including circuits and medical imaging	Terre Haute, IN
1999- 2006	GE Global Research Center Electrical Engineer System design and algorithms for x-ray computed tomography medical imaging.	Niskayuna, NY
1994 – 1999	Pennsylvania State University Research/Teaching Assistant Taught courses in electrical engineering and conducted research in atmospheric electrodynamics.	State College, PA

PROFESSIONAL EXPERIENCE

<i>Summer Faculty Research Fellow</i>	<i>Summers</i>
<i>Sensors Directorate, Air Force Research Lab, Dayton, OH</i>	<i>2011-2013</i>
I worked with Electronic Warfare Techniques Development & Analysis branch to complete a modeling and simulation study that shows small, expendable UAVs, using COTS, low-accuracy DF systems successfully locate stationary, continuously transmitting emitters. I developed a Genetic Algorithm to autonomously control UAV flight paths for the emitter location.	
<i>Electrical Engineer</i>	<i>1999 - 2006</i>
<i>General Electric Global Research Center, Niskayuna, NY</i>	
As a member of the Computed Tomography Systems and Applications Laboratory at GE's Global Research Center, I worked on a number of projects related to medical imaging and non-destructive testing. My main contributions were in the area of new system designs, algorithms for image correction and calibration, and the use of energy information in explosive detection and clinical applications. I served as a principle investigator for a NIH sponsored grant to develop dual energy algorithms for CT colonography. I am the inventor or co-inventor of 9 issued patents and 21 patent applications	

SELECTED GRANTS EXPERIENCE

*NSF, TUES Phase 2 Collaborative Research
Center For Mobile Hands-on STEM*

2002-2014

Rensselaer Polytechnic Institute (RPI) is the lead institution in this collaborative research program. Rose-Hulman Institute of Technology is working along with Georgia Tech, Virginia Tech, University of Albany, Howard University, and Morgan State University to disseminate Mobile Hands-On STEM pedagogy to the entire STEM community.

Air Force Research Laboratory, NEWSTARS

2009-2011

Direction Finding (DFing) Technique Using Multiple Small UAVs

I mentored a graduate student research project in support of the NEWSTARS project. This is an Air Force funded project utilizing technology in a multiple Unmanned Airborne Vehicle scenario that can provide a quick and effective solution to electronic emitter location problems. A total of 4 undergraduate students also worked on the project. This led to a senior project to build a bench-top prototype direction finding system completed in April 2011.

NSF STEM, RoseBUD

2009-2014

Rose Building Undergraduate Diversity (ROSE-BUD): Improving Enrollment and Retention of Women and Minorities in Electrical and Computer Engineering

Starting in August 2009, I will be the principle investigator of this project to develop a scholarship and mentoring program to encourage broader participation among women and minority students in electrical engineering. This is a five year STEM grant from the NSF, which will provide approximately \$600,000 for scholarship aid to Rose-Hulman students.

SELECTED PUBLICATIONS

1. **D.J. Walter**, Bryan, K., Stephens, J. Bullmaster, C., Chakravarthy, V., "Localization of RF Signals using Compressed Sensing with Multiple Cooperative Sensors", Proceedings of the 2012 IEEE National Aerospace & Electronics Conference, Dayton, OH July 25 - 27, 2012.
2. H. Li, Chakravarthy, V., Wu, Z., Dehnie, S., Ma, Y., and **Walter, D.J.**, "Spectrum utilization efficiency of cognitive radio systems with limited sampling capability: The impact of spectrum non-contiguity", Proceedings of the 2012 IEEE Dynamic Spectrum Access Networks (DySPAN) Conference, Bellevue, Washington, October 16-19, 2012.
3. H. Li, Chakravarthy, V., Dehnie, S., Wu, and **Walter, D.J.**, "Hybrid pursuit-evasion game between UAVs and RF emitters with controllable observations: A hawk-dove fight", Proceedings of the 3rd International Conference on Game Theory for Networks (GAMENETS), 2012.
4. **Walter, D.J.**, Mu, X., Xu, H., "Audio-Visual Lab Tutorials to Develop Independent Learners", Proceedings of the 2011 ASEE Conference, No. 1618, Vancouver, BC, Canada, June 26-29, 2011.
5. Carlson, P, Hylton, P, Robinson, M, Rogge, R, Shearer, J, Syed, M, **Walter, D.J.**, "Work in Progress: Merging Science Inquiry and Engineering Design: A Summer Workshop Series for Middle and High School Science Teachers", to appear in Proceedings of the 2011 FIE Conference, Rapid City, SD, October 12-15, 2011,
6. Xu, H., Mu, X., **Walter, D.J.**, "Three practical demonstrations in BEEM project", Proceedings of the 2010 ASEE Conference, AC 2010-2017, Louisville, KY, June 20-23, 2010.