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CONFERENCE
INFORMATION
10 April 2011

Dear 2010 ASEE Southeastern Conference Attendees:

On behalf of the faculty, staff, and students of the School of Engineering at The Citadel, I wish to welcome you to the 2011 American Society for Engineering Educators Southeast Section Annual Meeting. We are excited about having you on our campus.

Future engineers will not only have to be technically sharp but also will have to acquire the skills associated with leadership and team participation to be players in a global market. The primary mission of The Citadel is to graduate principle leaders for the engineering community. As such I am particularly interested in the conference theme “Creating the Academic Culture to Educate Engineering Leaders.”

April is an ideal time to visit Charleston. The Citadel campus is one of the top tourist attractions in the area. In addition, the location of the conference is within a 5-minute drive of downtown Charleston which is noted for its many upscale shops, open market, superb restaurants, historical homes, churches, and unique walking/carriage tours. Several plantations are within a short driving distance from the conference site: Drayton Hall, Boone Hall, Magnolia Gardens, and Middleton Place. There are several museums that portray Charleston’s rich historical past. In addition, Charleston has an excellent downtown aquarium. Finally, a conference participant can visit civil and revolutionary war forts such as Fort Sumter and Fort Moultrie.

If I can provide any service to ensure that your visit to Charleston and our campus turns out to be an excellent event, please let me know. Again, we are absolutely delighted to have you at our campus.

Best regards,

Dennis J. Fallon, PhD, PE, F.ASEE, F.ASCE
Dean of Engineering Engineering and Louis S LeTellier Chair
The Citadel School of Engineering
Welcome to the 2011 ASEE Southeastern Section Annual Conference: "Creating the Academic Culture to Educate Engineering Leaders." With the increasingly rapid growth of technology and its impact on everyday life, it is essential that we produce engineering graduates who not only have the technical knowledge we expect of engineering professionals, but also the qualities of judgment, critical thinking, and high ethical standards necessary for leaders to take engineering into the twenty-first century. The Southeastern Section of ASEE dates back to 1934, and currently has approximately 1500 members from Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee and Virginia. This conference brings together an extremely talented and dedicated group of engineering educators, and gives us all the opportunity to learn from each other, and share our experiences, goals, and best practices in this very special learning community.

It takes many dedicated people to put together an event like this. The Site Committee at the Citadel has put in a tremendous amount of work to make this conference happen, and I would like to express my appreciation for all that they have done in preparation for our visit. I hope you will take this opportunity to explore both the Citadel and Charleston, one of the most interesting and historic cities in the southeast, and take advantage of all of the events that the Site Committee has prepared for us. We also owe thanks to all who have worked to make this conference a success: those of you who contributed and will present papers, the Section officers who coordinated the peer review of those papers, and those who have agreed to chair technical sessions. Those who coordinated the technical program, the review of award nominations, workshops, and student poster sessions have all made a tremendous contribution to the success of this conference—thank you! The preparation of the Conference Proceedings and the Book of Abstracts are also very labor-intensive, and we are in the debt of those who have generated these for our use. Thanks to all of you who have worked in these, and many other capacities to make this conference successful—you have made an invaluable contribution to engineering education.

I have no doubt that the conference here at the Citadel will be absolutely excellent. The first ASEE conference I ever attended was the Section conference at the Citadel ten years ago, and I still recall that conference as a high point of my experience as an engineering educator. It was that conference that lead to my involvement in the Section, and I hope that those of you who are new to the Section will take advantage of this opportunity to make connections and to become involved in the workings of the Section in the areas of engineering education dearest to your heart. Whether you are currently an engineering educator, are a graduate or undergraduate student, or are a professional in another aspect of engineering, we give you our warmest welcome, and hope that you will continue to be a part of engineering education. Remember the words of Confucius: “If you think in terms of a year, plant a seed; if in terms of ten years, plant trees; if in terms of 100 years, teach....”

Our ASEE-SE Conference in 2012 will be at Mississippi State University, and the preparations are already well underway for our visit. I look forward to the opportunity to explore this excellent university, and hope that you will plan to join us there.

It has been my privilege to serve as the President of the Section for the past year. I very much appreciate all the support I have received and I know that the same support will be given to the next President. Thank you for your generosity in giving your time, your creativity, your work, and your dedication to this Section—I hope that you will find it as rewarding as I have.

Claire McCullough
President ASEE-SE
Acknowledgements

The planning and execution of any conference such as this involves the hard work of many individuals and groups. I would like to express my sincere appreciate to:

- the 112 registered conference attendees representing 34 higher education institutions and 3 companies/institutions
- the 12 student teams in the poster competition
- all of the presenters in the technical sessions
- the Session Moderators
- Members of the Civil and Environmental Department at The Citadel
- Jarrett Sonta who handled the registration site for the conference
- ASCE Chapter of ASCE especially cadet drivers
- Dr. J. P. Mohsen (Keynote Speaker)
- Claire McCullough, Scott Schultz, and Barbara Bernal and the members of the Executive Board for their guidance and planning
- Nancy Leftner and The Citadel Chorale
- MSGT Greene and The Citadel Rifle team
- All those conference sites who went before us that provided planning guidance and support
- Verdell Rouse Executive Assistant to the Dean of Engineering at The Citadel

I would especially like to thank our official sponsors: National Instruments, Stantec, Simmons & White, Trader Construction Co., Armstrong Glen P.C, Arp Engineering, and McDermott International.

It is a pleasure to serve you. If you need any assistance during the conference, stop by the Conference Registration area. Enjoy the conference and your time visiting Charleston.

Dennis Fallon
Site Coordinator
Conference Information

Sunday Reception
On Sunday The Citadel School of Engineering will host a 2-1/2 hour dinner cruise starting at 6:00PM at no charge to the members. The limit is around 120 people and it will be on a first come first serve basis. Families of members are welcome to attend. For detail information on the cruise go to http://www.charlestonharbortours.com/. Buses will transport participates from the Riverview Holiday Inn starting at 5:30 PM and return around 9:00 PM. This cruise is sponsored by The Citadel School of Engineering and various engineering companies. If you are located at another hotel please let us know.

Conference Sponsors

National Instruments
National Instruments transforms the way engineers and scientists around the world design, prototype, and deploy systems for test, control, and embedded design applications. Using NI open graphical programming software and modular hardware, customers at more than 30,000 companies annually simplify development, increase productivity, and dramatically reduce time to market. From testing next-generation gaming systems to creating breakthrough medical devices, NI customers continuously develop innovative technologies that impact millions of people.

Liberty Mutual Group.
See registration packet for flyer on insurance opportunities

Engineering companies helping sponsor conference (see back of abstract book for details):

- Stantec,
- Simmons & White,
- Trader Construction Co.,
- Armstrong Glen P.C,
- Arp Engineering,
- McDermott International and
- Lindbergh and Associates.
Conference Overview

Transportation will be provided between the Riverview Holiday Inn and locations of events

Sunday, April 10, 2011
12:00pm – 07:00pm  Conference Registration  LeTellier Hall Auditorium
11:00am – 03:30 pm  Workshop: Session 1  LeTellier Hall Room 202
10:00am – 03:00pm  Workshop: Session 2  LeTellier Hall Room 209
Noon-4:00pm  Workshop: Session 3  LeTellier Hall Room 303
03:00pm – 05:00pm  Executive Board Meeting  Gordon Room Grimsley Hall
05:30pm – 08:30pm  Dinner Cruise  Holiday Inn bus pick up

Monday, April 11, 2011
07:30am – 08:30 am  Conference Registration  LeTellier Hall Auditorium
07:30am – 08:30 am  Breakfast & Unit Meetings  Riverview Room
08:45am – 10:00am  Welcome & Keynote Address  Skelton Grimsley Hall
10:00am – 10:20am  Morning Break  LeTellier Hall Auditorium
10:00am – 12:00pm  Student Poster Session  Grimsley Hall
10:20am – 12:00pm  Technical Session 1  LeTellier Hall
12:00pm – 01:30pm  Lunch and Presentation  Buyer Auditorium Mark Clark Hall
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Tuesday, April 12, 2011
08:00am – 09:00am  Breakfast & Division Meetings  Riverview Room
09:20am – 10:20am  Technical Session 4  LeTellier Hall
10:20am – 10:40am  Break  LeTellier Hall Auditorium
10:40am – 11:40pm  Technical Session 5  LeTellier Hall
11:40pm – 1:00pm  Lunch & Business Meeting  Riverview Room
01:00pm  Conference Adjourn
# Conference Technical Sessions at a Glance

## Monday, April 11, 2011

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<td>T5-C 303 LeTellier Hall</td>
<td>Ahmed Abukmail</td>
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<td>Software/Computer Engineering Divisions</td>
<td>T5-D 309 LeTellier Hall</td>
<td>Rebecca Toghiani</td>
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<td>Chemical Engineering Division</td>
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</table>
The Citadel Campus Map

CITADEL CAMPUS
LeTellier Hall Map (3rd Floor)
Technical Session Information

Session and Presentation Timing
Sessions are scheduled for 5 or 3 presentations. Some technical sessions have sections with a non-uniform number of papers. This is a result of late cancellations and attempting to theme sessions. In order to facilitate movement between sections in a technical section, each paper in a given technical section will be allotted the same amount of time. The presentation start times are listed in the grid below. This includes the introduction time and a 3 minute question/answer period. If there is a no-show author in a session, a break will be called. Papers should not be moved up or rearranged in sessions.

<table>
<thead>
<tr>
<th>Presentation #1</th>
<th>10:20</th>
<th>1:40</th>
<th>3:40</th>
<th>9:20</th>
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<tr>
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<td>Presentation #4</td>
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<tr>
<td>Presentation #5</td>
<td>11:40</td>
<td>3:00</td>
<td>5:00</td>
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</tbody>
</table>

Instructions for Technical Session Moderator Chairs

**Be prepared to moderate the session.**
Arrive 10 minutes early to the room where the session you are moderating is being held. Meet the presenters as they enter the room and go over the pronunciation of their name. Make sure all presentations are loaded and ready to go before the session starts. Bring a watch.

**Provide presentation guidelines at the beginning of the session.**
Introduce yourself at the beginning of the session. Remind presenters of the time limitations and that you will give a hand signal to warn that there are 5 minutes and then 2 minutes remaining.

**Introduce each presenter or presenters prior to their presentation.**
At the end of each presentation, the next speaker should come up and ready their slide show. Introduce the presenter when ready.

**Maintain the presentation schedule.**
One primary responsibility of the moderator is to ensure that the presenters begin and finish their presentations on time according to the technical program. Maintaining the presentation schedule within the session allocated time helps to have fair treatment for all presenters. If the presenter is not present or has canceled, please wait to begin the next paper at the scheduled time, so that all who planned to attend the remaining paper(s) can. The moderator has the authority to stop a presentation that is about to run overtime in a respectful manner. It is also the job of the presenter to prepare to fit the presentation in the allotted time. Try your level best to not let a presentation and Q&A overrun the allotted time.
Conference Workshops

All workshops are scheduled for Sunday on The Citadel Campus

Note box lunches will be provided for all workshops

Workshop 1
Title: “High Performance Learning Environments (Hi-PeLE)
Instructors: Pedro E. Arce and Jennifer A. Pascal.
LeTellier Hall Room 202 Time 1100AM-3:30PM

Hi-PeLE is a student-centered, active, and collaborative intensive learning methodology that enhances the development of the student ability to become an independent learner. The methodology uses some of the most advanced pedagogical approaches to learning (see, for example, "How People Learn" by Branford et al., NAE) and it is organized in three key "engines": One related to the knowledge development and acquisition (by the students) and based on two embedded cycles of learning and documentation; another one related to a "Linear Engineering Sequence" (LES) where the students focus on innovation and creativity; the third one is a "connector" between the two engines mentioned and it is related to "Recourses" where instructors, TA, materials, experts, etc are placed to serve the student's learning needs. This methodology has been implemented in numerous places here within the USA and in Argentina, Peru and Chile with excellent results. The workshop conductors will introduce the audience, in an interactive fashion, to the the key aspects of Hi-PeLE and help instructors to develop their own strategy for their courses.

Workshop 2
Title: “Introduction to BioMEMS on a Shoestring”
Instructor: Kevin Seales
LeTellier Hall Room 209 Time 10:00AM-3:00PM

This workshop will provide the background and basic information about microfabrication and microfluidic devices for biological research. It is intended for investigators and teachers wishing to begin educational and research projects in biomicroelectromechanical (bioMEMS) devices. The workshop consists of a brief presentation followed by hands-on design and fabrication of microfluidic devices using inexpensive shrinky-dinks, inkjet printers and toaster ovens.

It's more fun than your average workshop!

Workshop 3
Title: “Robert E. Noyce Program
Instructor: Dr. Sheryl Sorby
LETellier Hall Room 303 Time Noon- 4:00PM

The Robert E. Noyce program was established by Congress and is administered through the National Science Foundation with a stated mission of: “The Robert Noyce Teacher
Scholarship Program, seeks to encourage talented science, technology, engineering and mathematics majors and professionals to become K-12 mathematics and science teachers. “The budget for the Noyce program has grown exponentially in recent years; in 2009 with stimulus funding, the success rate for Noyce was ~75%.
We are offering a ½ day workshop that informs engineering faculty and administrators about working with the K-12 system and about how to successfully prepare a proposal for the Noyce program. We are offering information that will improve your professional understanding of the Noyce program and upon completion of our workshop you will be able to write competitive grant applications to future cycles of Noyce funding.
These workshops will be led by a former NSF program officer, and engineering faculty who have extensive experience in working with K-12 educators.
Keynote Speaker

Dr. J. P. Mohsen
Immediate Past President of ASEE
Chair of the Civil and Environmental Engineering Department
University of Louisville

J. P. Mohsen, is Immediate Past President of the American Society for Engineering Education. He is Professor and Chair of the Civil and Environmental Engineering Department at the University of Louisville and has taught there since 1981. He holds a Ph.D. in civil engineering from the University of Cincinnati.

His area of research is non-destructive testing of structural materials and has conducted research funded by the National Science Foundation, Homeland Security Administration, Federal Highway Administration, Portland Cement Association, and the American Concrete Pavement Association.

He has previously served on the ASEE Board of Directors as Vice President of Member Affairs 2006 to 2008, as Vice President of PICs in 2006, as PIC-I Chair 2004 to 2006 and as Zone II Chair in 2002 to 2004 and served as the ASEE National Campus Representative from 1994 to 2000. He has been active in ASEE’s Civil Engineering Division and served as chair of the division in 2002 and as the program chair for the 2000 national meeting. Previously, he served as Civil Engineering Division director from 1996 to 1999. He also served as the ASEE liaison with the American Society of Civil Engineer’s (ASCE) Educational Activities Committee (EdAC), and as the news correspondent for EdAC. He currently serves on the ASCE Regional Board of Direction as Region 4 Governor representing the Kentucky Section.

Mohsen is currently the Campus Representative (CR) for the University of Louisville and served as the Southeastern Section Coordinator for Campus Representatives from 1998 to 2001. He received the Outstanding Section Campus Representative Award in 1996 and again in 2011. In 2000, he was recognized as the Campus Representative who recruited the most new ASEE members in the Southeastern Section.

Mohsen served the Southeastern Section as President in 1993-94, and as editor of the conference proceedings from 1992 to 1997. He was Vice President and Instructional Unit Chair in 1990-1991, Civil Engineering Division chair in 1989-1990, and Technical Program Chair of the annual meeting in 1991. He was the first recipient of the prestigious Tony Tilmans Service Award in 2002 for outstanding service to the section. In addition to his contributions at the national and the Southeastern Section meetings, he has published and presented papers at other ASEE section meetings.

In his role as the ASEE national campus representative, he instituted technical paper and panel sessions at national meetings for campus representatives and served as the CR program chair from 1995 to 1998. He hosted and moderated the CR awards presentations at the national meetings from 1994 to 2000. Mohsen was the recipient of the Distinguished Service Award in 1999, and was named Engineer of the Year in Education by the Kentucky Section of ASCE, also in 1999. He received the Distinguished Teaching Professor Award in 2003.
2010-2011 ASEE SE Officers’ List

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Secretary Salame AMR  samr@ieee.org  Virginia Commonwealth Univ.
<table>
<thead>
<tr>
<th>Participant Name</th>
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<tbody>
<tr>
<td>Melissa Dagley</td>
<td>University of Central Florida</td>
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<tr>
<td>Joseph DeCarolis</td>
<td>NC State University</td>
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<td>Walter Lee</td>
<td>Virginia Tech - Engineering Education</td>
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<td>Ahmed Abukmail</td>
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<td>Aaron Ball</td>
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<td>Jimmy Hahs</td>
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Tyson Hall          Southern Adventist University
Priscilla Hill      Mississippi State University
Anant Honkan        Georgia Perimeter College
William Janna       Mercer University
Brent Jenkins       Southern Polytechnic State University
Hodge Jenkins       University of South Florida
Autar Kaw           University of Memphis
Dick Kunz           Mercer University
Laura Lackey        Mercer University
Jerome Lavelle      North Carolina State University
Michael Leonard     Mercer University
Rachel Louis        Virginia Tech
Kaitlin Marley      The Citadel
Philip McCreanor    Mercer University
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Rich Mines          Mercer University
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Laura Moody         Mercer University
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Kenneth Murray      North Carolina A&T State University
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Jerry Newman        University of Memphis
Gillian Nicholls    University of Alabama in Huntsville
Fatih Oncul         Southern Polytechnic State University
Danny Overstreet    Knovel
Samuel Owusu-Ofori  NCA&T State University
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Scott R. Schultz  
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David Silverstein  
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Sanjiv Sinha  
University of Georgia

Atin Sinha  
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Alice E. Smith  
Auburn University

Sheryl Sorby  
MTU

Tulio Sulbaran  
University of Southern Mississippi

Lulu Sun  
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Diane Thiede  
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Beth Todd  
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Rebecca K. Toghiani  
Mississippi State University

Douglas Tougaw  
Valparaiso University

John Vadnal  
Liberty University

Thomas Walker  
Virginia Tech

Robert Whalin  
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Cecelia Wigal  
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Raymond Winton  
Mississippi State University

Michael Woo  
The Citadel

Ali Yalcin  
University of South Florida

Tianyu Yang  
Embry-Riddle Aeronautical University

Ozgur Yurur  
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Zhaoxian Zhou  
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Matthew T. Luby  
The Citadel School of Engineering

Kayce L. McCall  
The Citadel School of Engineering

John K. Nowocin  
The Citadel School of Engineering

Lawrence J. Pearl  
The Citadel School of Engineering

Matthew D. Player  
The Citadel School of Engineering

Matthew E. Rentz  
The Citadel School of Engineering
Eric S. Roberts  The Citadel School of Engineering
Julie Shell  Tennessee Tech
Nathan K. Sinclair  The Citadel School of Engineering
Call for 2012

ASEE Southeastern Section
Annual Conference
April 1-3, 2012
James Worth Bagley College of Engineering
Mississippi State University

The Global Reach of Engineering
Call for Papers and Presentation Abstracts

Authors are invited to submit full-length manuscripts for presentation at the conference and inclusion in its proceedings. Papers addressing the conference theme have first priority and may include topics such as:

- What Is “Global Engineering”?
- Learning Styles Around the World
- Service Learning on a Global Scale
- Effect of Trans-cultural Issues on Engineering Education
- Study Abroad Experiences
- Going Global While Staying Home
- Educating Engineers for Nontraditional Engineering Careers
- Recruiting and Educating Veterans in Engineering
- Integration of Design throughout the Curriculum
- Capstone and Multi-disciplinary Design
- ABET Accreditation Projects
- K-12 Initiatives
- Engineering Communication Issues and Innovations
- Learning Communities
- Distance Education
- Diversity Recruitment and Retention
- Outcomes Assessment Programs
- Preparation for Engineering Practice
- Engagement and Retention Efforts
- Professional Development
- Fostering Undergraduate Research
- Freshman Engineering Programs
- Two-year / Four-year Partnerships
- Industrial Partnerships
- Virtual Classrooms and Laboratories
- Lifelong Learning

Authors may address other topics of interest to the engineering education community as well. Guidelines for preparing the manuscripts are available at http://www.asee-se.org

This is a peer reviewed conference. Papers will be accepted on the basis of peer review of the complete manuscript. Accepted papers with a registered presenting author will be included in the conference proceedings. Authors of accepted papers are expected to register and present their papers at the conference to facilitate the transfer of knowledge through discussion and debate.

In addition to full manuscripts, a limited number of abstracts may be accepted for presentation. These abstracts will be published in the book of abstracts, but will neither be peer reviewed nor included in the reviewed proceedings.

We also anticipate a poster session in which students will discuss their experiences in engineering education (design projects, research, etc.). Information about this session will be available in the fall.

**Schedule for Submission of Papers and Abstracts**

- **Oct. 7, 2011**: Abstracts submitted for consideration;
- **Oct. 14, 2011**: Authors notified regarding acceptance;
- **Dec. 2, 2011**: Manuscripts due from authors for review;
- **Jan. 6, 2012**: Reviewed manuscripts returned to authors;
- **Feb. 3, 2012**: Final manuscript and extended abstract due from authors;
- **March 2, 2012**: Deadline for presentation author to register for conference

Submit a 250–300 word abstract in doc, docx, or pdf file format by October 7, 2011 to http://asee.spsu.edu

**Contacts:** Tyson Hall, Technical Program Chair, tyson@southern.edu
John Brocato, Conference Site Chair, brocato@bagley.msstate.edu
CHAPTER 2

TECHNICAL SESSION

EXTENDED ABSTRACTS

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
### Technical Session 1  Monday, April 11, 2011  10:20am – 12:00 noon

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
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<tr>
<td>10:20 – 12:00 noon</td>
<td></td>
<td>T1-A</td>
<td>202 LeTellier Hall</td>
<td>Instructional Division No. 1</td>
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<td>T1-B</td>
<td>209 LeTellier Hall</td>
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<td>T1-D</td>
<td>309 LeTellier Hall</td>
<td>Engineering Tech. / Mechanical Division</td>
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<td>Moderator</td>
<td>Beth Todd</td>
<td>Zhaoxian Zhou</td>
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<td>Saleme Amr</td>
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</tbody>
</table>

**T1 – A: Instructional Division No. 1**

**LeTellier Hall**

- 119 - Development of Multi-Disciplinary Systems Engineering Courses Focused on Secure Computing  
  David Umphress, Alice E. Smith* and Drew Hamilton  
  2-3

- 208 - Mini-mesters as a Process to Enhance Freshman Education  
  Beth A. Todd, Timothy M. Pyles, and Ashley F. Randolph  
  2-4

- 134 - Integrating Digital Storytelling into an Engineering Design Course  
  Richard O. Mines, Jr. and Beth P. Mines  
  2-5

- 130 - The Documentation Cycle: A Student-Centered Tool for Efficient Learning  
  M. Paula Arce-Trigatti, Jennifer A. Pascal, Jeffery W. Thompson, Pedro E. Arce  
  2-6

- 182 - Retests – A Rescue Plan for the Sophomore Slump  
  Richard Kunz, Monika Bubacz, Jack Mahaney  
  2-7

**T1 – B**

- 178 - Using a Thesis Project on Gray Water Re-use to Develop the Foundations for Future Student Research Projects  
  Philip T. McCreanor and Douglas M. Doud  
  2-8

- 179 - Senior Design to Graduate Thesis: Designing and Evaluating a Bench-Scale Sand Filter for the Treatment of Residential Wastewater in Georgia  
  Sarah Dorminy and Philip McCreanor  
  2-9

- 127 - Healthy Homes: Lead Elimination Program Improves Quality of Life  
  Walter Boles, Norman L. Weatherby, Mary K. Mathis, Carol Boraiko, Faye Ralston, Brooks D. Russell, Chuncey J. Vinson, Glenn Hollandsworth  
  2-10

- 152 - Face Recognition Algorithms: Review, Benchmarking, and Applications  
  Zhaoxian Zhou, Hua Sun, and Chaoyang Zhang  
  2-11

- 120 - Biomass Gasification and Char production  
  David Domermuth, Ph.D.  
  2-12

**T1 – C**

- 159 - Case Study: Ten Document Needs for Schedule Litigation Support  
  Dr. Tulio Sulbaran  
  2-13

- 216 - Internationalizing Architecture, Civil Engineering Technology, and Construction Management Students through Sustainability  
  Shariar Makarechi, Ph.D., Fatih Oncul, Ph.D., Pegah Zamani, Ph.D.  
  2-14

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
110 - BIM – A New Teaching Tool
Pavan Meadati, Ph.D. and Javier Irizarry, Ph.D.

172 - Sequential Course Outcome Linkage: Integrating Learning Outcomes Throughout the Civil Engineering Curriculum to Meet Geotechnical Engineering Needs

T1 - D
180 - The First Two Years of Engineering Technology: Systems or Components Approach
Jerry Newman

111 - Alternate Deliver of Distance Engineering Technology Programs
Aaron K. Ball and William L. McDaniel

169 - A Comparison of Industry Relations Between Two Accrediting Organizations in Construction Education
Kevin T. Perry, PE, AIA

Hodge E. Jenkins

147 - The Design of a Fluid Meters Apparatus for the Fluid Mechanics Laboratory
William S. Janna

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
This talk will describe the development of two courses in systems engineering with an emphasis in secure computing. The course development and initial delivery were sponsored by the U.S. Department of Defense with intent to increase the number of students with interest and qualifications in this area. An advisory board of government and private industry specialists in systems engineering was formed to help further guide the effort. The first course has been offered during fall of 2010 while the second course, a team project oriented course, is offered during spring of 2011. Both upperclassman undergraduates and graduate students are in the courses from both industrial and systems engineering and computer science and software engineering. Further challenging the effort is a cadre of outreach graduate students. Some novel aspects of the first course are a certification included in the first course (Committee on National Security Systems for Certification CNSS 4012, National Information Assurance Training Standard for Senior Systems Managers. This is a federal certification that is offered at no cost and has no expiration date.) and a field trip to a secure computing site. In the second course, each team will be assigned a mentor from government or industry along with the faculty advisors. The project will involve producing a tangible product to demonstrate secure computing in a portable environment.
208 - Mini-mesters as a Process to Enhance Freshman Education

Beth A. Todd, Timothy M. Pyles, and Ashley F. Randolph

University of Alabama

EXTENDED ABSTRACT

Traditionally our campus has described itself as a “public institution with a private education” due to the small size of our classes. Within the past 10 years, a planned enrollment expansion has occurred with a doubling of enrollment within mechanical engineering. As members of the faculty adjust to having classes grow from 25 to 50 to 100 students, there is concern about the quality of education that is now offered.

As with many institutions, there is concern about retention of students, and simply putting more students into a classroom does not address this issue. One potential solution is the concept of mini-mesters with freshman courses.

The freshman year has been modified to create a number of narrow-topic 1-credit courses. With the mini-mester, a student would take a course for five weeks (meeting three times per week), then another 1-credit course for the second five weeks, and a third 1-credit course for the final five weeks. We are currently experimenting with this scheduling in the new Introduction to Mechanical Engineering course. This delivery technique allows us to interact with over 100 freshmen in small groups of less than 36.

The paper will describe logistical issues of introducing a mini-mester course in a traditional semester environment. Also the content of the new course will be discussed with student learning outcomes. Reactions of the students to the course will be presented.
134 - Integrating Digital Storytelling into an Engineering Design Course

Richard O. Mines, Jr. and Beth P. Mines
Mercer University School of Engineering / Wells Elementary School

EXTENDED ABSTRACT

In recent years, multimedia and technology have been hailed as educational tools used to engage students in the classroom hopefully leading to enhanced student performance. The author, over a period of years, has used a variety of teaching assignments to appeal to various learning styles and used PowerPoint presentations to facilitate the ease of presenting complex equations and principles in the classroom. This paper focuses on integrating digital storytelling into a 400 level engineering design course.

EVE 406, Design and Analysis of Water Treatment Systems, is a required course in the Environmental Engineering Specialization at Mercer University in Macon, Georgia. In past course offerings, students were placed in teams of two or three to work on the process design of a water treatment plant. Each group is responsible for selecting and designing the appropriate unit operations and unit processes for either a ground water or surface water source. The treated water has to meet Primary and Secondary Water Treatment Standards. The project is turned in at the end of the semester along with a detailed technical report documenting the design, specifications, and equipment required for each process. This is quite an overwhelming task; however, students comment on how pleased they are to come up with a final product that can be shown to prospective employers. On more than one occasion, student teams have not able to put forth the level of effort necessary to achieve the required outcome of a functional process design.

During the fall 2010 semester, the design project was dropped from being a course requirement and replaced with a digital storytelling project. Rather than work collaborative on a team, each student is required to prepare a design module on some specific unit operation or unit process used for treating drinking water. The design module must use multimedia in a digital storytelling format. Students are required to complete their projects by the end of the semester and turn in a digital copy of their work which should take approximately 10 minutes to view.

The objectives were to communicate the design of a specific process through video clips, PowerPoint slides, design equations, and case histories; and to include a design example and photos of actual equipment. Pre- and post-surveys of student attitudes were conducted and the results are presented. Overall, the students had a positive experience in creating their digital stories and indicated they would recommend this type of assignment in other courses in lieu of a term paper.

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
**130 - The Documentation Cycle: A Student-Centered Tool for Efficient Learning**

M. Paula Arce-Trigatti, Jennifer A. Pascal, Jeffery W. Thompson, Pedro E. Arce

*University of Houston Department of Economics / Tennessee Technological University Department of Chemical Engineering*

**EXTENDED ABSTRACT**

On the educator-front, it is suggested by the abundance of literature related to general note-taking procedures (Kiewra 1989) that educators are perhaps overly concerned with providing students a singular technique for learning and ignoring the substantial impact a cycle of documentation might have on learning efficacy. While note-taking is just one tool in the arsenal of options students may wish to use in their learning paths, an approach based on the macro-scale level of the subject combined with the micro-scale details seems to yield an efficient way of learning that may prove to be more successful. In this presentation, we will describe a Documentation Cycle that details and outlines a procedure that students may repeatedly employ in their classroom endeavors in order to more completely grasp the material at hand. In addition, the integration of the Documentation Cycle within the HiPeLE framework will be discussed as it pertains to efficiency of student learning.

The cycle begins with the students’ initial interaction with the material in the form of “Dirty Notes,” followed by a cycle of activities ranging from the students’ analysis of the material, asking questions, seeking answers, obtaining feedback, and beginning the data collection process once again. The results from such a series of events are the “Clean Notes,” accompanied by the greater aftereffect, the potential mastery of the material by the students. Qualitative assessments and testimonials based on the implementation of the documentation cycle in various courses will also be presented. The tangible documents (for example, in the form of a "Personalized Class Binder", see Rawlings et al. 2005) obtained as a direct result of the cycle provides the students with a set of materials which are then accessible throughout their careers.


182 - Retests – A Rescue Plan for the Sophomore Slump

Richard Kunz, Monika Bubacz, Jack Mahaney

Mercer University

EXTENDED ABSTRACT

Entering freshman engineering students typically take calculus and science courses similar to (but more advanced than) courses they have taken in high school, along with introductory engineering courses designed to provide brief exposure to the various engineering disciplines as well as basic principles of design, working in teams, communication, and programming. Then, in the first semester of the sophomore year, they are confronted with the first real discipline-specific engineering core courses: typically Statics and Electrical Fundamentals. They have successfully completed the prerequisites and have a year of college under their belts; yet typically up to one-third will earn a grade of D or F on the first test in these two courses.

There are many possible reasons for this result, but the most obvious one may be the most overlooked: students tend to underestimate the amount of independent work outside of class necessary to succeed in these courses and in the upper-level engineering courses they will subsequently encounter. Systematic solution of problems involving multiple steps takes practice and a discipline that can best be achieved by working such problems on one’s own. Students often learn this the hard way after scoring poorly on the first major test, and then are faced with the monumental task of both re-tooling their study habits and making up for a substandard grade. Some buckle down and recover; many others give up.

At Mercer, a pilot program of “retesting” for the first of three exams in Statics is in its second year. Students are eligible for a second chance on this exam, but only after completing and turning in a fairly substantial list of problems over and above the regularly assigned work: this is their “admission ticket” to the retest. Their recorded grade for the exam is a weighted average of their original score and their score on the retest. The intent is to provide the students an opportunity to recover from a bad first grade, while demonstrating the benefits of hard work outside of class. Preliminary results indicate that a substantial percentage of students not only improved their grade upon retesting, but also improved their chances of successfully completing the course over students who did not retest.

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
*178 - Using a Thesis Project on Gray Water Re-use to Develop the Foundations for Future Student Research Projects

Philip T. McCreanor and Douglas M. Doud
Mercer University / Mercer University

EXTENDED ABSTRACT

Mercer University’s School of Engineering recently began offering Master of Science degrees in both Environmental Engineering and Environmental Systems. Students have the option of pursuing project or thesis work to complete the degree requirements. This paper describes a Master’s Thesis project that sets the foundation for three continuation or future research projects, i) monitoring of a full-scale residential re-use of gray water for landscape irrigation project, ii) bench scale evaluation of gray water treatment technologies, and iii) impact of gray water irrigation on soils and plants.

Wastewater generated from laundry and bathing, commonly termed gray water, accounts for 50 to 70% of the total wastewater production from a residence. Gray water is significantly more dilute and can be expected to have lower BOD5, COD, solids, and microbial counts than the black water discharged from toilets, dishwashers, and garbage disposals.

The large generation volumes and relatively low substrate concentrations make on-site treatment and re-use of gray water for irrigation an attractive option for conserving potable water. However, many questions about the long and short term effects from different treatment systems must be answered. Public health concerns include the increased potential for contact with pathogenic organisms through servicing of the irrigation system or contact with contaminated soils or plant matter. From an environmental health standpoint, concerns include altering the microbial population in the soil matrix, concentration of salt in the soils, and impact of detergents on the soil hydrologic properties. This project aims to lay the foundations for future research work on a full-scale gray water irrigation system installed at a Macon Area Habitat for Humanity Home. The project will also develop protocols for bench-scale evaluation of gray water treatment technologies and the impact of gray water irrigation on plants and soils.
179 - Senior Design to Graduate Thesis: Designing and Evaluating a Bench-Scale Sand Filter for the Treatment of Residential Wastewater in Georgia
Sarah Dorminy and Philip McCreanor
Mercer University / Mercer University

EXTENDED ABSTRACT

On-site sewage management systems provide treatment of wastewater on properties that are not served by municipal wastewater treatment services. Conventional on-site systems use a septic tank to absorption field design. Alternatives to this design may be used where higher degrees of treatment are required due to sub-standard soils, high groundwater tables, or limited plot areas. One such alternative involves the addition of a post-septic tank sand filter to further treat water before it is released to either a traditional absorption field or a drip-emitter system. Currently, the State of Georgia’s Department of Community Health, Land Use Program does not have a design standard for sand filtration systems. The goal of this project was to design a bench-scale system for the evaluation of design standards for on-site sewage management with sand filters in Georgia. In the first phase of this project, a prototype bench-scale treatment system was designed and constructed by a Mercer University School of Engineering senior design team. In the second phase of this project, one of the team members conducted advanced analysis and re-design of the system components for their graduate thesis project.

The primary components of the system were i) wastewater storage and release unit, ii) septic tank, iii) flow division unit, iv) three independent sand filter columns, and v) sample collection. The wastewater storage and release unit was required to comply with the NSF International’s dosing requirements for testing experimental on-site sewage management systems. Saturated and unsaturated flow tracer studies were conducted to evaluate the overall hydraulic performance of the system and provide reference data for the assessment of column clogging.
Middle Tennessee State University’s (MTSU) Tennessee Lead Elimination Action Program (TN LEAP) received three separate grant awards from the US Department of Housing and Urban Development’s Office of Healthy Homes and Lead Hazard Control. The purpose of the awards is to reduce childhood lead poisoning through lead-based paint hazard remediation. TN LEAP has remediated over three hundred homes since 2006. Information generated from TN LEAP activities supplied data to a related research project funded by the National Science Foundation titled STEPping up Undergraduate Research at Middle Tennessee (STEPMT). The NSF-supported project used the data generated from TN LEAP activities to determine the extent to which participants in TN LEAP remediation experience detectible improvements in their quality of life as it relates to a healthier home environment. Survey questionnaires of pre-remediation (n = 54) and post-remediation (n = 36) sites (separate samples) proved an overall improvement in conditions such as respiratory problems, headaches, peeling paint, visible powder, dust, insects, pest droppings, ventilation, and mold. The significance is that improvements indicate participants experience additional benefits beyond the elimination of lead hazards. Post-remediation individuals are more aware of health issues in the home and take steps to mitigate hazards other than lead. For example, the percent of rooms in houses without insects and pest droppings increased from 38.3% to 67.6%. Post-remediation homes that pass retesting are certified safe from major lead hazards. Surveys reported children under age six living in 70.6% of the post-remediation homes. The homes are cleaner and healthier environments for the children and adults.
152 - Face Recognition Algorithms: Review, Benchmarking, and Applications
Zhaoxian Zhou, Hua Sun, and Chaoyang Zhang
The University of Southern Mississippi

EXTENDED ABSTRACT

Face recognition has received substantial attention in recent years due to applications in fields such as biometrics community and computer vision research. A lot of face recognition algorithms have been developed during the past decades. These algorithms can be classified into appearance-based and modal-based schemes. Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) or Fisher Discriminant Analysis (FDA) are two typical linear appearance-algorithms, and Elastic Bunch Graph Matching (EBGM) is a two-dimensional modal-based approach. Both PCA and LDA have different representations (i.e., basis vectors) of a high dimensional face vector space based on different statistical viewpoints. PCA algorithms use eigenfaces for dimensionality reduction to find the vectors that best account for the distribution of face images within the entire image space. The objective of LDA is to perform dimensionality reduction while preserving as much of the class discriminatory information as possible. LDA algorithms search for those vectors in the underlying space that best discriminate among classes. It seeks to find directions along which the classes are best separated. In both PCA and LDA, by projecting the face vector to the basis vectors, the projection coefficients are used as the feature representation of each face image. The distance between a test face image and the training prototype is calculated. If the distance is small enough, the image is recognized; otherwise, a new image is established. LDA takes into consideration the scatter within-classes and the scatter between-classes and thus is more capable of distinguishing image variation due to other sources such as illumination and expression. It is generally believed that LDA algorithms are superior to PCA algorithms, although it is not always the case. When the training data set is small, PCA may outperform LDA (this has been proved in our experiment), and PCA is less sensitive to different training data sets. In EBGM algorithm, faces are represented as labeled graphs, with nodes positioned at fiducial points (eyes, nose, mouth, and etc.) based on a Gabor wavelet transform. In a typical EBGM algorithm, a set of Gabor wavelet coefficients for each point is generated after the wavelet transform process. Several feature points representing the local features are extracted from the training faces. After that, for each feature point, a feature vector is generated by combining the Gabor wavelet transform coefficients with its coordinate. Every feature point is represented by a feature vector that includes a bunch of Gabor wavelet transform coefficients and its coordinate. Finally, all the feature vectors mentioned above are combined together to represent face that is used in comparison and recognition process. EBGM is best in terms of identification rate and performance reliability, however, poor illumination reduces recognition especially at nighttime. Three algorithms are implemented with Matlab. Scenarios and performance benchmarking are compared for each of the algorithms. The effectiveness and bottlenecks of each computation are discussed and possible improvements in different applications are given.
120 - Biomass Gasification and Char production
David Domermuth, Ph.D.

Abstract – Biomass gasification is a well developed process of converting wood to fuel gas. The gas produced is currently not as economical or convenient as fossil fuel but has great promise as an alternative source. The process can also be used to convert waste streams of almost any organic material to power. The ongoing research presented in this paper is multifold; the production of biochar that can be used for soil augmentation, a proposal to gasify coffee bean hauls in Nicaragua, biochar as a soil amendment for green roof systems, and an economical analysis of woodgas and char for business models. Biochar enhances farming productivity by storing and slowly releasing nutrients to the soil that would otherwise be leached away. This paper explains how education is integrated with the research and opportunities for future developments and additional projects.

Keywords: gasification, woodgas, syngas, producer gas, pyrolosis, renewable energy, biochar, EPA P3 grant
159 - Case Study: Ten Document Needs for Schedule Litigation Support

Dr. Tulio Sulbaran

The University of Southern Mississippi

EXTENDED ABSTRACT

This paper will present record keeping documentation of the construction schedule with regard to litigation. A lack of documentation of construction scheduling opens entities to litigation and liabilities regarding scheduling issues. Timely, informative, communicative, and accurate record keeping is not only desirable, but essential to the success of today’s construction project [Sweet, 1989]. Record keeping and documentation of the construction schedule is often required by law and most contracts [Sweet, 1989].

The objective of this paper is to determine a set of ten documents commonly considered the most important for the purpose of preserving entities rights under the contract for the purposes of schedule litigation. The approach used by the authors was grounded on gathering information through a survey.

The result from the survey support that contractors consider the “original contract” to be the most important of these documents. It is anticipated that the reader of this paper will have a heightened awareness of the ten record keeping and documentation instruments that are considered the most important by the construction industry related to schedule litigation. These ten documents should form the basis of a construction firm’s documentation and record keeping system, but are not to be considered the complete system by themselves.
Internationalizing Architecture, Civil Engineering Technology, and Construction Management Students through Sustainability

Shariar Makarechi, Ph.D., Fatih Oncul, Ph.D., Pegah Zamani, Ph.D.
Southern Polytechnic State University

EXTENDED ABSTRACT

In Southern Polytechnic State University’s initiative of Globalization of Architecture, Construction and Civil Engineering (GAAC), a new course, Global Sustainable Strategies, has been offered to bring an international experience to students rather than having the students go outside the U.S. The course has been carefully developed to serve as an academic bridge spanning three disciplines of architecture, construction management and civil engineering technology. The primary pedagogical focus of the course is two folds: first, it emphasizes the exploration of sustainable design strategies of world precedents in order to enrich the design and procedural vocabulary of students; second, it aspires to educate professionals sensitive about sustainability and who are likely to act as active members for propagating sustainable practices in their communities in the future.

Course Outline and Learning Outcomes

The course is a 3 credit hour upper division core course with 15 weeks of class and 1 final examination, and taught by one architecture, one civil engineering technology, and one construction management faculty. Class weeks each contain 2 lecture or video presentation sessions at 1 ½ hour per. The world sustainability issues are studied within the topics including passive environmental systems, low & high energy systems, methods of construction, water supply, waste management, transportation. Course learning outcomes are:

- Identify form giving factors in international buildings with emphasis on their sustainability backbone.
- Derive practical solutions for incorporating sustainable building systems sensitive to the local traditional costumes, codes, needs and practices during planning of international projects.
- Understand the culture and economy of different countries and be able to identify major sustainability issues associated with such countries.
- Predict problems and propose solutions for integration of latest technologies by reviewing case studies.

Conclusions

Global Sustainable Strategies has been successfully offered three semesters and received positive feedbacks. The course focuses on learning outcomes related to global issues affecting Architectural, Construction and Civil Engineering areas and bring an international experience to promote understanding of other cultures and life styles. This presentation discusses the course outline, teaching experiences of the faculty, and student feedbacks. Recommendations for future improvements are also presented.
110 - BIM – A New Teaching Tool

Pavan Meadati, Ph.D. and Javier Irizarry, Ph.D.
Southern Polytechnic State University / Georgia Institute of Technology

EXTENDED ABSTRACT

Based on learning styles, students can be identified as auditory, visual, and kinesthetic learners. Due to lack of conducive learning environment which provides hearing, seeing, and doing capabilities, currently construction engineering and management (CEM) students struggle to gain the required skills to solve many real world problems. A user-friendly interactive learning tool that provides a conducive learning environment is needed to enhance students’ learning capabilities. BIM facilitates development of a knowledge repository, which fosters conducive learning environments. Some of the BIM characteristics such as easy access to the information, visualization, and simulation capabilities provide auditory, visual, and kinesthetic learning environments. These environments allow the students to discover strengths and weaknesses of their learning practices and improve accordingly. Any time access to the repository creates learning environment beyond time and space boundaries. An interactive access to the repository through three dimensional (3D) model facilitates students to learn at their own pace. This paper discusses the feasibility of development of knowledge repositories through BIM that facilitate a conducive learning environment for CEM students. This paper also discusses about the residential house and wall formwork system knowledge repositories developed through BIM for teaching residential house construction process and concrete formwork courses respectively.
172 - Sequential Course Outcome Linkage: Integrating Learning Outcomes Throughout the Civil Engineering Curriculum to Meet Geotechnical Engineering Needs


The Citadel

EXTENDED ABSTRACT

The Citadel’s Department of Civil and Environmental Engineering has recently adopted an expanded set of twenty-four outcomes identified in the second edition of the American Society of Civil Engineers Body of Knowledge (BOK2) and undertaken work to develop course goals at the appropriate cognitive levels of achievement based on Bloom’s taxonomy. In addition, the department has continued to examine and analyze the linkage of individual course goals in various discipline-specific areas of concentration within the curriculum. A major objective has been to develop sequential course outcome maps or “threads” for each of the department’s major discipline tracts (structural, environmental, site development, transportation, and geotechnical) to evaluate the effectiveness of continuity in course goals and to provide framework for assessment based on BOK2. This paper describes the process utilized to develop the sequential course outcome maps and presents an example outcome thread for the geotechnical engineering curriculum. As such, this paper examines what constitutes the practice of geotechnical engineering, the associated subject matter that provides a knowledge and skill base for this practice after graduation, the sequence of course material related to geotechnical engineering, and the levels of cognitive achievement expected from students in order to meet the intended BOK2 outcomes. Finally, a summary of findings and recommendations resulting from the development of course threads as a framework for assessment are provided. These findings could be utilized to improve a student’s educational experience in the geotechnical engineering area of practice and to better integrate courses and learning objectives within a civil engineering curriculum.
There have been some amazing advances in many areas of science and technology in the last few decades. This has resulted in many changes to textbook content and the delivery of curriculum in the undergraduate engineering classroom. On the engineering science side, the electrical and computer engineering disciplines at many universities have adopted the system or 'what is inside the box' approach in the classroom. With many graduates choosing career paths in design or research and development, the system approach appears to be the academic choice for many colleges.

The technologist came about when engineering technology evolved as an offshoot of engineering science. While the engineer may be responsible for the analysis and design, the technologist may be responsible for product improvement, manufacturing production, or operational functions. The technologist today can wear many different shoes and is sometimes seen as the 'go between' between the engineer and the production floor in many different industrial environments.

There are many similarities in the curriculum of the science major versus the technology major during the freshman and sophomore years, but the science student typically will get more deeper into theory while the technologist will get more hands-on experience during the academic process. Many university technology programs are moving more toward the science approach of more theory or a systems approach.

The quality of curriculum is measured and hopefully blessed through the accreditation process. Two and four year schools then work together through articulation and the content of course material is evaluated and measured if a school is to accept transfer credits. The other factor to consider is the content and quality of course material for a two year graduate going directly into the workforce. Does the engineering technology school teach the component or system approach in the first two years? This paper will attempt to identify through research and survey feedback which approach is considered more appropriate or productive given several factors. Specific areas examined will be the academic, economic, and local industrial conditions at two-year and four-year schools across the country.
111 - Alternate Deliver of Distance Engineering Technology Programs

Aaron K. Ball and William L. McDaniel
Western Carolina University

EXTENDED ABSTRACT

Equitable delivery of quality distance education for engineering technology programs relative to traditional on-campus programs continues to be a challenge for many programs. Western Carolina University has sought to insure the delivery of quality instruction through multiple delivery systems including, taking the baccalaureate engineering technology program on-site to regional community colleges, hybrid, Interactive Televised Learning (ITV), web-enhanced, online courses, and laboratories available to students 24 hours per day via the Virtual Computer Laboratory (VCL). This paper will provide a brief history, curriculum, and delivery of Engineering Technology distance education programs at Western Carolina University. Emphasis will be placed on instructional alternative methods including face-to-face, web-enhanced, ITV, and laboratory instruction using VCL. Educational merits of these methods will be presented.

Summary and Conclusion

The distance program in Engineering Technology at Western Carolina University is currently enjoying growth and success. In order for that success to continue, adequate resources must be committed to sustain and further grow the program. One of the major factors for its success is the personal interaction between advisors/faculty and the students. The face-to-face delivery of instruction by tenured WCU faculty ensures a constant link to the main campus. Students believe they are getting the same quality instruction as their on-campus counterparts. Advisors regularly schedule visits to their classrooms and maintain regular office hours at each location. Some alternative methods of delivery have been more successful that others. Web-enhanced methods along with on-site instruction are preferred over ITV and web-based interactive video. VCL opens the door for extended methods of laboratory instruction and software access that was previously not available; however the response rate and reliability of the system has made this approach less that desirable. With high investments into the infrastructure for running VCL, efforts will continue to improve the performance of this delivery approach.

Successes include a high-quality, face-to-face, curriculum taught by highly qualified tenured/tenure-track professors. Western’s commitment to engagement with the region is admirable, and faculty/administrators are to be commended for their contributions toward building a strong distance program.
169 - A Comparison of Industry Relations Between Two Accrediting Organizations in Construction Education

Kevin T. Perry, PE, AIA
Murray State University

EXTENDED ABSTRACT

The relationship with industry and academia is an important aspect of the educational process. In fact, both ABET, Inc. and ACCE, the American Council for Construction Education require their accredited programs to maintain an advisory board consisting of industry professionals as part of the accreditation. For the construction industry, ABET, Inc. accredits programs in Construction Engineering and Construction Engineering Technology and ACCE accredits programs in Construction Management, Building Science and other similarly named programs.

Construction higher education has developed from a trade oriented focus to a technical and management focus as the construction industry has become more complex and demanding on time and resources. In addition to programs from the design side of construction, such as Civil Engineering, Architecture, Mechanical Engineering and Electrical Engineering, construction education has become more focused on these technological and managerial aspects of the industry to meet demands. A close relationship with the construction industry is important to stay attuned to these increased demands through interaction of academia and industry. This interaction can assist educators in providing graduates that are more readily able to contribute in the workforce. One way to measure this involvement and interaction is by the number of student chapters from ABET and ACCE programs in construction trade associations. This paper compares the relationship with the construction industry of ABET, Inc. and ACCE by examining memberships of their respective programs in construction education with industry trade associations and related organizations.

Hodge E. Jenkins
School of Engineering
Mercer University
Macon, GA

EXTENDED ABSTRACT

The demand for distance learning by students and the flexibility afforded to both students and faculty via asynchronous, online instruction has increased the number of engineering courses offered online. A review of current approaches in the development and delivery of course content for online instruction of introductory, sophomore engineering mechanics courses, focusing on statics and dynamics courses is presented. The challenges, failures, and successes of providing an online, self-paced learning experience that is an equivalent to (or better) than a face-to-face lecture/recitation format are discussed. Formats and structures of the course are discussed. Introductory mechanics courses face additional challenges over many currently offered, online courses engineering courses, which tend to be at a higher undergraduate or graduate level. These hurdles include the graphical nature of the materials and the enrollment demographics of primarily sophomores and some freshman students, who may be less mature and less disciplined for self-paced nature of courses, than upper classmen and graduate students. As the first engineering course for many students, many concepts and visualization techniques will be novel to these students. Where possible, assessment results or a discussion of learning outcomes are presented to evaluate the effectiveness of the methods and technology, especially in comparison to tradition classroom versions of these courses. Technology, materials and resources available for instructors through publishers, universities and other sources are also reviewed. Considerations of costs, faculty time, and student retention question the value of teaching early engineering courses in an online format.
147 - The Design of a Fluid Meters Apparatus for the Fluid Mechanics Laboratory

William S. Janna
University of Memphis

EXTENDED ABSTRACT

An inexpensive yet portable device for calibrating four different flow meters in the undergraduate fluid mechanics laboratory was designed and constructed. The apparatus contains a rotameter, a turbine-type meter, a venturi meter, and an orifice meter. All four meters are calibrated simultaneously using a volumetric measuring tank. Results obtained by undergraduate students are presented, and advantages of using this apparatus are described.

Laboratory instruction is an extremely valuable teaching tool, especially when integrated with a lecture course. The Fluid Mechanics Laboratory appears in many curricula, and one important experiment performed in the laboratory is in the calibration of a meter in a pipeline.

There are a number of meters that are used to measure flow rate in a pipeline. To calibrate each and every one would involve weeks of work. So it is important to determine which meters to have in the laboratory, and to be able to calibrate them in as few sessions as appropriate.

In this study, an inexpensive, portable apparatus was constructed for calibrating four different rate meters using water as the fluid medium. The apparatus and the experiment was designed so that all four meters can be calibrated in one laboratory session by a group of three-to-five students. This approach allows data to be obtained on all meters simultaneously, and it exposes the students firsthand to more than just a single meter during one effective laboratory session.

Before performing the experiment, students are given a lecture about the four meters, and instructions on how to operate the apparatus as well as how to obtain data. They are also told what to submit as part of their report. Experience has shown that it is expedient to have the students submit a group report consisting of an introduction, raw data, reduced data, sample calculation, and pertinent graphs. In this way, the students will become familiar with meters in general, without a major expenditure of effort. Data provided in this study were obtained by students.
**Technical Session 2**  
**Monday, April 11, 2011**  
**1:40pm – 3:20pm**

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<td>Autar Kaw</td>
<td>Robert Chin</td>
<td>Rich Mines</td>
<td>Terry Brumback</td>
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**T2 - A**

*133 - High Performance Learning Environments (Hi-PeLE): A New Paradigm in Engineering Education?*  
Pedro E. Arce and Jennifer Pascal  
*114 - Testing Concepts in a Numerical Methods Course*  
Ali Yalcin, Autar Kaw  
117 - Integrating the humanities and engineering: The implications of an interdisciplinary-based learning module  
Kerri Patrick Singer, Timothy Foutz, Maria Navarro, Sidney Thompson

**T2 - B**

115 - A Discussion of Tort Liability in Engineering Technology Laboratories  
Chip Ferguson, George Ford, and Ronald Bumgarner  
184 - Tennessee Higher Education Funding And Its Initial Impact On An Engineering Technology Department  
Thomas E. Banning & Scott C. Southall  
165 - What Makes a College Graduate "Educated"? A Proposed Curriculum Revision Across Disciplines  
Claire L. McCullough, P.E., Ph.D.  
181 - Measuring the Performance of an Online Journal: Preliminary Findings  
Robert A. Chin

**T2 - C**

113 - Analysis of the air conditioning systems in a blown films manufacturing plant in the southeastern United States  
Dr. George Ford, Dr. William McDaniel and Mr. Paul Yanik  
123 - Providing Sub-Saharan Africans with Drinking Water through Service Learning  
Elizabeth Hyde, Laura Lackey, Richard O. Mines, Loren Sumner, and Kristen Wyckoff  
171 - Influential Factors of Helmet Use  
Asha John, Dr. Fazil T. Najafi  
Undergraduate Student, Professor

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
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**133 - High Performance Learning Environments (Hi-PeLE): A New Paradigm in Engineering Education?**

Pedro E. Arce and Jennifer Pascal  
*Department of Chemical Engineering, Tennessee Technological University*

Sound pedagogical and high retention instructional environments are built on four key pedagogical principles: learning-centered, knowledge-centered, assessment-centered, and community centered. These effectively help students to critically explore a new concept, build a fact-knowledge pool, and when to apply it, eliminate misconceptions, and connect with the (engineering) culture to be effective professionals. Arce and Schreiber (*Chem. Eng. Educ.*, 2004) described a philosophy of a model to capture several of these characteristics and helped the development of a foundation for a new environment of student-based learning: High Performance Learning Environments or Hi-PeLE.

The new learning-centered approach is unique in the sense that it captures the four centerness described above by using students-centered activities aided by a pool of resources that includes information materials, instructors, classmates, etc. The overall strategy of these activities is guided by the Principal Object of Knowledge (POK, see Arce, *Jr. of Science, Educ. and Tech.*, 1994). These activities maybe organized in a group that contains learning and documentation cycles (Arce and Sauer, *AIChE*, 2007; Arce-Trigatti et al, 2009, *pre-print*) and focused on learning fundamentals of a given subject; another group is composed of (longer) team-based activities and focused on the transfer of knowledge to new situations. This group does not use cycles and, instead, it uses a “linear” strategy where students plan or engineer a prototype (experimental, computational, etc.) and after careful design, they build it, test it and report findings. We have named this group “Linear Engineering Sequence” or LES. Although the “signature” of Hi-PeLE was included in Arce and Schreiber (2004), this implementation-based model was not discussed in the original article since the authors’ goals were focused on primarily describing the general philosophy and ideas behind the methodology.

The introduction of LES is an important aspect that it is not usually present in others collaborative-based learning environments and focuses the students on the transfer process of knowledge to new (unknown) situations leading to a prototype (experimental device, computational algorithm, mathematical sequence, etc.). As oppose to other team-based learning with “projects” the students are required to identify the prototype which in turn leads to technological innovation. A corollary of LES is that “process” is more important than “results” for the learning of the students and, therefore, a change of educational paradigm is proposed. In this presentation, the authors will outline the basis for a new Paradigm in Engineering Education where the Hi-PeLE plays a central role to develop a new kind of engineer: Innovative, creative and entrepreneurial.
**114 - Testing Concepts in a Numerical Methods Course**

Ali Yalcin, Autar Kaw  
Department of Industrial and Management Systems Engineering/Department of Mechanical Engineering, University of South Florida

**EXTENDED ABSTRACT**

An undergraduate course in numerical methods in engineering departments follows the typical mathematics course sequence of Calculus I, II, and III, and Ordinary Differential Equations. As part of an effort of improved learning and effective assessment, in 2008, we decided to give a concept test to the students of the class at the beginning and the end of the course. The concept test was designed as a 16-question multiple-choice test, where two questions each are asked related to the 8 topics that are taught in the course.

The eight topics taught in the course are 1) Fundamentals of Scientific Computing, 2) Differentiation, 3) Nonlinear Equations, 4) Simultaneous Linear Equations, 5) Interpolation, 6) Regression, 7) Integration, and 8) Ordinary Differential Equations.

The questions were designed such that one would expect the students to know the correct answers to the questions in the beginning of the course because the Numerical Methods course simply involves developing approximate solutions to the mathematical procedures learned in the calculus series, ordinary differential equations, and college algebra. The distracters in the test were based on common student mistakes and misconceptions. No calculators were allowed.

The test is intentionally not called a concept-inventory test, as it may not meet the strict definition of a CI test [1]. We were simply interested in knowing how well each of the topics is known by the students, and how much they gain in the understanding of these concepts by the end of the semester.

So far, the concept test has been given to the USF students three times. The item analysis process, which examines student responses to individual test questions to assess the quality of the questions and of the test as a whole, showed that 3 of the 16 questions are below desirable standards. These issues are being addressed in spring and summer 2011 semesters.

**References**

117 - Integrating the humanities and engineering: The implications of an interdisciplinary-based learning module

Kerri Patrick Singer, Timothy Foutz, Maria Navarro, Sidney Thompson

College of Public Health, University of Georgia/ Faculty of Engineering, University of Georgia/
College of Agricultural and Environmental Sciences, University of Georgia/ Faculty of
Engineering, University of Georgia

EXTENDED ABSTRACT

A learning module, entitled The Water Module, was developed as an example for integrating the humanities and engineering topics in engineering courses. This module was the result of the collaboration of an interdisciplinary Model Teaching Team who discussed what skills engineering students need to connect the humanities with engineering. Five Guiding Principles were established from the team, and the Water Module was created to satisfy the criteria of those five principles. The interdisciplinary Model Teaching Team consisted of faculty members from the following fields: social work, art, English, health policy, curriculum, life sciences, etc. The purpose of this manuscript is to demonstrate what students liked and did not like about the Water Module as an instructional method of integrating the humanities into engineering course material.

An interdisciplinary Model Teaching Team was established to determine what skills students needed in order to make this integration. The team collaboration resulted in the development of five guiding principles of essential skills, and the Water Module was created as a way to incorporate these principles into an engineering course. This module was implemented into a freshman engineering course. Interviews were used to gather students’ reactions to this module and to evaluate the module’s success in teaching students this integration. A control group was used to compare other instructional methods against the module.

The findings indicate that the treatment group had a clearer understanding of how the humanities are imbedded in engineering practice. A limitation of this study is that it does not include any quantifiable measurements of students’ understanding of the connection between the humanities and engineering.
187 - Introducing Supplemental Instruction to Mercer University Engineering Curriculum

Monika Bubacz, Richard K. Kunz, Hodge E. Jenkins

School of Engineering, Mercer University, Macon, GA

EXTENDED ABSTRACT

Supplemental Instruction (SI) is an academic assistance program that utilizes peer-assisted study sessions. SI sessions are regularly-scheduled, free of charge, informal review meetings in which students compare notes, discuss readings, develop organizational tools, and predict test items. Students learn how to integrate course content and study skills while working together. The sessions are facilitated by “SI leaders”, students who have previously done well in the course and who attend all class lectures, take notes, and act as model students. SI is offered on campuses around the world and targets historically difficult courses - those that traditionally have high rates of D's, F's and W's as final grades. National statistics indicate that students who attend SI sessions regularly can expect to earn final grades up to a letter grade higher than their classmates who do not attend SI.

Mercer University has been offering SI sessions in different colleges through the university’s Academic Resource Center (ARC) for over thirteen years; however, Fall 2010 was the first semester in which Mercer University School of Engineering (MUSE) participated. Three courses were selected: EGR 232 “Statics / Solid Mechanics”, EGR 235 “Thermodynamics”, and EGR 236 “Dynamics” which are all instructed by Mechanical Engineering faculty. All of these courses are considered Engineering Core Sophomore subject areas and are required for all students for the BSE degree. Students specializing in Mechanical Engineering must achieve a grade of C or better in all three of these courses. Since these courses represent engineering fundamentals and cover basic tools and techniques of mechanical engineering, they are often considered by students as mechanical engineering “weed-out” classes.

In Fall 2010 Mercer University School of Engineering offered three sections of Statics with two SI leaders, two sections of Thermodynamics with one SI leader, and a section of Dynamics with one leader as well. This paper is focused on a comparison of test and final grades for the Fall 2010 and previous semesters. It consists of statistical analyses of those grades and students’ attendance in SI sessions, and proves a significant positive influence of the pilot program on students’ performance.
168 - The Role of an Introduction to Engineering Course on Retention

Priya T. Goeser, Cameron W. Coates and Wayne M. Johnson

Associate Professor, Engineering Studies Program, Armstrong Atlantic State University, Savannah, GA / Associate Professor and Interim Program Coordinator, Engineering Studies Program, Armstrong Atlantic State University, Savannah, GA / Associate Professor, Engineering Studies Program, Armstrong Atlantic State University, Savannah, GA

EXTENDED ABSTRACT

Introduction to Engineering (ENGR1100) is a multidisciplinary, freshmen engineering course at Armstrong Atlantic State University (AASU) in which students are introduced to the engineering process from problem formulation to the evolution of creative design. The main objectives of this course are to excite students about engineering, cultivate problem-solving skills, encourage creativity in design, emphasize professionalism, team work and communication skills, and introduce essential mathematics and science skills. Currently, the course is a combination of lectures as well as project-based materials. While this does excite and motivate students about engineering, it is not clear if it prepares them adequately for the intense, mathematics and science based curriculum ahead.

This paper presents an investigative study and analysis of retention rates of this program with the objective to answer the following pertinent questions:

- What are the primary factors that influence the student retention rates in the Engineering Studies Program at AASU?
- What role do courses such as ENGR1100 play in influencing and motivating freshmen engineering students to continue in the engineering discipline?
- What changes need to be made in ENGR1100 to better prepare students for the rest of the engineering curriculum?

Assessment data based on student surveys, student comments and student performance in this and other engineering courses have been used to answer the above questions. It has been observed that the retention rates in the program are primarily impacted by the difficulties faced by students in the mathematics, science, and programming courses taken after ENGR 1100. While ENGR 1100 has served well in motivating and exciting students about engineering, students’ perceptions and the faculty’s observation of academic performance in subsequent courses suggests that more can and should be done in the course to better engage and prepare students for these mathematics, science and programming courses. Further details on these assessment results and the proposed changes in ENGR1100 are presented in the paper.
115 - A Discussion of Tort Liability in Engineering Technology Laboratories

Chip Ferguson, George Ford, and Ronald Bumgarner

EXTENDED ABSTRACT

Industry and the military will often provide mandatory training on safety procedures for their employees in order to ensure the safest working environment. Academia often does not have the funding or other assets to provide similar training for professors and students. Engineering technology professors must provide laboratory experiences for their students, which may be unsafe if proper procedures and guidelines are not followed. A manufacturing engineering technology program, for instance, will often include courses which require welding, drilling, grinding, milling, and other potentially dangerous activities in a machine shop setting. Are professors legally liable if a student is injured during a laboratory exercise? The current paper summarizes several law cases where students were injured during an educational experience and discusses the development and use of a risk assessment model for engineering technology laboratories. Hopefully, this discussion will help professors who teach laboratory courses avoid legal liability in the pursuit of their trade.

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
Tennessee Higher Education Funding And Its Initial Impact On An Engineering Technology Department

Thomas E. Banning & Scott C. Southall

University of Memphis, Herff College of Engineering, Engineering Technology Department/University of Memphis, Herff College of Engineering, Engineering Technology Department

The Complete College Tennessee Act of 2010 (CCTA) is a public policy statement that established expectations for the State’s system of higher education. Pursuant to that public policy statute, the Tennessee Higher Education Commission (THEC) was tasked with developing the master plan to hold higher education accountable for increasing the educational success in the state of Tennessee. The Five Year Master Plan has been developed to implement that objective and its title is “The Public Agenda for Tennessee Higher Education 2010-2015.”

The Master Plan has many metrics but the most striking are: (1) increase the undergraduate degree production based on the national average for undergraduate degree attainment, (2) improve efficiency (time to degree, retention rates during specific milestones and graduation rates), (3) increase underserved students, (4) increase undersupplied occupations, (5) enhance research achievements, (6) improve the quality of the programs as volumes increase, and (7) fund institutions that obtain these objectives.

When the Engineering Technology Department at The University of Memphis received an advance copy of the Master Plan, the Department Chairperson, Scott C. Southall and the Undergraduate Curriculum Coordinator, Thomas E. Banning, started the implementation of an overlay of the existing data from the university’s Institutional Research Department and the new funding formula from the Master Plan. Additionally the concept of measuring the effectiveness (quality) of the student’s education started a separate discussion.

The purpose of this paper is to explain the new plan for the University and document the initial efforts in reviewing the current condition of the department using the new funding formula that would improve the support of the university’s Master Plan metrics to accomplish the goal of maximizing state funding for The University of Memphis.
Each university has its own understanding of, and definitions for, the critical skills, knowledge, and abilities that are required for a modern college graduate. The University of Tennessee at Chattanooga has recently begun an examination of current curricula, and has proposed as a set of shared educational values eleven ASK’s (Abilities, Skills, and Knowledge), which are viewed as crucial to each student, regardless of major. These principles, which were recently approved at the fall full faculty meeting at UTC, are: communication in a variety of genres and settings; information literacy; intercultural literacy; ethical decision making; inquiry and analysis; quantitative literacy; creativity and creative thinking; critical thinking; collaboration in diverse groups; civic engagement; and integrative and applied learning. [1] While some of these items, such as ethics and communication, are required by ABET, and are included in every accredited engineering program, others are not; yet such items as critical thinking and information literacy are essential for the effective practice of engineering. The university currently has a group of "Blue Ribbon" committees addressing these ASK’s, charged with developing a set of measurable student learning outcomes for each at freshman, sophomore, junior, and senior levels, but how these would be incorporated into different majors is not yet being addressed. Also, in an era when more and more state legislatures and university administrators are reducing the number of hours engineering programs are allowed to include in their graduation requirements, educators reasonably ask how anything else can possibly be squeezed into already time-crunched programs. This paper explores the relation between the ASK’s and the ABET accreditation standards for engineering, the relation between these and skills necessary for engineering practice, and how they might be incorporated into an engineering curriculum.

**Keywords:** Information literacy, Critical Thinking, Curriculum Reform

[1] Marcia Noe, Minutes of the Meeting of the Full Faculty, University of Tennessee at Chattanooga, September 7, 2010.
181 - Measuring the Performance of an Online Journal: Preliminary Findings

Robert A. Chin
Department of Technology Systems, East Carolina University, Greenville, NC

EXTENDED ABSTRACT

The Engineering Design Graphics Journal recently transitioned from being a print-only journal to being an online-only journal aided by Open Journal Systems. Developed and administered by the Public Knowledge Project, Open Journal Systems is an integrated open source journal management and publishing system that facilitates the publication of over 2000 journals. Among Open Journal Systems’ numerous features are the following: Open Journal Systems is installed locally and locally controlled; editors can configure requirements, sections, review process, etc; submission and management of all content is accomplished online; a subscription module is available with delayed open access options; comprehensive indexing of a journal’s content is part of a global system; reading tools for content is based on the discipline and editors' choice; email notification and commenting ability are available for readers; and complete context-sensitive online Help support is available.

While the continued success of any journal in transition includes ensuring that authors can continue negotiating the submission, editorial, and publication process; reviewers can continue evaluating manuscripts; and editors can continue working with authors and reviewers with relative ease; sustaining a journal’s performance can only be achieve by the editorial staff with the aid of data and the use of the that data to ascertain its performance. The data can be used to measure the journal’s current performance, an editorial staff can intervene with improvement strategies, and the data can be used to ascertain the extent of success of intervention strategies. The purpose of this study was to begin developing online journal visitor profiles and behavior patterns. The ultimate goal was to begin identify performance improvement opportunities for online journals.

Google Analytics (GA), a Google product, is a tool that generates detailed statistics on how users find a web site, how they explored it, and aided by the statistics, can be used to enhance user experience. While the intent of GA is to assist an endeavor in improving their website return on investment, GA can help a journal improve its performance.

GA generates a plethora of descriptive statistics an endeavor can use make improvements to their site: improvements that can lead to return visits and new visits. It appears, through this limited study, GA has the potential to characterize the performance of online journals and to identify improvement opportunities.
113 - Analysis of the air conditioning systems in a blown films manufacturing plant in the southeastern United States

Dr. George Ford\textsuperscript{1}, Dr. William McDaniel\textsuperscript{2} and Mr. Paul Yanik\textsuperscript{3}

ABSTRACT – This paper is a study of the ventilating and air conditioning systems in a blown films manufacturing plant with a substantial number of heat producing plastic extrusion machines and significant building envelope cooling requirements. Many manufacturing technology educational programs include a course in polymers or plastic product manufacturing. Plastic extrusion, injection molding and film production processes require special considerations to accurately calculate plant cooling requirements. This paper provides a brief discussion describing a step by step design process. Included in the analysis are the cooling loads created by the employees, lighting and miscellaneous equipment. A brief discussion of a typical blown films manufacturing line provides the background information for cooling load calculations. Heating, cooling and ventilation equipment is expensive to purchase and to operate, but process stability and employee satisfaction are two major benefits to be realized.

Keywords: blown films, cooling load, ventilation load, energy conversion

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123 - Providing Sub-Saharan Africans with Drinking Water through Service Learning

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Mercer University School of Engineering

EXTENDED ABSTRACT

In June 2010, Mercer University sent a group of students and professors to the community of Sisit in Kenya’s Northwest Rift Valley through an undergraduate service-learning program, Mercer on Mission. The Mercer on Mission course and associated trip focused on the availability and quality of water in Sub-Saharan Africa with an emphasis on marginalized communities.

Two notable outcomes from this service-learning experience are shared here. First, the experience is an example of a simple project having an immediate and sustainable impact with little resources. Secondly, technical questions arising from the project resulted in research appropriate for student thesis work.

Through collaboration with Africa Exchange—a non-profit, Nairobi-based organization run by Sam Harrell—the students from Mercer served the community of Sisit through the installation of 25 home water filters as well as a pump that relays water from the Wei-Wei River to a 10,000-liter tank near Sisit’s Nursery School, located 400 ft up a hill half a mile away. The water filtration units are modified biological sand filters, constructed from a local sand source, milled brass, and a plastic 70-liter container and PVC. The water pump runs without electricity, as it harnesses the kinetic energy in the source water to provide the force to pump the water up the hill. These solutions seek to serve as appropriate technology for the community—thus, they are not only “sustainable” and affordable, but they also address the available skills and resources of the people living in Sisit.

The focus of the thesis work outlined in this document is to investigate guidelines for appropriate filter construction, use and maintenance. Preliminary testing implies that biological sand filters are an effective form of water treatment, and that a copper or brass biocide may not be influential. An assessment of undergraduate student learning and reaction to the service-learning experience will be presented in a subsequent manuscript.
171 - Influential Factors of Helmet Use

Asha John, Dr. Fazil T. Najafi
Undergraduate Student, Professor

EXTENDED ABSTRACT

Although no federal law requiring the use of bicycle helmets exists, many states and districts have formed legislation to specify the age limits for mandatory helmet use. College students are not subject to the helmet law in Florida, where helmets are only required for bicyclists under the age of 16. The objective of this paper is to identify influential factors regarding helmet use at the University of Florida. Further, this study correlates those factors to behavior models developed by psychologists. An on-campus survey was conducted to gather information on bicyclists and their habits. Participants were requested to provide details regarding routes taken, accident experience, and law familiarity. The study found that of the 100 individuals who commuted to campus, 41 never wear a helmet, 37 always wear a helmet, and 22 sometimes do. Results indicate that the most significant factors affecting helmet use were commute distances and number of traffic signals passed, law familiarity, and perceptions of wearing a helmet. Each factor was categorized under various behavioral aspects described in either the Health Behavior Model or the Theory of Planned Behavior. The author believes that educational campaigns and helmet manufacturers have a significant impact on helmet-wearing trends. In order to promote helmet use on campus, safety organizations must strategically target college-aged bicyclists. Further studies on how to best appeal to college students might create opportunities to share relevant statistics and the reality of the protection that helmets provide. Also, manufacturers can economically improve aesthetics and create convenient storage capabilities to possibly increase the number of helmet users at the University of Florida.
163 - Malawi Solar Powered Water Pump System

Hunter King and Dr. Andre Butler
Mercer University School of Engineering

Extended Abstract

This project will consist of a water pumping system to supply potable water to an orphanage located in the Chuluchosema community of Malawi, Africa. Malawi is a landlocked country located in the southeast region of Africa and is surrounded by Mozambique, Zambia, and Tanzania. The water will be pumped from a nearby well up to a water tower located in the orphanage center. The pump will be powered by solar panels that will capture the solar energy from the sun. This pump is a submersible pump that will be placed inside the well. The solar panels will be installed on the roof of a nearby building to the well to receive the most sunlight. This project is in association with Mercer’s University’s Master’s Program for Environmental Engineering and Mercer on Mission. Mercer on Mission is a unique study abroad program that Mercer University developed which takes place during the summer months. This system will be built at Mercer University during the months of March and April in 2011. The system will then be dismantled and shipped to Malawi where the student will install the system permanently in June of 2011. The water pumping system will be built by materials that are sustainable enough to allow the system to function properly long after the student has installed the system and has left. Designated personnel that live in the orphanage will be taught the proper maintenance procedures to be able to keep the system running once the student leaves. The intent of this project is to provide a hands-on experience for the graduate student by working with various professors and manufacturers as well as different contacts from the developing country. The goal of this project is to supply potable water to an orphanage without the residents retrieving it from a well.
157 - Statistical Analysis to Assess Effectiveness of Rumble Stripes on Highway Safety

Dr. Tulio Sulbaran
The University of Southern Mississippi

EXTENDED ABSTRACT

Although traffic deaths are caused by an array of factors, in the United States more than half of all roadway fatalities are caused by roadway departures. In 2003, there were 25,562 roadway departure fatalities, accounting for 55 percent of all roadway fatalities in the United States. Roadway departure includes run-off-the-road (ROR) and head-on fatalities. In 2003, more than 16,700 people died in ROR crashes (39 percent of all roadway fatalities), and head-on crashes represented 12 percent of all fatal crashes. On average, one roadway departure fatality crash occurred every 23 minutes. An average of one roadway departure injury crash occurred every 43 seconds. In short, roadway departures are a significant and serious problem in the United States.

MDOT through the Traffic Engineering Division is commitment to improve Mississippi highway safety. MDOT has invested valuable resources to implement a series of safety improvement programs such as the “Rumble Stripes” program. Despite MDOT’s high commitment and efforts to improve highway safety, MDOT does not know the impact of the “Rumble Strip” program in reducing crashes. In other words, MDOT lacks quantifiable evidence that demonstrates the effectiveness of this program.

This paper focuses on the descriptive statistical analysis that was performed to measure the impact of rumble stripes in the studied area. More specifically, this paper includes statistical analyzes of traffic trends, crash information as well as characteristics of the studied area such as: a- Traffic Volume Overtime per Segment, b- Total Crashes per Segment Before and After Construction, c- Roadway Departures and Overturn per Segment Before and After Construction, d- Total Crashes per Segment under Different Lighting Conditions Before and After Construction, e- Roadway Departures and Overturn per Segment under Different Lighting Conditions Before and After Construction, f- Total Crashes per Segment under Different Road Condition Before and After Construction , and g- Roadway Departures and Overturn per Segment under Different Road Conditions Before and After Construction. The analysis presented in this paper can also be used to support case studies for class discussion and therefore prepare the engineers and technologist of tomorrow with activities that make connections between real data and educational experiences.
195 - Assessing the Pro-STEM Impact of an Intensive Summer Program on Secondary Students’ Interests in Transportation Careers

Sampson Gholston and Gillian Nicholls
The University of Alabama in Huntsville / The University of Alabama in Huntsville

ABSTRACT

The University of Alabama in Huntsville (UAHuntsville) is part of the Federal Highway Administration’s Summer Transportation Institute (STI) program to encourage minority secondary school students to explore a career in the Transportation field. The STI is an intensive four week program that exposes students to careers in science, technology, engineering, and mathematics (STEM). Students engage in hands-on exercises, lab assignments, computer training, field trips, and listen to presentations from professionals. The program is designed to make the students aware of the interesting and rewarding careers that are available in STEM generally and particularly the Transportation industry. UAHuntsville is fortunate to be located within minutes of the U.S. Space and Rocket Center where students are exposed to the history of the space program and how the technology developed in the early space program has broad applications in the current day. The ultimate goal of the STI program is to engage the students’ interest in the Transportation field and increase the number of students that ultimately enter a STEM career.

Although the program receives enthusiastic responses from the students and their parents, it is not possible to know whether it is effective in increasing the number of students that choose STEM until students choose a career. This research was undertaken to begin the process of measuring how effective the program is at increasing students’ interest in the STEM field. A survey was administered to the students at the conclusion of the 2010 STI to find out more about the students’ educational background, demographic characteristics, educational plans, career aspirations, family support for education, and impressions of the STI. The goal of the survey was to determine if the STI program positively influences students’ educational and career choices and whether students attending the STI can be shown to have a higher probability of pursuing a STEM major in college. The analysis in this paper reviews the initial findings from the STI completion surveys and how the program affected the students. Further longitudinal and comparative studies will be needed to assess whether students attending STI are more likely to pursue a STEM major than students who were not exposed to this program.

The findings from the initial survey indicate that the forty students that attended the 2010 UAHuntsville STI program were very academically focused and many planned to pursue a graduate degree. They reported doing well in school and having parents that were supportive of their academic aspirations. They had a positive reaction to the STI program and most felt it increased their likelihood of pursuing a degree in engineering. The survey results indicated that female students appeared to respond more positively than the male students. No conclusions were drawn about this finding, but it presents an interesting area for future inquiry.
140 - Obstacles and Barriers to the Implementation of Engineering Education Coursework in Rural K-12 School System

Terry Brumback, Daniel Fonseca, and Kevin Whitaker
The University of Alabama

EXTENDED ABSTRACT

It is the purpose of this study to examine the obstacles and barriers to the development and implementation of engineering educational programs in rural K-12 school systems, where learners are more likely to benefit from collaborative learning experiences and less likely to be exposed to the engineering profession through peer groups and role models. The researchers found that rural school systems offer a unique set of obstacles and barriers to the implementation of engineering education that require a greater manipulation of the environment than found in urban and inner-city schools. Presented using the imbedded multiple case study methodology, the study examines the issue from the perspective of the classroom teacher, in-service educational specialist, instructional designer, university researcher, and educational administrator. Participants were drawn from members of the “Building Alabama” project, a U.S. Department of Education funded program targeting rural Alabama school systems in the development of engineering related science labs. Data were collected through semi-structured interviews and then analyzed using the constant comparative methodology defined in the original studies presented by Glaser and Strauss.

Results of the study indicate that a gulf exists between rural school systems and university colleges of engineering that must be overcome to maximize the potential of engineering education programs in rural K-12 environments. Researchers found that the development and delivery of engineering education programming in rural school systems demands a more concentrated effort to adapt programming to the technical capabilities and professional development needs of rural science teachers. It was also found that teachers in these areas have a superficial understanding of the engineering profession and difficulty with the conception of the design function of engineering. On the university side, it was determined that university engineering faculty were unfamiliar with professional educational issues such as “high stakes testing,” “time on task,” state standards, and developmentally appropriate materials; making it difficult for the two groups to effectively communicate without remediation.

In addition to outlining the obstacles and barriers encountered over the three year duration of the “Building Alabama” project, guidelines for overcoming these concerns are discussed along with issues related to curriculum planning and sustainability. The study is limited by its case study approach that does not allow generalization beyond the “Building Alabama” project.
**153 - Creating Engineering Teaching Modules for High School Math Courses**

Tianyu Yang and Jose Fernandez  
*Embry-Riddle Aeronautical University / Miami Lakes Educational Center*

**EXTENDED ABSTRACT**

Incorporating engineering examples in K-12 math courses is a highly beneficial and desirable teaching practice. Unlike science courses, math subjects require more efforts and additional knowledge to be related to practical applications. Currently, many math teachers use examples in biology, medicine, economics or business in their classrooms. However, very few engineering examples are being introduced to students in math classes.

In this paper, we describe our recent efforts to create engineering teaching modules for high school math courses. Our project was part of the six-week summer program at Embry-Riddle Aeronautical University (ERAU), and was funded by a National Science Foundation (NSF)’s Research Experience for Teachers (RET) grant. The program pairs up a university engineering faculty member and a K-12 math or science teacher, and provides the teacher an opportunity to participate in engineering research under the supervision of the faculty member. An important goal of ERAU’s RET program is to create teaching modules describing engineering examples related to K-12 curriculum, and let the teachers bring them back to their classrooms.

In our project, two electrical engineering modules were created for high school math courses. The first module introduces the modeling of Direct Current (DC) circuits using linear systems of equations, while the second one introduces the analysis of signal processing in a simple wireless communication receiver using trigonometric identities. The modules not only inspire students’ interests in learning math subjects, but also have the potential to motivate some students to choose engineering as their major in college.

Currently, Mr. Fernandez is incorporating the two teaching modules in his classes, and he is also seeking to disseminate the materials among math teachers in Miami-Dade County Public Schools. In the future, we plan to promote the use of these modules through publications and workshops. We believe equipping K-12 teachers with basic engineering knowledge is critical to improving K-12 math education through practical engineering examples, and engineering teaching modules should be widely disseminated among K-12 teachers.
109 - Education Case Analysis For Pre-engineering Robotics After School Programs : Assessing The Intangibles
Marcos Chu

Abstract - In today’s economic situation, school districts are facing very challenging budget environments. School leaders need to have a sound education case analysis (ECA) strategy to invest in pre-engineering programs that are sustainable in the long run. As part of ECA it is necessary to understand how intangible factors such as current pre-engineering curriculum established within the district, community acceptance of the program and metrics used to calculate after-school program effectiveness can affect the educational case analysis. The purpose of an ECA is to enable school leaders to integrate financial information such as one-time program cost and recurring program support cost with intangible program benefits and costs. The ECA will also enable school leaders in making an informed decision to approve the after school program implementation, identify requirements for additional information or reject the project at time.

The success of an after-school STEM program is dependent mainly in the commitment and engagement of all the stakeholders in the learning community. There needs to be a broad support across the community and not only be a program driven from a sole organization. The goals is not necessarily to engage students so they will pursue a STEM career, but rather the purpose is to engage the whole community that will enable the goal of more students to pursue careers in STEM.

Keywords: education case analysis, pre-engineering, curriculum development, robotics, systems engineering.

1 INCOSE MG Spiral 5 Demo Robot Team Leader, marcos.chu@incose.org
### Technical Session 3  
**Monday, April 11, 2011**  
**3:40pm – 5:20pm**

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**Moderator**: Ted Branoff  
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### T3 - A
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  Dr. Tulio Sulbaran

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* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
T3 - D

*185 - Building a Robotics STEM Outreach Program from the Ground Up
Daniel Kohn

128 - A Robotics Workshop for Middle School STEM Teachers
Donald U. Ekong1, T. Anthony Choi1, Barbara Rascoe2

141 - Exploring the Middle School Mathematics Teacher Student Relationship
Jean Mistele and Rachel Louis

207 - Teaching Force Concepts with Biomechanics
Daniel Christ and Beth Todd

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
GC 120 – Foundations of Graphics is a hybrid introductory engineering graphics course at North Carolina State University. A majority of the students enrolled in the course are completing their second year of coursework in engineering. Previous studies in this course suggest that students had multiple strategies for making use of the online resources, and that these strategies had implications for learning outcomes on summative measures in the course. The next progression in evaluating the effectiveness of the course is to examine the resources supporting solid modeling. By placing the instructional resources online within a learning management system (LMS), a more accurate picture of student use is available. It is now possible to conduct a more thorough evaluation of the resources supporting solid modeling by examining the concepts presented in the online materials (i.e., video demonstrations) and compare them with those presented in the required textbook for the course.

In addition, the researchers are studying the efficiency of knowledge transfer between concepts presented within the online solid modeling demonstrations and submitted student work. Data were collected and analyzed to better understand if viewing the online software demonstrations improved students’ performance on modeling activities. The analysis involved assessing student work based upon measurable concepts presented in the video demonstrations. Student work was selected in a manner that assessed near transfer of knowledge and concepts (i.e., simply following the video verbatim) along with farther transfers of concepts where students did similar work without the assistance of step-by-step instruction from the video demonstrations supporting solid modeling.

Similar to previous studies of this course where students’ use of video lectures were examined, not all students took advantage of the online materials. For this first look at these few near and far transfer activities, there does not appear to be a big difference in student performance between students who watched the videos and those who did not. This could be explained by several factors. First, the instructor did demonstrate and reinforce concepts in the face-to-face sessions of the class. It is possible that students who did not watch the online videos felt that the explanations given by the course instructor in class were sufficient. Another possible explanation could be that students who did not watch the videos had prior experience in high school with the software. SolidWorks™ is used in about half of the high school drafting programs in North Carolina. A third explanation could be that the explicit objectives introduced in each video were not an exhaustive list of all the concepts present. Pre-instructional objectives consisted of the main ideas that would be presented in the video and were kept to a relatively short list. Students may not have perceived the importance of incorporating previous concepts (far transfer) into their work.
121 - Pilot Testing Mobile Solutions for Transmitting Digital Data to Online Learners

Te-Shun Chou and J. Barry DuVall
Department of Technology Systems
East Carolina University, Greenville, NC 27858

EXTENDED ABSTRACT

There are many different tools and platforms used today for Online Learning. The challenge is to pick carefully from a host of alternatives, many of which are costly and inflexible, and make wise use of limited resources. Our goal is to provide courses that are exciting and engage learners. The purpose for this paper is to provide information on three mobile technology solutions that can be taken into the field and used to capture and then transmit real-time digital data back on the Internet to students located anywhere in the world. In this paper we evaluate the performance of three systems: (1) Firetide Mobile Mesh Network, (2) Verizon MiFi Intelligent Mobile Hotspot, and (3) the Librestream Onsight Mobile and Visual Collaboration system. A web conferencing platform, Saba Centra, was used as a virtual classroom enabling transmission of video, audio and other forms of data from the remote sites. Faculty and students can attend a class “live” from anywhere in the world when they connect to Centra on Internet. Video and audio transmissions from mobile field locations can be embedded in Centra and shared with students in real-time connecting from their Internet-based desktops and laptops.
The Apple iPad was developed as a platform for the consumption of media and comes with dedicated applications installed for playing audio and video, displaying photos, web browsing, and reading electronic printed material such as books, newspapers, and magazines. The iPad at 7.47 by 9.56 by 0.5 inches and 1.5 or 1.6 pounds depending on the model is a little smaller than an 8.5 by 11 inch pad of paper. It has a 9.7 inch diagonal touch sensitive LED screen with a 1024 by 768 pixel resolution.

The small form factor and features supporting multimedia consumption also make the iPad a potentially useful platform for presenting class material. It can be considered a cheaper alternative to a tablet PC for presenting material. The iPad is easily connected to portable projectors and classroom multimedia systems for playing audio clips, playing video, displaying web pages, displaying portable document format (pdf) and eBook materials, and displaying electronic slides/presentations. There are several third party applications (apps) that support the importation of schematics and diagrams which can be annotated during by drawing on the iPad touch screen before or during a lecture. In this paper, the capabilities and limitations of the iPad as a classroom presentation platform are explored.

The authors found the iPad to be a robust and viable alternative to notebooks, netbooks, or even personal computers in the classroom. While there are some weaknesses with presenting certain types of data using an iPad, the portability and ease-of-use of the iPad outweighs any shortcomings that were discovered. After being used in three different classroom settings, participating faculty members agreed that the iPad was a more than capable presentation platform.
Presentation Only

As technology continues to evolve, instructors are faced with difficult choices regarding how to spend their course preparation and lecture time. One particularly difficult question is when to adopt a new technology and integrate it into the teaching-learning experience.

The primary purpose of this presentation will be to demonstrate the capabilities of pen-enabled PCs for lecture, specifically using a tablet-style PC. The demonstration is intended to provide a basic overview for those who have heard of the technology but never used it. The content will begin with a description of what “pen-enabled” computing is, including its current form factors, but will quickly progress to a demonstration of key classroom capabilities, including “virtual whiteboarding,” slide and document annotation, and text-based input methods.

There will also be discussion of the process of converting from traditional chalk/whiteboard lectures and from more modern slide-based lectures to pen-enabled lectures. The presentation will include examples from upper-level Transportation Engineering courses, helping to highlight some of the benefits of the technology. The goal is to provide enough insight into both the benefits of pen-enabled lectures and the investment required to become proficient with the technology, enabling attendees to make an informed decision about adopting this technology.
Peer mentoring is continually being evaluated as an effective means of guiding new engineering students during various stages of their college endeavors. It is presumed that peer mentoring plays a role in retention of students in science, technology, engineering, and mathematics (STEM) fields. This paper compares the data collection from fall 2009 that was used to evaluate the initial implementation of a large scale peer mentoring program that is led by peers instead of a single administrator with data collected during the fall 2010 program. The major changes that were implemented in fall 2009 were shifting leadership from the single administrator to a group of six peer leaders, shortening the program length from a full semester to ten weeks, and utilizing the university’s web-based course management system, Scholar. Based on feedback received during a focus group discussion and an online survey, significant changes for the fall 2010 program included developing a mentor handbook, providing peer leaders with more administrative responsibility, and assigning a group of mentors to one peer leader to improve the consistency of feedback and foster a peer leader to mentor relationship. Voluntary veteran and new mentors comprised a focus group that enabled feedback to be collected regarding the program leadership, effectiveness and organization of the program structure, and areas for future program improvement. Data was coded for qualitative themes to examine the effectiveness and success of the peer led large scale peer mentoring program in fall 2010 in comparison with the peer led model during its implementation year of fall 2009. Preliminary findings indicate that organization of the fall 2010 program was improved over fall 2009 and the structure allowed for peer leader-mentor as well as mentor-mentor relationships to be fostered. More consistent and timely feedback was provided over the 2010 program and there were positive comments about the new mentor handbook. Finally suggestions were made for future program improvement.
137 - NAE Grand Challenges and Academic Culture in Engineering Education at NC State

Jerome P. Lavelle and Laura J. Bottomley
College of Engineering, NC State University

EXTENDED ABSTRACT

This paper describes efforts in the College of Engineering at NC State University to develop and incorporate themes from the National Academy of Engineering (NAE) Grand Challenges for Engineering in the 21st Century into a cogent and cohesive academic culture. Strategically this approach is also informed by conclusions from many important recent reports such as NAE’s Changing the Conversation, and Educating the Engineer of 2020.

We first define and describe the Grand Challenges establishing their place and importance in today’s conversations about engineering. We then look at national trends that are currently affecting engineering and engineering education. A set of responses and initiatives resulting from these effects and trends are also described. Lastly, we detail the NC State strategy and discuss implementation to create a new academic culture.
136 - The Development of a Regional Engineering Center: A Collaboration That Works

William L. McDaniel and Sidney G. Connor
Western Carolina University/Appalachian State University

EXTENDED ABSTRACT

The North Carolina Center for Engineering Technologies (NCCET) was created to provide a facility for applied research in engineering related fields in the Unifour region of North Carolina. The center serves as a conduit to baccalaureate engineering education delivered by University of North Carolina system schools, including Appalachian State University, Western Carolina University, East Carolina University, and the University of North Carolina at Charlotte. Instructional delivery is multifaceted and includes face-to-face, online, hybrid, interactive television (ITV), and laboratory instruction via a Virtual Computer Laboratory (VCL).

Conceived as a community supported higher education effort in technical and engineering disciplines, the NCCET was established through a collaboration of business, government and higher education organized as the Future Forward Economic Alliance. This collaboration resulted in a major public-private capital campaign, which raised enough money to purchase and renovate the current building. Once completed, the building was presented to the University of North Carolina system for its intended use. The UNC system assigned Appalachian State University as the center’s fiscal agent. The center opened in 2008 with Western Carolina University’s Engineering Technology curriculum as the resident degree program. Since that time, the center has served an average of 50 students per semester in engineering related disciplines and currently serves an additional 100 students per semester in other programs.

This paper will discuss the history and development of the center, its current status, and challenges and opportunities involved in cooperating with other universities for a common goal. In addition, educational merit and future plans for utilization of the center will be discussed.

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
170 - Developing an Effective Community College Transfer Pre-Engineering Program

Cecelia M. Wigal, Ph.D., P.E and Tim McGhee, M.S.
The University of Tennessee at Chattanooga / Chattanooga State Community College

EXTENDED ABSTRACT

Many states, including Tennessee, are actively addressing strengthening the ties between the states’ 2-year and 4-year degree granting institutions. The stated purpose for this activity is to define articulation agreements that aid students in completing 4-year degrees in 4 years whether the students begin their academic careers at the 4-year institution or at the 2-year institution. For most BS and BA degree programs this activity does not create much anxiety. However, for professional programs, such as Nursing and Engineering, this task creates much apprehension.

The State of Tennessee’s solution for engineering is to define an A.S. degree of 66 hours that includes meeting the state’s general education requirements (42 hours) as well as 24 hours in the major. For most engineering programs this means meeting mathematics, chemistry, and physics requirements and a few major specific courses (Circuits I, Statics, Dynamics for example) that are necessary for the student to progress at the Junior level once the A.S. degree is obtained. However, due to the general education requirements of the A.S. degree, it is not possible to include all required sophomore level engineering courses in the agreement. Thus these agreements have only been accepted by the 4-year programs if they include notes strongly suggesting the student complete other courses prior to entering the 4-year institution.

This paper presents another means to address the 2-year program pre-engineering curriculum – an A.A.S degree that does not have the same general education completion requirements. Chattanooga State Community College and the University of Tennessee at Chattanooga (UTC) College of Engineering and Computer Science are teaming to provide students the first two years of the engineering program in parallel.

Having a parallel 2 year program at the local community college provides a number of opportunities to the 4-year degree program other than receiving transfer students prepared for beginning the 3rd year of their engineering program. It also provides a means for 4 – year program students to take courses they could otherwise not take due to closed status or scheduling conflicts. It can also increase student participation in extracurricular program activities.

The success of the parallel program depends on the open communication between the faculties of the 2- and 4-year programs. The 4-year program must relinquish the thought that they own the 4-year degree. The 2-year program must be open to serving the needs of the 4-year program. Both sets of faculty must be open to learning from each other especially with respect to how students assimilate material. Both programs can benefit from the teaching strategies practiced at both institutions. The possibilities are numerous if the institutions maintain an open partnership and remember to emphasize the benefit the partnership has for student education.
The ABET 2011-2012 Criteria for Accrediting Engineering Programs has substantially revised Criterion 4. Continuous Improvement. The criterion now specifies,

“The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which both the program educational objectives and the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

Under the revised criterion, the faculty of engineering programs must present a case for continuous programmatic improvement primarily on the bases of accumulated program educational objectives and student outcomes achievement measures, supplemented by a description of program changes made outside the assessment and evaluation loops.

This paper provides a description of an approach to integrate inputs that provides a summary of program status in terms of comparison to a program specific baseline for continuous quality improvement measurement. Continuous improvement over time is demonstrated by an aggregation of accumulated changes to program educational objective and student outcome achievement measures along with a collection of qualitative measures and associated comments. The approach is demonstrated by the use of an example.
183 - The Challenger Disaster: Making it Personal

Richard Kunz
Mercer University

EXTENDED ABSTRACT

The space shuttle Challenger disaster fundamentally changed the way the public views NASA, the way the public perceives the engineering profession, and the way engineers view themselves. The decision to launch, the technical reasons for the failure, and the management culture at the time of the accident have all been the subject of intense scrutiny and numerous reports, papers and books. From an educational perspective, the incident has provided the opportunity to explore questions of engineering ethics, the relation between engineering and management, and the effective use of technical communication in conveying risk. It is a rare engineering curriculum that does not expose its students to at least one case study on the subject of Challenger.

The year 2011 marks the 25th anniversary of the Challenger tragedy. Few of our current engineering undergraduates were born when Challenger went down. Given the passage of a quarter century, the issue of convincing today’s students of its relevance to their careers should be confronted even as the example of Challenger is used to convey timeless insights into engineering ethics. The loss of immediacy can be compensated for by the perspective gained by the intervening years and by reflecting on the personal experiences of the individuals involved. Who was involved in the decision to launch? How was the decision made? How did these people react to the events that unfolded as a result of the decision? And how were their careers affected over the long term?

For fifteen years, beginning five years after Challenger, the author was employed as an engineer at Thiokol, the manufacturer of the solid rocket boosters whose failure led to the disaster. During those years, he became acquainted with many of the engineers and managers involved in the events leading up to the launch and its aftermath. The perspective gained from their experiences and insights can add a personal dimension to accounts of the Challenger tragedy that will resonate with today’s engineering students.
148 - The Evolution of the Global Positioning System
Mr. Robert Ford1, Dr. George Ford2, Mr. Jay McBride3

EXTENDED ABSTRACT

As society benefits from the new technologies related to the Global Positioning System (GPS), they probably do not realize the trials and tribulations surrounding its planning, development, implementation, and utilization. This paper will discuss the evolution of the system starting with the conceptual idea in 1838 by two brothers that were ship navigators and ending with the utilization of the system in modern surveying applications. Although, the initial purpose behind the system was based on specific requirements related to the Department of Defense, it was adapted to provide numerous resources and applications to the civilian sector of the world.

Keywords: Department of Defense, Global Positioning System, technologies, evolution, civilian, surveying.

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Abstract - Multidisciplinary projects provide a unique opportunity to foster critical thinking in undergraduate engineering students and to help students develop an understanding of the design process. These types of projects can also motivate student interest in the engineering design process. In this paper, the authors will present a case study of one such interdisciplinary project, which combined engineering analysis and a study of technological history, conducted by an undergraduate mechanical engineering student. The student investigated three different designs for a hand-held flamethrower that projected a highly flammable liquid, known as Greek fire. For this project, a student used historical accounts to design, construct, and test each of three flamethrower designs to determine the feasible operation for each. This work concentrated on the student’s ascertaining the similarities and differences between the three designs and on the student’s developing effective operating and valve systems. The original project was to investigate Chinese and Byzantine designs, but during the project, information in the Arab design was obtained and that design was also constructed by the student. [Englehart, 3]

Keywords: Flamethrower, Byzantine, Chinese, Arab, medieval.
Due to the unfortunate terrorist attacks of September 11, 2001, additional multiple security measures are required to protect the life of the people attending large sport events such as football. One of these multiple measures is the proper training of security personnel to detect threats. The preparation and delivery of this training is very challenging due to many factors such as: vast number of possible threats, high range of stadium conditions, and constant security personnel turn-over just to mention a few of the challenges.

Pre-event training was featured as standard procedure for most secure stadiums, but lower level security stadiums showed no emphasis for pre-event training. This is a problem because outsourcing security professionals to merely establish a security presence is no longer a guarantee of safety. An attack on a stadium during an event could kill or injure thousands so it is imperative that security professionals receive timely training using improved training programs so that threats that can lead to disasters can be detected, controlled, and avoided.

This paper will focus on the detailed description of the integration methodology for a Web based virtual reality training simulation tool prototype for security personnel in identifying possible threats that can occur during a stadium event. This paper also explains the initial ideas in the planning phase of the project, leading into the details of the final prototype.
*185 - Building a Robotics STEM Outreach Program from the Ground Up

Daniel Kohn
University of Memphis

EXTENDED ABSTRACT

Since joining the University of Memphis Engineering Technology faculty two and a half years ago, the author has made a concerted effort to be involved with outreach to the K-12 students in Memphis City Schools and the community at large to generate interest in STEM fields via mobile robotics. Through public events, national robotics programs like USFIRST and B.E.S.T., mentoring robotics teams, internet blogging and hobbyist organizations, this effort is starting to build a network of robotics enthusiasts in the Memphis area.

This interim report on ongoing outreach efforts will discuss various steps taken to get K-12 students, as well as the public at large, interested in mobile robotics as a tool to generate interest in STEM education. It will also discuss building partnerships with Memphis City Schools, companies, professional organizations and hobbyists to support these efforts and the need to create this network to support the teachers interested in promoting STEM through mobile robotics projects and contests.
128 - A Robotics Workshop for Middle School STEM Teachers

Donald U. Ekong¹, T. Anthony Choi¹, Barbara Rascoe²

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²Tift College of Education, Mercer University, Macon, GA 31207

Keywords: K-12 Initiatives; Robotics.

EXTENDED ABSTRACT

In June 2010, the Mercer University School of Engineering, with support from Boeing, organized a 5-day robotics workshop for middle-school teachers of STEM (science, technology, engineering, and mathematics) subjects. The objective of the workshop was to introduce robotics into the middle-school curriculum to inspire students to study and pursue careers in science and engineering. Youths are naturally intrigued, fascinated, and drawn to robots. By utilizing the robotics to excite and open up youths to technology, more students will consider STEM disciplines.

To promote such an educational culture, middle school teachers were introduced to how hands-on robotics activities that are fun and engaging can be used to teach STEM subjects. For example, students can learn applied physics concepts, such as mechanical advantage in design of gears; speed and friction, by observing a robot’s movement in response to motor actuation; and electronics sensors through sensor integration, calibration, and measurements. Without formal training in structured programming, students can also learn to program using visual module programming. Eight middle school teachers were selected from 3 central-Georgia counties - Bibb, Crawford, and Houston. These included two teachers from gifted science programs, and six teachers from science and technology programs. Some of the topics that were covered included robot programming, (touch and light) sensors, gears and speed with constant distance, gears and speed with constant time, and relationships between wheel sizes/shapes and distance. The workshop also addressed strategies for enhancing students' academic science achievement.

This paper discusses our experience with organizing the workshop, describes the robotics kits that were used, Georgia STEM standards that were covered, and workshop participants comments.

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
141 - Exploring the Middle School Mathematics Teacher Student Relationship
Jean Mistele and Rachel Louis
Virginia Tech

EXTENDED ABSTRACT

Purpose
Engineering, grounded in mathematics, mandates that students have a deep understanding of mathematics and highly developed mathematics skills. Unfortunately, large-scale studies reveal that many students’ performance at the K-12 level remains at moderate levels. We believe the teacher student relationship informed by care theory holds a key to student performance in mathematics and students’ future career choices in engineering. To prepare for an engineering career, middle school students must participate in a college bound algebra course by the eighth grade to be situated to enroll in college preparatory mathematics courses in high school.

Methods
We used multiple linear regression analyses and path analysis on eighth grade teacher and student data from the 2007 Trends in International Mathematics and Science Study (TIMMS) to link the teacher attitudes, the student attitudes and the student performance scores in mathematics. The research design consists of four parts: 1) explores the teachers’ attitudes toward their level of preparedness to teach mathematics, 2) explores the relationship between teacher attitudes and student mathematics achievement scores and the relationship between student attitudes and their mathematics achievement scores, 3) examines the impact of the mediating factor, teacher attitude, on student achievement scores, and 4) examines the general relationship between teacher attitudes and student attitudes in the sample.

Conclusion
Based on multiple linear regression techniques and path analysis, the student attitude and student achievement scores in mathematics are mediated by teacher attitudes. This observation, framed in care-theory, suggests that improvements to the teacher student relationship can increase student mathematics achievement, which may lead more students to pursue careers in engineering.
207 - Teaching Force Concepts with Biomechanics

Daniel Christ and Beth Todd

The University of Alabama

EXTENDED ABSTRACT

Current trends in prosthetics design include the use of pneumatic artificial muscles. Chemically produced hot gases can be used to power muscle actuators in small volumes allowing for lightweight, small-sized devices. However, the ultimate design still contains basic physical principles of action/reaction, pressure, and work.

A lesson has been developed for middle school science students on the topics of pressure and its capacity to do work. Incorporated into the lesson is an activity for students to design and build pneumatic artificial muscles out of balloons and pipe cleaners. The muscles were then used to actuate elbow joints made from tongue depressors. This paper includes a description of the activity relating it to the topics to be covered in the science class. Results of the lesson were found by observing multiple classrooms with approximately thirty students each and are discussed in terms of both student learning as well as student enthusiasm.

Purpose of Pneumatic Artificial Muscle Module

As part of a National Science Foundation GK-12 project, graduate student fellows at The University of Alabama work in conjunction with science and mathematics teachers from Sumter County schools by presenting their research and developing classroom modules to aid in instruction of topics. This particular module was developed in order to help a middle school class better understand the research topic of their graduate fellow; development of a pneumatic artificial muscle prosthetic arm. This module also was intended to help students visualize and understand topics in their course of study such as forces, pressure, machines, biology, chemical reactions and action/reaction.

Handout Version

A one page handout was also developed for distribution to students in the classroom and to other teachers wishing to use the activity with their class.

Conclusions

After successfully using this module in multiple classes of approximately thirty middle school students it is fair to say that it is a good learning tool that is ready for use in other classrooms. It is a fun activity that helps students learn, understand and retain difficult concepts such as pressure, force, action/reaction, robotics, and prosthetics. This understanding better prepares students for the ever expanding world of science, technology, engineering and mathematics and encourages them to consider careers in STEM fields.

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
Technical Session 4  
Tuesday, April 12, 2011  
9:20am – 10:20am

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**T4 - A**

161 - A Conceptual View of the Building Blocks to Develop a Web-Based Training and Educational Tool  
Dr. Tulio Sulbaran

149 - Incorporating Graphical User Interface (GUI) Design Component in Engineering Curriculum  
Tiffany Phagan, Thomas Yang, Ilteris Demirkiran

194 - The Path of Innovation: from Traditional Classroom to Hybrid Experience  
Lulu Sun, Matthew Kindy, and Caroline Liron

**T4 - B**

151 - Assessing the Effect on Retention of an Engineering Living/Learning Community  
Donna S. Reese

198 - Summer Enrichment Program to Enhance Retention  
Robert W. Whalin and Qing pang

214 - First Steps; Moving from the Freshman to the Sophomore Year in Engineering  
Paul Palazolo and Stephanie Ivey

**T4 - C**

193 - Learning by doing: A studio-based approach to teaching ergonomics and human factors  
Laura Moody

156 - Introducing Healthcare Engineering into the Undergraduate and Graduate Industrial Engineering Curriculum  
Joan Burtner

**T4 - D**

125 - Introduction to Biomedical Engineering: an Effective Way to Motivate Prospective High School Students and Engage Freshman to the Biomedical Engineering Program  
Jorge Bohórquez, Noel M. Ziebarth and Cherie L. Stabler

155 - Modeling of Breakage Equations Using PBE Software  
Priscilla J. Hill

*126 - The “Single-Pellet Reactor”: A “Cool” Multiscale Device, or a Powerful Chemical Engineering POK  
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* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
Jennifer Pascal, Pedro E. Arce, Vinten Diwakar, Seth Wynne

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
161 - A Conceptual View of the Building Blocks to Develop a Web-Based Training and Educational Tool

Dr. Tulio Sulbaran
The University of Southern Mississippi

EXTENDED ABSTRACT

For years, primitive tools such as text and 2D drawings, sketches, graphs and figures have been used for training and education in many areas. With the improvement of technology, a new tool known as virtual reality was born with the idea that perhaps computers could be used to digitally display information three dimensionally. Since its inception, virtual reality has been used successfully for many applications such as flight simulations, medical training, scientific simulations, education and more.

Recently, virtual reality has made a significant impact on the Internet. People are able to not only create virtual worlds or environments, but place them over the World Wide Web so that others may view them and even interact with them within their Internet browser. The Virtual Reality environments can also be used in conjunction with other technologies, namely database and programming languages, to enhance functionality. A user of the combination of these technologies can be absorbed into a VR environment, interact with it, and the user’s input can be recorded into a database.

This paper provides information about the most common features of virtual reality modeling language, current database management tools, and current programming languages available to the public. This paper also provides a conceptual view on how virtual reality modeling language, Microsoft SQL Server 2005 database management software, and Java programming can be used collectively to create a Web based virtual reality training and educational tool. It is anticipated that this paper will help the advancement of scholarship in engineering education by providing a foundation for a variety of teaching tools using this or similar technologies.
The knowledge of Systems Engineering (SE) is increasingly valued by the engineering community. An important aspect of SE is human factors, i.e., design for usability. User-friendliness has always been an essential measure of product quality. For many engineering products, customers’ paramount concern is ease of use. It is our belief that engineering students should establish such a mindset and possess relevant skills to develop user-friendly products. However, there is not enough emphasis in this area in the current engineering curriculum.

This paper describes our recent efforts in addressing the above issue by incorporating Graphical User Interface (GUI) design component in engineering courses at Embry-Riddle Aeronautical University. A GUI is a pictographic interface that makes software programs and computer controlled devices easy to use by providing consistent appearance and intuitive controls like push buttons, list boxes, slider, menus, etc. The concepts and basic steps to create GUI with MATLAB are introduced in several engineering classes, including Introduction to Engineering, Introduction to Computing for Engineers, and Electrical Engineering I. Then, we assign students projects to design simple GUIs to perform functions related to course materials. For example, students in Electrical Engineering I design a GUI to convert complex-valued numbers between polar and rectangular forms. The GUI can be used to solve AC circuit homework problems, which significantly reduces the amount of calculation performed by hand. Additional assessment is performed through an end-of-course survey.

This new teaching practice was well received by engineering students. It not only increased their awareness of user-friendliness for engineering products, but also improved their confidence in working with computer software to solve engineering problems. It is our belief that the benefit of such practice will well extend into students’ future professional career.
194 - The Path of Innovation: from Traditional Classroom to Hybrid Experience

Lulu Sun, Matthew Kindy, and Caroline Liron
Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

“Introduction to Computing for Engineers” is a programming course emphasizing problem solving. However, the lack of time for practice and the algorithm-centric nature of programming results in inadequate comprehension of this course material. Through course evaluations, faculty experience, and discussions, we feel that students in a programming course should have more time for “hands-on” learning, rather than trying to absorb content through lectures. We think that by getting students involved and excited about engineering from the beginning of their first year, we will markedly improve comprehension of the course content. To that end, a hybrid course is implemented that involves the creation and implementation of online activities, incorporating student-paced active learning and evaluation modules and in-class student implementation/demonstration. The objective is to enhance student involvement in the learning process, as well as to improve interest and retention in engineering.

Four out of ten sections were implemented as the hybrid courses. Investigators involved in the hybrid course design not only taught hybrid course sections in the fall of 2010, but taught the same content using traditional face-to-face methods. By doing this, investigators could implement a course wide assessment to not only assess the hybrid course design, but to compare and analyze the assessment results between the traditional and hybrid course to improve student learning outcomes.
151 - Assessing the Effect on Retention of an Engineering Living/Learning Community

Donna S. Reese
Mississippi State University

EXTENDED ABSTRACT

Beginning in the fall of 2007, the Bagley College of Engineering at Mississippi State University began offering engineering students the option of a living/learning community in one of its older residence halls. This program was started in response to a survey of students who had left engineering majors. These students listed as one of the primary reasons for their leaving engineering that they did not feel a sense of community within their major. Engineering freshmen live on the same floor with upper-division mentors and are co-registered in a freshman chemistry class in addition to the other first-year courses as appropriate for their majors (based on their ACT scores). Admission to the program is by application and requires only that the students be admitted to the Bagley College of Engineering and have a math ACT that will allow them to take the chemistry class (24).

The program consists of both community building and academic success components. The students in this program participate in monthly social activities such as bowling, tailgating, pizza nights in the dorm and visits to the local Boy Scout camp to participate in team-building activities. Mentors in the community provide on-demand career counseling as well as scheduled tutoring hours each week in the chemistry class as well as math and other courses students are enrolled in their first year. In the fall of 2009, a one-hour seminar course was also added as a requirement for students participating in this program. This class provides a scheduled one-hour meeting time per week and covers basic college survival skills (time management, study skills) and an introduction to various enhancements provided by the college (co-op, study abroad, graduate school, etc.).

Students in this program have a higher retention rate within engineering than the general engineering student population. This increase is in spite of this group having a lower average ACT than the general population. The differences in retention rates do appear to drop off in later years but the program is too new to have more than one class on whom the retention to the third year numbers can be compared.
198 - Summer Enrichment Program to Enhance Retention

Robert W. Whalin and Qing pang

Jackson State University

EXTENDED ABSTRACT

Engineering departments in Historically Black Colleges and Universities (HBCUs) typically provide admission to incoming freshmen with a wide range of ACT/SAT scores, reflecting a variety of preparedness levels for college curriculums. The historical attrition rate is high for freshmen and sophomores in engineering majors at Jackson State University. One of the major barriers causing engineering freshmen and sophomores to transfer from a engineering major is that they face challenges passing Calculus I and Calculus II, which are pre-requisite courses for almost all core courses in any engineering curriculum.

Analyses performed show that 2/3 of the School of Engineering graduates for which ACT scores were available (184 Math ACT and 188 Composite ACT out of 237 graduates) had ACT Math scores between 17 and 25, almost all are performing well in engineering positions or in graduate/professional school. Average ACT Math scores of First-Time-Freshmen students have steadily increased from 18 or below (2000-2004) to just over 20 (2010), and we expect a continuous steady increase. The two year retention rate (in an engineering major) was nominally 40% (2000-2008); however it was nominally 50% and 25% when analyzed for groups with ACT Math scores of 17 or greater and less than 17 respectively. Therefore, a Summer Engineering Enrichment Program (SEEP) focusing on the group with ACT Math scores between 17 and 25 was initiated in summer 2009 in order to help resolve the attrition challenge and to enhance retention and graduation rates. The Summer Engineering Enrichment Program is designed to prepare First-Time-Freshmen School of Engineering majors with sufficient mathematics knowledge to succeed in Calculus I during the fall semester, to provide an acclimation to college life, to provide an introduction to engineering careers and to promote self confidence.

In this article, a detailed design and implementation of the Summer Engineering Enrichment Program is presented, as well as the results to date, which are encouraging.
214 - First Steps; Moving from the Freshman to the Sophomore Year in Engineering

Paul Palazolo and Stephanie Ivey

Herff College of Engineering, The University of Memphis

EXTENDED ABSTRACT

With the nationwide emphasis on increasing STEM enrollments and persistence to graduation, researchers at the University of Memphis (U of M) are conducting a study designed to investigate factors that may influence retention, by identifying discernable trends in successful progress from the first year of the programs into the second and following years. In the fall of 2009, approximately 260 students were enrolled in classes that were identified as introductory/freshman level classes in the U of M Herff College of Engineering. Represented were entry-level classes in Civil, Mechanical/Biomedical, Electrical/Computer/Biomedical, and Engineering Technology. Each of the classes has an introductory nature but all have a significant computational component, an introduction to the engineering design process, and a communication component. Students were tracked academically through registration in the fall of 2010. Transcripts of all the students who were registered in the fall of 2009 were reviewed and the status of the students as well as possible reasons for lack of success were classified. Additional data based on characteristics of the students upon admission is being integrated into the study and a limited statistical analysis of the data is presented.
193 - Learning by doing: A studio-based approach to teaching ergonomics and human factors

Laura Moody
Mercer University School of Engineering

EXTENDED ABSTRACT

This paper describes the development of a studio-based approach for teaching ergonomics and work measurement to undergraduate engineering students. Studio-based methods in engineering education draw on the concept of a “design studio” as the basis for learning and applying fundamental skills and knowledge through a series of directed exploration and design projects under the guidance of the course instructor. The use of these methods for teaching foundational courses in ergonomics and human factors is especially promising, as laboratory experiences and design projects are often an integral part of the course. In our school, like many others, undergraduate courses in ergonomics and human factors are required for industrial engineering and are popular electives for students in other engineering disciplines. This mix of students produces a variety of backgrounds and perspectives. In a studio-based class interdisciplinary teams of students are created that draw on the strengths and perspectives each student brings from his or her own discipline. The studio approach allows the instructor to guide the student teams as they work on a series of integrated assignments that introduce or reinforce fundamental concepts through laboratory experiments or design problems. Peer review and class discussions are used to reinforce concepts and encourage students to learn from each other as well as their instructor.

The first course to implement these methods was Ergonomics and Work Measurement in the spring semester of 2010. Due to a unique set of circumstances that semester, the class size was unusually large (30 students). To accommodate this larger class size, a number of communication and control strategies were employed. In addition, the instructor implemented one formal and several informal feedback sessions in which the students provided specific feedback concerning the effectiveness of the course and the instructor made mid-course improvements.

The overall experience of the first course offering and feedback from the students suggested several refinements to the course, including smaller class size, refinements to the course assignments, and development of a series of concept inventory quizzes that students will use for self-assessment and the instructor will use to assess the effectiveness of the exercises. Based on the lessons learned, a refined version of the Ergonomics and Work Measurement course has been developed for the spring semester of 2011. This will include the implementation of ongoing assessment mechanisms to ensure continuous improvement. Future work will include a second course, Human Factors Engineering, in the fall semester of 2011.
156 - Introducing Healthcare Engineering into the Undergraduate and Graduate Industrial Engineering Curriculum

Joan Burtner
Mercer University School of Engineering, Macon, Georgia

EXTENDED ABSTRACT

Recently, the need to reform the way healthcare is delivered in the United States has been in the forefront of public awareness. Advocates for improvement in healthcare delivery recognize that increased productivity, cost containment, and continuous quality improvement are essential components of the new approach. Increasingly, methods from Six Sigma and lean manufacturing are being applied in the healthcare industry. Emphasis on cost containment, increased productivity, continuous quality improvement, and lean philosophy naturally leads to the potential contributions of industrial engineering to the delivery of healthcare. Therefore, for the past several years at Mercer University, we have modified the traditional industrial engineering curriculum to include course components that involve projects related to healthcare engineering.

This paper discusses how we have used short course units in required courses, senior design projects and technical electives to help prepare our graduates for careers in the healthcare field. We have added healthcare-related units to three required semester-long courses: IDM 404 (Industrial Management Case Studies), ISE 482 (Industrial Engineering Capstone Design Experience) and IDM 355 (Quality Management). For the past six years we have worked with local hospitals to develop long-term projects that would involve significant industrial engineering content. Several teams of students have selected these healthcare-related projects to complete the two-semester senior design sequence (ISE 487, ISE 488 or IDM 487, IDM 488). More recently, we have offered two semester-long technical electives related to the healthcare industry. Two years ago, the author developed and taught ISE 491 (Healthcare Process Improvement) to undergraduate engineering students. Last year, the author developed and taught ISE 427/ETM 591 (Reliability and Quality Assurance) to a mixed class of undergraduate industrial engineering and graduate engineering management students. As designed, fifty percent of the course content was related to quality assurance in the healthcare field.

In addition, the paper discusses the career paths of several of our students who are currently employed in the healthcare industry.
190 - Project Dynamics: Review of the Value of Systems Analysis Methodologies in Improving Information Technology Project Management

Okechi Geoffrey Egekwu and Timothy C. Delobe

James Madison University / James Madison University

EXTENDED ABSTRACT

Project failures in the Information Technology (IT) sector are well documented in the literature; project managers miss their target budgets and schedules more than twice as often as they meet them. Traditional project management methodologies initially developed for the large-scale engineering projects of the 1950’s, while still relevant and useful, are reductionist in nature and are therefore missing a systems approach that concentrates on knowledge creation before, during and after a project. This paper highlights the role of system dynamics and other analysis tools in augmenting a project’s control processes, as well as the skill set used by the project manager. Research from a wide variety of projects within the information technology sector and others, will be synthesized (e.g. system dynamics methodology), and will suggest the need for more robust and value added project management approaches. Understanding the project dynamics will illustrate the complex interactions and feedback structures inherent in all projects, as well as seek to educate project managers on how to handle cause-effect relationships through the phases of a project. Furthermore, the research will illustrate problematic project dynamics, using various conceptual models, and suggest the need to integrate system analysis methodologies for project management into traditional project management processes and bodies of knowledge instead of solely relying on them as a post-mortem tool for project analysis.

Contemporary business processes are more complex than in decades past and resemble structures with more interrelationships and interdependencies. It is becoming clear that the conventional (i.e. reductionist) project management methods are inadequate for handling this new era of complexity. The Project Management Institute recognizes this trend and research is currently underway by PMI, as well as others in academia, to learn how best to manage complex projects. Management styles and organizational structures are also following this trend towards complexity. Historically, managers subscribed to a Newtonian philosophy of management resembling a machine model predicated on linear thinking, control theory and predictability; this model is proving very difficult to tender in the new era of complexity. Some executives are even rejecting traditional organizational structures in favor of more complex models, like the matrix organization, or another type that Haas refers to as “alliances,” whereby an organization creates an organizational structure comprised of complex interrelationships between suppliers, partners, regulatory entities, customers and sometimes even competitors. Out of the complex organizations, complex projects are born.
125 - Introduction to Biomedical Engineering: an Effective Way to Motivate Prospective High School Students and Engage Freshman to the Biomedical Engineering Program

Jorge Bohórquez, Noel M. Ziebarth and Cherie L. Stabler
Department of Biomedical Engineering, University of Miami

EXTENDED ABSTRACT

As a part of the curriculum for the Biomedical Engineering (BME) program at the University of Miami, two courses were developed with the goal of introducing BME concepts at either the freshman (BME112) or high school (BME100) student level. BME112 is a second semester freshman course taught in a revised lecture/laboratory format since 2005. BME100, a summer scholar program, was developed in 2009 and has been offered twice. While both courses share primary objectives and methodology, some adaptations were incorporated to account for variable schedules and student enrollment. The main objectives of these courses is to engage students in the aspects of a BME program by providing them with a solid understanding on the main topics relative to this dynamic discipline, in addition to exposing them to the diverse professional development options. The following strategy has been used: 1) students interact with BME faculty, covering a broad spectrum of BME topics; 2) students perform a series of hands-on experiments where they make measurements on from living systems and interpret data; and 3) teams of students design and develop a short research topic involving data collection, interpretation and an oral presentation. In BME100, a condensed version is employed, where the faculty lectures are followed, within a day, with a hands-on laboratory experience guided by the same instructor. This experience is done either in the main campus or in laboratories or clinical sites in the medical campus. Summer students develop and test a Lab-View based medical device in lieu of a final project. The two courses were observed to be effective in engaging the BME students to the various aspects of the discipline, while also providing hands on experience. The student reaction to the courses, assessed by end of semester evaluations, is very positive as they acknowledge learning about the broad spectrum of the BME discipline and show satisfaction with the hands-on experience.
155 - Modeling of Breakage Equations Using PBE Software

Priscilla J. Hill
Mississippi State University

EXTENDED ABSTRACT

Particle breakage occurs in a variety of processing units in chemical processing ranging from crushers and grinders to breakage of particles in stirred vessels. Changes in the particle size distribution due to breakage are most often accounted for using population balance equations (PBEs). These PBEs are partial integral differential equations that are difficult to solve and for which there are few analytical solutions. This often makes solving these equations intractable for undergraduate students.

The goal is to remove this barrier so that students can focus on the effects of breakage model parameters on the resulting particle size distributions. An initial version of a computer program has been developed for use in a particle and crystallization technology elective course in chemical engineering. The course is a split level course that is mainly populated by undergraduate students. The program uses MS Excel as an interface and allows the user to set the initial particle size distribution, the model parameters for two breakage distribution functions, the specific rates of breakage, and the residence time for breakage in a batch process. Since the interface is a spreadsheet, it facilitates graphing the results.

The basics of the software will be presented as well as case studies that can be performed with the software. Since the software allows the particle size distribution to be plotted at regular time intervals, the change in particle size distribution as a function of time can be observed. Also, since two breakage functions are available, the distributions produced by different breakage models can be observed.
*126 - The “Single-Pellet Reactor”: A “Cool” Multiscale Device, or a Powerful Chemical Engineering POK

Jennifer Pascal, Pedro E. Arce, Vinten Diwakar, Seth Wynne
Department of Chemical Engineering Tennessee Technological University

In the field of Chemical Engineering, scaling aspects of mass transport is one of the most crucial subjects for students since the subject sets, most likely, chemical engineers apart from all other engineering disciplines. Multiphase problems are widely present in chemical, biological, environmental, textile, and intracellular applications, just to name a few (Cassano and Whitaker, 1986; Truskey et al., 2009). Examples of such systems include gas-liquid, gas-solid, and colloidal dispersion phenomena (Probstein, 2003). Furthermore, new technological developments use the addition of nanoparticles to a large class of systems (Arce, 2010) producing an even wider and less known class of multiphase systems that need, from chemical engineers, a very efficient treatment. Therefore, it is imperative that chemical engineering students have a very accurate and rigorous fundamental understanding of principles, model formulation, and scaling in mass transport associated with systems with more than one phase.

A system that is within the domain of the multiphase family is the so-called “Single-Pellet Catalytic Reactor, SPCR” (Petersen, 1965); this device that has been motivated by the need of analyzing and extracting information for either mass transfer coefficients or reaction kinetics (Sherwood, 1975; Carberry, 1977; Berty, 2011) is, in addition to its technological and exploring capabilities, a wonderful pedagogical “device”. The SPCR is a natural example of a two-phase, gas-solid system and, therefore, one of the simplest multiphase systems. As its name indicates, the SPCR is made of a single pellet (usually in spherical shapes) housed in a vessel of a given volume and it can be operated in different modes, i.e. batch, continuous, etc. When the pellet is inactive, the device is simply a mass transfer system similar to those found in mass transfer operations, i.e. adsorption, separations, etc.

In the current chemical engineering curriculum, the textbooks used do not provide a systematic, didactic approach for learning scaling in mass transport associated with multiphase systems. They often include problems already scaled-up and, therefore, missing the process of up-scaling so crucial for technology innovation. The SPCR described above provides a powerful example of a “principle object of knowledge (POK)” (Arce, 1994, 2009) that can better aid in students’ understanding of modeling and scaling mass transport in the “classical” two phase system model consisting of a single solid or porous pellet immersed in a vessel of fluid.

Based on the POK concept and building on previous efforts (see Arce et al, 2007) the authors present a didactic approach, that introduces the students to the analysis of a two phase system and to its up-scaling aspects. Several key aspects and results will be presented and discussed.


* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.

2-74
Technical Session 5  

Tuesday, April 12, 2011  

10:40am – 11:40am

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- 154 - A Practical Approach to Embedded Systems Engineering Workforce Development
  Özgür Yürür and Wilfrido Moreno

- 162 - Simple Accurate Measurement of Semiconductor Device Conduction Characteristics using the Standard Undergraduate Laboratory Instrument Cluster
  Raymond S. Winton

- 213 - Case Studies in Engineering Economics for Electrical Engineering Students
  Robert J. Barsanti

**T5 - C**

- 212 - A Dual Abstraction Mobile Computing Framework for Developing Programming Skills
  Ahmed Abukmail

- 202 - Integrating Robotics into First-Year Experience Courses
  Tyson S. Hall and P. Willard Munger

- 143 - Single Board Computer System Undergraduate Education: Design and Fabrication of a mixed signal automated Guitar tuning system
  Charles Duvall, Ross Pettingill GTRI

**T5 - D**

- *129 - The Total Mass Balance: A Road Map for Student’s Introduction to Transport Phenomena and Scaling*
  Jennifer Pascal, Parvin Golbayani, Pedro E. Arce

- 177 - Freshman Seminar in Chemical Engineering: Strategies for Student Success
  Rebecca K. Toghiani and Bill B. Elmore

* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
105 – Challenges in the Pedagogy of Virtual Classrooms

Barbara Victoria Bernal

Southern Polytechnic State University

Extended Abstract

The academic world continuously incorporates the advantages of modern technologies such as the Internet, portable computing devices, and dynamic media into the educational arena. The Internet has evolved into a global and commercial communication infrastructure with supporting applications for use at work, at home and in between. The progressive, never ending characteristics and requirements needed by both professors and students include a wide spectrum from new media expertise to new interface interaction protocols. With the use of supporting applications tailored for the classroom, professors gain a new presence and can offer new opportunities for student-student interactions. Use of mobile computing helps students instantly communicate and collaborate with each other and with their professors. These various technologies create what are commonly referred to as “virtual classrooms,” i.e., instruction where mentors and learners are separated by time and/or space.

Professors experience the dramatic increase of students’ understanding of complex information by offering the material in several formats rather than the single format of lecture. Multiple representations of information delivered in visual, interactive, experiential, and/or participatory formats enable learners of all types to access and reinforce the lesson. The goal is flexibility and accommodation of a wide range of learning differences. Study of the online learning uncovers two personas: mentor and learner. Both are contributors and participants striving towards an engaging experience. The paper gives participants’ comments regarding their experience as mentors and as learners. These shared comments can uncover some of the challenges and answers to successful online learning experience. The use of appropriate technology to achieve pedagogical purposes needs the feedback of the participants.

The total success within the virtual classroom is a challenge. No magical formula exists to guarantee success. The current pedagogy demands continuous improvement of online learning environments and successful ventures of educating online. We need more formative designs of online learning environments to bring to the surface the invisible tasks and activities we actually do. Hopefully, collaborative learning designs will soon advance with faster communications technology, wireless and handheld computing, and with the integration of software agents. Innovations in online learning environment interfaces and advancements in online pedagogy should evolve together, and should no longer be handled as separate directions for development.

This paper will review current practices in some virtual classrooms to examine key learning elements such as engaging, interactive, effective methods. Specifically, this paper explores collaborative or team-based learning, in which groups of students use computer mediated communication to work together on projects and assignments. The strength of the professor-student and student-student relationships that developed during the virtual class is discussed with thoughts towards the future of mentors and learners.
124 - Phased Retirement A Transition from Administrator to Professor

Kenneth H. Murray, PhD, PE⁶, William J. Craft, PhD, PE⁷

The University of North Carolina established a Phased Retirement benefit for faculty in 1997 to provide “an orderly transition to retirement through half-time (or equivalent) service. The goals of the Program are to promote renewal of the professoriate in order to ensure institutional vitality and to provide additional flexibility and support for individual faculty members who are nearing retirement.” Administrators with faculty credentials are allowed to retreat from administrator to faculty and then to phased retirement at the same time. The transition from administrator to professor requires many changes in daily activities and actions.

After many years as an administrator with control over budgets and authority, suddenly you have no budget and little or no authority. After living and sleeping your administrative responsibilities as an administrator, suddenly you have time to think, relax, and do some things that you have put off for years. After many years with a large office and administrative support, suddenly you have a small office or you share one with a colleague and have little or no administrative support. The students and faculty you remember from when you were teaching have changed and require that you change too. This transition is complex at times and simple at other times.

This paper is about the experiences of several administrators at North Carolina A&T State University who earned faculty rank and tenure before becoming an administrator and took advantage of this program. The transitioned back to the classroom with changes in administrative support are presented for these retiring administrators. The retiree’s personal financial considerations are discussed along with the academic department’s concerns. Some conclusions are discussed to help other administrators considering applying for the UNC Phased Retirement Program. It is hoped that their experiences will prove helpful for others.

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* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
145 - Using Case Studies to Engage Engineering Students in Library Instruction

Elizabeth Connor
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EXTENDED ABSTRACT

The rising trend has been for library instruction to go beyond lecture, demonstration and unstructured hands-on practice time to incorporate active learning activities. This paper describes specific teaching methods that were used with CIVL208 students scheduled to attend library instruction sessions. At The Citadel, CIVL208 covers Geospatial Representation. The engineering liaison librarian developed a lesson plan to be completed in a 50-minute class session. The underlying message was that knowledge is fluid, rather than static, and that engineers and engineering students consult discipline-specific literature to solve problems. This session incorporated a snowboarding case study, popular articles, video clips, clicker technology, and engineering databases. The intention was to use subject content that would resonate with younger generations of learners and to focus on tasks that required higher-order thought processes (analysis, synthesis and evaluation). The class was divided into small groups that were introduced to the facts of the case and asked to consult the popular literature. Each student was given a laptop to use during the session. As the case unfolded, students progressed to developing criteria to rank various ski resorts based on geographical and climatological data. After ranking the ski resorts, students were tasked with finding scholarly articles related to using GIS to make business/engineering decisions. Throughout the session, clicker technology was used to gauge understanding of key concepts. The author describes some of the techniques designed to engage student interest and participation in this information-seeking assignment and explain the usefulness of discipline-specific case studies for developing and improving library research skills.
154 - A Practical Approach to Embedded Systems Engineering Workforce Development

Özgür Yürür and Wilfrido Moreno
Department of Electrical Engineering, University of South Florida, Tampa, FL, 33620

EXTENDED ABSTRACT

It is common to find digital electronic devices at the source of controlling many aspects of a modern consumer’s daily routine; these devices regularly influence our comfort, and provide a means of flexibility. Companies designing and manufacturing these devices use advanced hardware and software tools. Engineering graduates sometimes find it challenging to secure an entry-level position since there are major differences between what they have been learning in school, and the latest development tools used in industry. This paper discusses a solution to this dilemma in the context of modern embedded systems. The Department of Electrical Engineering at University of South Florida (USF) recognized this necessity and developed a state of the art embedded systems laboratory course that enables its students to interact with the latest technology and development tools, and provides the environment for students to create their own projects. The course, besides expecting to teach theoretical and practical organizational and architectural concepts of microprocessors, provides students with the experience of designing and implementing applications in embedded systems using modern hardware and software development tools. Therefore, the proposed lab experiments are totally fruitful to students to understand embedded concepts used presently in the design of smart phones and its daily growing applications. One goal is to create a culture among the students to properly meet the challenges encountered in embedded systems hardware and software design; but most importantly, the lab serves as a vehicle to prepare new graduates for the engineering workforce and placing them in high demand due to their competencies in embedded design. Evaluation results show the impact on how this new lab course extends students’ engineering vision, and respond to enhancements of mentioned challenges.
162 - Simple Accurate Measurement of Semiconductor Device Conduction Characteristics using the Standard Undergraduate Laboratory Instrument Cluster

Raymond S. Winton
Mississippi State University, Starkville, MS

EXTENDED ABSTRACT

The undergraduate lab in electronics is usually confined to a relatively simple cluster of instruments, usually centered around the oscilloscope and the waveform generator. In the undergraduate treatment of electronics the lab is the environment used to take a direct look at circuits which use real components and evaluate their wrinkles and vicissitudes. The first part of this closer look is to make an assessment of the conduction (current versus voltage) characteristics of semiconductor devices, usually diodes and transistors. This assessment is usually graphical. The oscilloscope is a natural and preferred vehicle for both visualization and measurement.

The principal difficulty with the conduction measurements is the fact that the nodes that must be used for assessment of current and voltage are contiguous but for display they must be separated. The usual technique is to add a resistance (as a linear component) to assess current. While it appears that this is a simple and direct process, it cannot be transferred to the display environment quite so readily. The fact that a dual-trace oscilloscope has a common ground for its two traces compromises its ability to separately provide a screen display measurement, whether time sweep or X-Y sweep.

The solution to this problem is to use an opamp as a means to make one node of the device under test (DUT) to be virtual, usually as a virtual ground. The opamp can then be used for an order-of-magnitude sampling switch for the measurement of current. The technique is clean and simple.

The technique can be applied to any device characterization or circuit characterization. Device conduction measurements for diodes (various types), bipolar-junction transistors, junction field-effect transistors, and MOS logic gates are represented. For purpose of the assessment of its conductance switching characteristic the MOS logic gate is treated as a pseudo-device.
Undergraduate students are often faced with the challenge of trying to relate the theories and concepts presented in the classroom to real world situations. It is evident that when such a connection is made that students become self motivated to master the concepts at hand. The junior undergraduate electrical engineering students at The Citadel are required to complete a one semester course in Engineering Administration as part of their degree requirements. This two credit hour course presents the basic principles of engineering economy as applied to the analysis of the costs of construction of various engineering works. This course is typically taught outside the electrical engineering department and tends to focus on construction projects. This paper presents two comprehensive case studies that can be used to demonstrate the relevant course concepts, and are specifically designed to peak the interest of electrical engineering students. The first case study covers the general topic of present worth analysis and is intended to be used in the first half of the course. This case requires the students to compare computer networking equipment alternatives through analysis of the various life-cycle costs including the financing, acquisition phase, and operational phases. The second case study covers cost benefit analysis and is intended to be used in the second half of the course. It requires the students to compare competing mutually exclusive proposals for an electrical distribution utility including benefits, disbenefits, maintenance and operation costs. The paper provides an introduction to each case along with overview of the necessary economic theory and concepts. Then for each case study the paper provides detailed mathematical solutions, outlines the suggested student activities, along with project assignment alternatives.
In this paper we propose a teaching framework for a mobile computing-based programming course. The target students will include first-time programmers, both computer science majors and non-majors. Normal daily use of a computer is the only assumed pre-requisite for this course. Student motivation is a key factor to the success of this course in developing programming skills. As a result we adopt a mobile computing approach to develop these skills. In particular we target the development of mobile applications on smart phones due to their popularity as well as their increasing capabilities. We believe that students will enjoy developing applications for their mobile phones, and they will be motivated to do so. At the beginning of course, we show the students how to program what they understand. We accomplish that by instructing the students to perform a task given as English instructions from the instructor. Then we start the first half of the course by introducing the students to a high-level method of program development with very little syntactic detail, for this we use Google’s App Inventor where program syntax is not prevalent in the learning process. Syntax tends to be somewhat cumbersome to some students, as it will constitute learning a new language. Therefore, using abstract concepts, we develop the students’ logical thinking without the burden of learning the full syntactic details of a programming language. Throughout this phase of the course, basic programming and logic concepts, such as variable declaration, loops and conditionals will be explained. In the second half of the course, we introduce a more detailed view of programming to illustrate the exact same programming concepts discussed in the first half of the course. This is where we would introduce more details about language syntax and show the students the power of how syntax and semantics work together. In specific we will show the students how to redevelop the same Google Android applications developed in the first half except now we develop them using Android SDK as opposed to App Inventor. We believe when students observe the development of these applications on their mobile devices, their attention and their motivation will increase. This is because they will be advancing the capabilities of their own mobile devices with applications that have the potential to be useful in their daily use. Moreover, we will start introducing the students to other high-level programming languages such as C, C++, and Java to show the students the significance of learning how to develop for other platforms besides those that are mobile.
202 - Integrating Robotics into First-Year Experience Courses

Tyson S. Hall and P. Willard Munger

Southern Adventist University

EXTENDED ABSTRACT

Adding first-year experience courses to the general education curriculum are a popular trend in postsecondary education today. At Southern Adventist University, the first-year experience course is a one semester hour, discipline-specific course that provides students with a roughly equal mix of general education content and discipline-specific content. Within the School of Computing, the discipline-specific content is designed to engage students in the basic problem-solving processes that are prevalent in computer science and engineering and introduce them to basic skills such as soldering, printed circuit board (PCB) design and simple programming logic.

Over the three years that the authors have taught the first-year experience course in the School of Computing, various robot systems (including LEGO MINDSTORMS NXT and iRobot Create) and projects have been used to engage the students in the problem-solving process and to excite students in their choice of a STEM career. Based on student feedback from previous classes, a new custom robot platform has been designed and distributed to students in kit form. Building a robot from a kit exposes students to both the mechanical, electronic, and software aspects of the design process. In addition, the robot has been designed to be affordable ($50-75) so students can purchase them from the campus bookstore in lieu of a textbook. Providing each student with his/her own robot platform allows them to experiment with the robot outside of class and even after the semester is over.

This paper will overview the design of the robot platform and the curriculum that is used for the first-year experience course at Southern Adventist University. It will also report on lessons learned from the first use of these robots in the first-year experience course and show results from an assessment of student attitudes regarding the robot project and their engagement in the course.
143 - Single Board Computer System Undergraduate Education: Design and Fabrication of a mixed signal automated Guitar tuning system
Charles Duvall, Ross Pettingill GTRI

EXTENDED ABSTRACT
Undergraduate students at Southern Polytechnic State University experience the system development cycle from design to fabrication in a semester length course based on single board computer system projects. System guidelines are provided and students define projects in areas of interest. This document describes an interesting and creative project designed and fabricated for Southern Polytechnic State University’s ECET Digital 3 class by Ross Pettingill, a recent graduate, completed as a senior student and will be discussed as an example of how computer systems are taught to our students. The project was a combination of a microcontroller based system and analog signal processing with the overall task of determining a guitar’s frequency and actually turning the tuning keys of the guitar with a stepper motor. The menu driven user interface, the operating instructions, hardware, and software descriptions are described in the paper. Programming code, screen flow layout, parts list, memory map, and schematic of the design will be presented and discussed for educational benefit.

Student summary of learning: “The project was able to satisfy every class requirement given, and in making it has not only enhanced my digital knowledge, but also my analog processing skills, my understanding of computer architecture, and my appreciation for the power of microcontrollers.”

Professor summary of learning: Project met all requirements and by following the systems engineering approach to the planning and documentation the student enhanced his organizational skills and created a great project document to use during job interviews that displayed his technical breadth and depth. The tradeoffs of filtering and frequency counting musical signals, in this case guitar strings, was a particularly interesting application to reinforce many concepts taught in other courses. This project exceeded requirements by fabrication of a through hold board for the construction of the system and much was learned about board layout and some of the board layout software tools which are typically used in industry. Mr. Pettingill is now leading microcontroller projects in industry shortly after his graduation from SPSU.
The concept of mass is introduced to students from a very young age, and is therefore a familiar topic once students reach the college level. In chemical engineering, the concept of mass is key for the development of a rigorous and useful understanding of professional applications with or without chemical reactions. Separations, drug delivery, environmental remediation and intracellular transport are some relevant examples where concepts based on “mass transfer” play a significant role in analyzing and “sizing” or scaling a device. Didactically, mass conservation offers a powerful road map to introduce students to the framework of conservation quantities and conservation principles, i.e. mass, energy, and momentum.

Moreover, if continuum-based concepts are used to describe the physics behind the conservation principles, then mass transfer is a simple but powerful pedagogical concept to introduce students to scaling, changes of scales (see Arce et al., CEE, 2007), and, more significantly, the idea of a systematic approach for all of them. Unfortunately, textbooks, in general, do not bring these connections or “learning template” when introducing students to the subject. Specifically, since mass is a concept students should be comfortable with, it didactically makes sense to begin the process of learning the aforementioned conservation laws, with mass. Once students are confident in their knowledge of this conservation law, they can move to the more complex, or less familiar cases, such as the conservation laws of linear momentum and energy, for example. In addition, mathematically, “mass” is a scalar as opposed to momentum that is a vector-based concept.

In this contribution, the authors will present a method to introduce engineering students to the conservation of total mass through a fundamental approach that builds upon the previous knowledge of the students. This approach begins with fully understanding what mass is (i.e. total mass vs. component mass), defining total mass from the continuum scale (see Arce et al., CEE, 2010), followed by systematically deriving the conservation of total mass from a continuum point of view for closed and open systems, and finally incorporating the idea of scaling into the analysis by converting the macroscopic equations into microscopic equations. The authors, here, apply concepts learned by students in calculus, i.e. the Green’s or divergence theorem, Leibniz’s rule of integration, and so on and offer the students an effective illustrative application by introducing the idea of “time-scale switcher” and a “space-scale switcher”.

Furthermore, students are connected with the idea that, in transport phenomena, global or macroscopic variables are associated with “integration” and microscopic or point variables are related to “differentials” (Arce, ASEE-SE plenary lecture, 2008). In short, the contribution describes an effective road map in educating students on conservation principles in continua. Several details of this road map will be introduced and illustrated.

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8 This type of transformation has been used in the past (see Rosner, Chemical Engineering Education, 1974); however the connections with scaling and the pedagogical aspects seem to have been overlooked.
177 - Freshman Seminar in Chemical Engineering: Strategies for Student Success
Rebecca K. Toghiani and Bill B. Elmore
Dave C. Swalm School of Chemical Engineering, Mississippi State University

EXTENDED ABSTRACT
A first year seminar for chemical engineering freshmen was developed to address a number of critical needs during the first semester on campus. In addition to developing a sense of community among the students and a sense of belonging to a department 'family', this first semester also provides the venue to introduce students to their profession and its diverse opportunities. Modules developed for the course focused on personal development, professional development, and topics related to the chemical engineering profession.
* This abstract is a presentation only abstract without a full manuscript in the conference proceedings.
# CHAPTER 3 STUDENT POSTER SESSION ABSTRACTS

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Testing of K’Nex Motors used in a Freshman Engineering Design Competition

Katie Mason
Mercer University School of Engineering

EXTENDED ABSTRACT

The freshman engineering class at Mercer University has participated annually in a competition in which K’Nex parts are used to build various types of vehicles. They have built these vehicles to perform specific tasks such as cable-car tug of war, hill climbing, and many others. The DC motor used in the K’Nex design kits uses a spring clutch to prevent damage to the motor. This clutch wears over time resulting in motors that can output significantly less torque than a new motor. The purpose of this project was to develop both a mechanical and an electrical method that students may use to evaluate the performance characteristics of their motors. The electrical method can be used as a preview to the electrical engineering courses that the students will be taking the next semester.

In an ideal motor, the maximum torque for pass-thru drive is 2.9 inch-pounds, and the maximum speed is 36.9 RPM. For end drive, these numbers are 1.1 and 36.4 respectively. The students will consider the motor acceptable if the pass-thru drive holds 2.6 inch-pounds and the end drive holds 1 inch-pound.

The mechanical testing method involves hanging weights off a string attached via a pulley wheel to the motor being tested. As the weight is increased, the motor’s clutch will eventually kick out. At this point the applied torque will have surpassed the spring clutch’s strength. Instructions will have been given to test the maximum strength of the motor by slowly increasing weight. This will have allowed the students to know the exact weight just before the clutch kicks out. Students will be provided with an acceptable performance range for their motors.

The electrical test method will also require that a mechanical load be applied to the motor and will allow the students to see what happens electrically when the motor’s clutch is overpowered mechanically. The mechanical load will be applied via a spring scale with the acceptable ranges clearly marked. The application of a constant voltage to the motor will greatly simplify evaluation of the motor’s performance, therefore a voltage regulator set at 3 V-DC will be used to supply power to the motor. An oscilloscope or multi-meter can then be used to evaluate the current drawn by the motor. In order to reduce the electric noise coming from the motor, a low pass filter will be added to the circuit and a gain of 100 will be used to magnify the oscillations when the clutch kicks out. When using a multimeter instead of an oscilloscope, a sample and hold circuit will be added and set up so that the maximum voltage is maintained for long enough for it register on the multimeter.
Design of an Environmentally Responsible Off-Road Bicycle using SolidWorks

Ryley Jones, Kaitlyn Haynes and Matthew Carroll

Engineering Studies Program, Armstrong Atlantic State University, Savannah, GA

EXTENDED ABSTRACT

Introduction
With the increase in consumer concern for the long term well being of the environment and the sustainability of products; there is a need to offer environmentally responsible products despite the tendency for such products to be more expensive. At the forefront of this new wave of concerned consumers are the outdoor recreationists. The bicycle design under consideration here is intended to be made with materials and manufacturing processes that are environmentally responsible and ‘green’. In addition, the bicycle’s aesthetics have been specifically designed to mimic the simplicity of nature. It is also designed with off-road capabilities, able to withstand a significant amount of stress. This 3D design project was performed using SolidWorks.

Roles of Team Members
The three members of the team had individual responsibilities. Ryley served as a leader in aesthetic design, supervising and coordinating aspects such as visual frame design and geometry, as well as overall color schemes and marketability. Kaitlyn performed materials research and design work, and made final decisions as to which materials were both suitable and coherent with our design. Matthew served as the project manager and coordinator, also designing the mechanical systems and sub-systems of the bicycle as well as SolidWorks modeling supervision.

Overview of Parts
Although the bicycle consists of numerous components, the main parts are the bamboo frame, wheels and rims, tensioner, continuously variable transmission (CVT), and the forks. Many of these parts are concealed carefully within the bicycle’s frame. Each individual part received special attention in order to maintain overall harmony with the design. Bamboo was specifically chosen because it is a material that is both strong and lightweight and also has a high elasticity making it suitable for the shock absorption required of an off-road bicycle. An important aspect of the CVT is that it is belt driven, allowing for a more quiet, smoother ride.

Conclusions
This 3D design of an off-road bicycle using SolidWorks presents a bicycle that is not only made of ‘green’ materials and manufacturing processes, but the overall simplistic design also reflects an organic design. Future work will involve further analysis of the structural and load carrying capabilities of the design.
Biochemical Properties of Laundry Detergent

Alfred Jason Kamczyc, Patrick Vande Lune
Mercer University School of Engineering – Sophomore Honors Engineering

EXTENDED ABSTRACT

The goal of the research was to test various laundry detergents and determine if factors such as concentration, brand, fragrance, etc… have a major impact on the results of the chemical oxygen demand tests (COD) and the biochemical oxygen demand tests (BOD). Because gray water is not easily collected NSF International has released a formula to produce synthetic gray water from a variety of household products (detergent, soap, shampoo, conditioner, etc) as well as analytic grade lab chemicals (sodium phosphate, calcium sulfate, boric acid, lactic acid, etc). This formula specified the amount of the household product but not the brand of the product to use. The brand of detergent used to produce the synthetic grey water could impact the final characteristics of the gray water.

Three detergent brands (2X Ultra All with Oxi-Active Stainlifters, 3X Ultra All with Stainlifters free and clear, and 2X Gain) were diluted as if a full load of laundry was being done and ran in triplicate for both chemical oxygen demand (COD) and five-day biochemical oxygen demand (BOD$_5$) tests. COD tests were performed first in order to approximate the BOD$_5$ of the sample. The approximated BOD$_5$ (0.667 COD) was then used to determine the amount of seed water and nutrient water needed to dilute the detergent sample for the BOD$_5$ test. Testing to date suggests that diluted detergents have similar COD characteristics ranging from 240 to 260 mg/L COD. An interesting discovery was that the 3X strength detergent did have the highest COD compared to the other 2X strength detergents. While BOD$_5$ testing is not complete, it is anticipated that diluted detergent samples will have similar BOD$_5$ characteristics ranging from 160 to 175 mg/l.
Hydrothermal Carbonization of Waste Paper

Beth Quattlebaum

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There are many components of waste that enter a municipal solid waste (MSW) landfill. One major component of that waste stream is paper. This research project involves the hydrothermal carbonization of four paper types commonly discarded and sent to MSW landfills. Hydrothermal carbonization (HTC) is a unique waste management process which involves carbonization of biomass in water under autogenous pressure at temperatures below the critical point of water (\(<374^\circ\text{C}\)). A solid, carbon-rich material, called hydrochar, results from this process. The carbonization of paper, as well as other waste materials, has many significant potential advantages. The two main concepts relating to using HTC for waste management include carbon sequestration and the potential for providing a sustainable energy supply for the future. The utilization of HTC to promote carbon sequestration and energy generation would be a significant milestone in establishing a more sustainable approach for managing wastes and energy. These advantages are attributed to not producing significant carbon dioxide because of carbon being stored within the hydrochar, the chemical structure of the hydrochar produced imitating natural coal, and the dramatic reduction in time required for biological processes to take place. With carbon being stored in the hydrochar, greenhouse gas emissions could be considerably reduced.

In exploring the use of HTC for waste management, it is necessary to understand how different types of paper influence reaction rates, carbon distribution, and hydrochar energy content. The use of HTC as an alternative waste management strategy may change how we manage our waste.

Four common paper types found in a landfill include printed office paper, non-printed office paper, newspaper, and cardboard. The carbonization of these four paper types was compared to determine whether there was any significant difference between the paper types on the overall reaction that takes place within the HTC reactor. The experiments were conducted in 160-mL tubular steel reactors equipped with gas sampling valves. The reactors were first loaded with 8 grams of paper and 32 grams of water, and subsequently heated at a constant temperature of 250°C over time periods ranging from 2 hours to 96 hours. After the HTC reactors were cooled, the liquid, solid, and gas properties were examined. Liquid properties measured include: pH, conductivity, chemical oxygen demand, total organic carbon, and biochemical oxygen demand. The solid properties measured were carbon content, energy content, and hydrochar yield. From the gas collected the volumes and compositions were recorded. The tests were run in four different cycles (in duplicate) with each cycle containing one paper type.

Experimental results show that the hydrochar yield decreases with time, while energy content increases with time. It has also been observed that the majority of carbon is being stored within the hydrochar, which promotes carbon sequestration. A more detailed explanation of these results will be presented.
Effect of Liquid Conductivity on Time Domain Reflectometry based Water Level Measurement in Porous Media

Jessica Pippard
Mercer University

EXTENDED ABSTRACT

Time domain reflectometry (TDR) is a measurement technique that makes use of the time it takes for an electrical impulse to reflect back to a source. The reflected signal (waveform) may be correlated to a variety of soil properties, including moisture content and conductivity. This project studied the potential for the application of TDR technology to the measurement of landfill leachate levels. There are a number of factors that could impact the use of TDR for leachate level measurement, including the media surrounding the probe, the conductivity of the liquid, and the probe configuration. This project evaluated the impact of the conductivity of the liquid and size of the media on the generated waveform. The TDR probe used in this study consisted of a 30.5-cm long, 5.08-cm diameter PVC well screen with 0.51-cm slots surrounded by a stainless steel mesh with a stainless steel rod running through the center. The outer stainless steel mesh was soldered to the outer braid (shield) of a co-axial cable while the center rod was soldered to the conductor of the co-axial cable. The TDR measurement was taken via a Campbell Scientific TDR 100.

Experiments were conducted by placing the probe in a large cylinder with tubes attached for draining of the cylinder and reading of the water level within the cylinder. The cylinder was filled with water at ~2cm intervals to a depth of 21cm and then completely drained at intervals of ~2cm. TDR waveforms were taken for each water level. The data was then manipulated to identify the correlation between the waveforms and the water depths. These experiments were conducted with the probe standing in open water and then standing in five conductivities ranging between approximately 2500 and 30000µS/cm. These experiments were then repeated with the same five conductivities and small, medium, and large rock media surrounding the probe. The evaluation of the data consisted of identifying a distinct change in the TDR waveform which could be correlated to the air-water interface. This point on the TDR waveform was then plotted against the water depth in the column. The relationship was found to be linear with a correlation coefficient of 0.9982 for the experiment with only water, 0.9990 for the lowest conductivity, 0.9930 for the second conductivity, 0.9964 for the third conductivity, 0.9972 for the fourth conductivity, and 0.9936 for the highest conductivity. The correlation coefficients for the small, medium, and large rock media when tested in conjunction with the five respective conductivities will also be included on the poster. These results indicate that the TDR waveforms can be used to accurately measure water depth in a variety of conductive liquids and rock media. The next phase of this project will be to evaluate the impact of probe configuration on the waveform measurement.
Novel Drive System for Spherical Robots

Kevin Eck

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EXTENDED ABSTRACT

The purpose of this project was to design a new drive assembly for spherical robots. As applications of robotics expand, the need for innovative and improved methods of drive systems is needed. One type of robot with a particularly challenging drive system is a spherical robot in which the entirety of the robot is inside of a spherical shell. Currently two methods exist for driving these robots. The first has a one-directional drive inside the shell. To change the direction, the drive is rotated relative to the spherical shell. The second has three orthogonal axes inside the shell that can exert torque. By combining the torques, acceleration of the robot in any direction is achieved. However both of these methods present disadvantages. The first method cannot instantaneously accelerate in any direction. The second method never has a permanent interior orientation which is needed for cameras or any sensors requiring a consistent. The design challenge was to design a drive system for spherical robots that could successfully address with each of these difficulties.

After considering several ideas, the design selected has two wheels that have axes of rotation that are parallel to the horizontal and are perpendicular to each other. These wheels are both tangent to a rubber sphere which is rotated by turning the wheels. By changing the direction and speeds of each wheel, the rubber sphere can be rotated in any direction. This rubber sphere is held by bearings on the bottom of the inside of the spherical shell. By acting as an omni-directional gear, the rubber sphere turns the shell. This allows the robot to accelerate in any direction by simply powering the two different drive trains as needed. This drive system also preserves a direction by keeping a horizontal plane inside the robot. This allows for sensors and cameras to be effectively used inside the robot.

To evaluate and demonstrate the capabilities of this design, a prototype of the drive system was developed. The prototype excluded the shell and instead was mounted on a T-shaped frame on a table. The rubber sphere translated a sheet of poster board across the table rather than spinning a shell. The two wheels were powered by individual motors. These motors were controlled by a microcontroller. The speed and direction of the motors could be manipulated with the software. The prototype design was successfully built. The principle behind the design was proven to work. The wheels did not interfere with each other. The combination of both motors was also shown to produce motion that was a composite of the two directions. However, while the principle was shown to work, two difficulties presented themselves. First the motors were barely strong enough to drive the rubber sphere and, the direction of motion could not be finely controlled. Stronger motors should solve this problem. The second difficulty was poor traction due to alignment. This issue could be addressed with higher quality parts and finer construction specifications. The next step in the evaluation of this drive system is to compact the drive train and install it in a spherical shell.
Analysis of Dialysis Performance by an Asymptotic Model

Katie Frederick and Pedro E. Arce
Chemical Engineering Department of Tennessee Technological University

EXTENDED ABSTRACT

Dialysis is commonly used in medical facilities to aid filtration of the blood when the kidney fails in the human body. New methods are needed in order to advance efforts in achieving an implantable kidney. The dialyzer today only performs outside the body in a large apparatus. One of the best filtration devices is the so-called “capillary membrane-based dialyzer” where the filter action can take place through a cylindrical semi-porous membrane, while the blood flows through the cylinders by a pump. The outside shell is used to flow a relatively high Reynolds cleaning solution that takes the waste out from the blood stream. The concentration of the waste in the blood, within the cylindrical capillary dialyzer, can be modeled mathematically through mass balances leading to a differential model in terms of partial differential equations. In general, this model is quite mathematical intensive to solve and illustrate the dialyzer behavior.

In this contribution, instead, we focus on obtaining an asymptotic solution of this system that will be presented as the model of the description of the concentration of waste profile inside the cylindrical capillary. The motion is due to convective-diffusive transport typically found in a dialyzer device. The solution to this model is obtained on the basis of steady state assumptions and the results will illustrate various parametrical situations within the device. For example, several illustrative concentration profiles showing potential practical protocols will be presented. In addition, the optimal performance parameters for the dialyzer will be described for this system. We believe that this method for modeling could lead to a reduction of the current size of the dialyzer device leading to, potentially, an implantable type of device in the future.
Imaging of Polymer Microcapsule Morphology in Pesticide Product

Julie Shell and Dr. Holly Stretz

Tennessee Tech, ChE Undergraduate/Tennessee Tech, ChE Assistant Professor

EXTENDED ABSTRACT

The polymer microcapsules used for pesticide product are often subjected to stresses from delivery. This stress can compromise the controlled time-release needed for desired distribution. Three types of commercial pesticides were sprayed and then analyzed by scanning electron microscopy (SEM). By doing this, morphology characteristics of each product could be examined. Wall thickness and surface roughness were studied through transmission electron microscopy (TEM) imaging. These wall traits can be related to wall permeation and can form conclusions about unwanted channeling of the encapsulated pesticide product. Conclusions from this study show that a product that has minimal wall porosity will have reduced amounts of unwanted channeling upon impact.
Device and Process to Aid in the Interpretation of Force Plate Data

Andrew Weems

EXTENDED ABSTRACT

ABSTRACT

Biomedical engineers use force plates for the analysis of moments and forces generated through motion. The interpretation of data received from the force plate requires that the user have a clear understanding of how the force plate is oriented relative to the forces that are being applied. If the plate is in an assembly or has been rotated for maintenance or another experiment, there is no precise way for an inexperienced user to check this. The purpose of this project was to develop a device and a process to help users understand the orientation of the force plate and to interpret the results. The device must provide users with both static and dynamic forces in the x-, y-, and z-planes as well as moments about the x-, y-, and z-axes.

Procedure:

The procedure used in this experiment was to first assemble a quadrapod for use in testing the force plate. A weight will be suspended from the center of quadrapod. For the force plate, the simulation of the force is read from the plate into the computer and then is output by the simulation program. This weight can then be swung in x-, y-, and z-planes as well as combined planes and rotated in clockwise and counter-clockwise directions. For the force plate, the simulation of the force is read from the plate into the computer and then is output by the simulation program. This data can be understood in two ways: the basic change in force on the plate as force components of the x,y,z coordinate plane, and more specific changes in force due to acceleration, velocity, and angles involved in the motion of the weight. The module is designed to allow a beginner to progress from the first type of data to the second, which is more useful for researching.

Future work on this experiment would be to design a full biomechanics assembly of modules and devices that would act as introductions into measurement sensors and simulations.
Bench-scale Demonstration of Flywheel Energy Storage and Release via a Continuously Variable Transmission.

Alan Westbay
Mercer University

EXTENDED ABSTRACT

Continuously variable transmissions (CVTs) allow for an infinite set of gear ratios, between a set maximum and minimum, which can be adjusted without disconnecting either the driving power or the driven load. Theoretically, a CVT could be coupled with a high moment of inertia flywheel to efficiently store energy in rotational energy of the flywheel. If flywheel based energy storage proves to be efficient and practical in automobiles, it would provide an alternative means of regenerative braking than the battery or super capacitor systems currently being explored. This storage system should not have the high price, relatively short life cycle, and inefficient recharge process of batteries. It could also prove to lack the inherent inefficiencies in any electrically based regenerative braking system, and could be integrated into vehicles that do not use electric drive motors; currently the vast majority of automobiles on the market.

In this project, the concept of using a CVT to store rotational energy in a flywheel was explored. Two moveable sheave setups were acquired from the centrifugal clutch systems of available motor scooters. One of these was coupled with a 7 to 1 reduction gearbox with the output splined to a motor scooter’s rear driven wheel. The tire of the rear wheel was filled with water, to increase its mass and moment of inertia. The two sheave setups were mounted on a wooden frame, and connected by a V-type drive belt. A lever system was implemented to change the radii of each sheave setup, inversely. Thus as the radii of one pulley was increased, the other would be allowed to decrease. One sheave of one of the setups was kept under tension via spring, in order to maintain the tension in the belt required to transmit power. The sheave setup not splined to a wheel can be driven by an electric motor, or other source of rotational energy which in turn drives the free spinning wheel, acting as a flywheel. The CVT actuating lever can be continually adjusted to constantly increase the angular velocity of the flywheel, while the motor is kept at a constant speed, until the maximum ratio limit is reached. The system can then be run in reverse, with the motor wired as a generator, to show how the rotational energy of the flywheel can be smoothly converted back to rotational energy of the motor’s armature and then electrical power. In an automotive application, the vehicle’s driveshaft could take the place of the electric motor. In this way, kinetic energy of the vehicle could be stored in rotational energy of the flywheel when braking is necessary. That rotational energy could then be converted back to kinetic energy when acceleration is again required, through entirely mechanical means.
Clean drinking water is often not readily available in many third world countries. As a result, there is a need to develop novel ways to provide water purification systems in people’s homes. One form of water treatment is slow sand filtration, which includes biological sand filtration. Biological Sand Filters (BSFs) are a form of slow sand filtration designed to serve as point-of-use treatment units in a home. BSFs are simple to make, as they are composed of a gravel layer, coarse to fine sand layers and a biolayer. BSFs are becoming a more common form of water treatment around the world, and when operated under the right conditions, studies in laboratories have shown BSFs to be highly effective.

The purpose of this experiment was to determine the impact of milled copper and user compliance on the effectiveness of biological sand filtration in order to provide enhanced water filtration systems to marginalized communities around the world. Testing entailed the creation of 4 BSFs, two built according to traditional BSF guidelines, and the other two were modified to contain copper. Each filter was watered with 20 liters at a time with water samples taken from the Ocmulgee River in Macon, Georgia. To test the effectiveness of user compliance, one set of filters were fed daily while the other set were fed once every three days. One filter from each set had copper mixed into the filter bed of fine sand.

In order to measure the effectiveness of the copper and the watering compliance, solids, coliforms, turbidity, pH, temperature and chemical oxygen demand (COD) were measured. Copper concentrations were also tested, and it was found that all copper levels in the effluent were below toxicity levels, including the EPA’s maximum contaminant level goal of 1.3 parts per million. All filters were effective, often removing over 99.5% of coliforms from the source water. In order to determine if any of the filters performed significantly better than the others, a set of paired t-tests with $\alpha=0.5$ were employed. Tests results determined that when a filter was watered daily, the addition of copper had a significant positive impact on its coliform removal efficiency, but the difference was not significant if the filter was watered irregularly. Unequal flowrates are a possible reason for why copper did not have an impact when the filter was watered irregularly. A longer residence time and slower flowrate is preferred for the removal of contaminants in the water.
This paper investigates sustainability of warm mix asphalt in comparison with the conventional hot mix asphalt. The comparison has been conducted through studying laboratory performance of warm mix asphalt as well as analyzing the environmental and economic impact of warm mix asphalt in comparison with hot mix asphalt. The trend toward sustainable construction has led state departments of transportation (DOTs) to place more emphasis on reducing the carbon footprints of pavements by reducing mixing and compaction temperature of asphalt paving mixtures. This has been conducted by using chemical and organic additives in asphalt mixtures to reduce shearing resistance of the mixtures during mixing and compaction. This in turn allow HMA production be conducted at 30° to over 100°F (16 to over 55°C). This particular technology labeled as Warm Mix Asphalt (WMA), was initiated by the German Bitumen Forum in 1997. Later in 2002, National Asphalt Pavement Association began to investigate the usefulness of this technology in the U.S.

In the U.S., the reduction in mixing and compaction temperature is achieved usually by adding synthetic zeolites, Sasobit wax, or asphalt emulsions to the overall mix. This allows a significant reduction in the temperature when mixing and laying the material and also results in lower consumptions of fossil fuels, thus releasing less carbon dioxide, aerosols, and vapors. Not only are the working conditions improved, but the temperature reduction also leads to more rapid availability of the surface for use, which is important for constructions sites with time schedules that are at a critical closing due date. Therefore, WMA is cost efficient, sustainable, and overall excellent product to utilize when managing a critical highway construction project.

Keywords: Bituminous, synthetic zeolites, Sasobit wax, asphalt emulsions, warm mix asphalt (WMA)
Use of Recycled Roofing Shingles in Hot Mix Asphalt Pavements

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EXTENDED ABSTRACT

The objective of this paper is to investigate the feasibility of using roofing shingles (tear-offs and manufacture defective shingles) as a substitute for virgin materials in the construction of new pavements.

Approximately 11 million tons of waste shingles are produced in the U.S. alone most of which are being deposited into landfills; however, when analyzing what we are actually dumping into landfills, it must be noted that most shingles have roughly a 20% liquid asphalt content per shingle. Using these numbers in calculations, the amount of asphalt material that is getting disposed of comes to total around 2.2 million tons which is quite significant in light of the current price of $500 per ton for virgin binder and that the U.S. places roughly 700 million tons of asphalt every year.

With this cost efficiency in mind, the world’s depleting virgin asphalt reserves, increasingly stricter environmental regulations, an increasing public awareness of our adverse effects from years of mounting waste disposals into landfills, and the useful benefits related to using recycled asphalt binder, the use of roofing shingles can be a sustainable solution for not only both waste management and road industries but for everyone who will benefit from a less hazardous environment. This could as stated, result in significant economic and environment impact in that less virgin petroleum or crude oil would have to be bought and countless tons of roofing shingle waste would not end up filling landfills.

Currently, most of the States Departments of Transportation allow around 5% of shingles be included in the surface mix. However, States Departments of Transportation are emphasizing the potential increase of percentages of recycled shingles in new paving mixture to enhance pavement sustainability. The main concern with use of shingles is that the resultant paving mixture becomes stiffer. Stiff mixtures are hard to place and compact, they also become more susceptible to low temperature cracking. Currently there is no comprehensive study on the feasibility of using high percentages of shingles in pavement.

Therefore, there is a need for a more in-depth study on the characteristics of shingles and their effects on paving mixtures. To address this concern, this paper investigates the rheological characteristics of the asphalt binder in shingles as well as the physio-chemical interaction between shingles and other constituents in asphalt pavements. The result of this study can help reduce the restrictions and limitations placed on how much recycled shingles can be used in new paving mixtures.
CitadeL Engineered Traversing Intelligent System
Matthew Player, Kendall Nowocin, Luther McBee, and Nathan Lett
The Citadel Department of Electrical and Computer Engineering

EXTENDED ABSTRACT
The Intelligent Ground Vehicle Competition provides a design experience that is at the forefront of engineering education. The end goal is product realization through theory-based simulation, prototype validation, and team implementation. The robot’s objective in the competition is to autonomously navigate a football field sized obstacle course within five minutes. Some real world applications include lane detection and following, obstacle detection, collision avoidance, driver aides, kinematic controls, and optimized path planning.

The project team members were selected based on prior collaborative experiences in The Citadel’s engineering education program. The team had multiple meetings to discuss background experiences, interest areas, and vote team leaders for each semester. Kendall Nowocin, first semester team leader, was responsible for mechanics and non-tactile sensing due to past robotic system integration. Nathan Lett’s Air Force experience in Combat Camera was essential for image processing and data communication. Luther McBee was in charge of navigation and component integration because of extensive marine electronics implementation. Matthew Player, second semester team leader, was developer of power distribution, control circuitry, and validation testing because of in-depth knowledge of electronics and environment testing.

The procedure for developing CLETIS was a multistep process involving design methodology and a variety of engineering tools. The design methodology was to: 1) Identify environmental variables to measure, 2) Identify sensor parameters, 3) Design the system in a virtual environment, 4) Develop and prototype subsystems, 5) Validate subsystems, and 6) Integrate subsystems and field test. Steps one through three were done in sequential order for the overall system while steps four and five were done in parallel for multiple subsystems to maximize development efficiency; total completion of steps one through five were a prerequisite for step six, which involves total system integration, implementation, and testing. In step one, flowcharts were created to determine the required sensor data that would be used to make intelligent navigation decisions. Step two analyzed engineering tradeoffs in speed regulation, image processing, pulse width modulation circuits, and etc. using Excel spreadsheets. In step three, computer aided design (Autodesk Inventor 2010) and modeling software (Matlab and Simulink) were used to develop the structural frame and simulate theory based design, respectively. Steps four and five used LabVIEW and a commercial off the shelf robotics controller to develop, prototype, and validate subsystems. A Gantt chart was created using Microsoft Project to give transparency and streamline the development process to the time constraints.

The development of the autonomous vehicle using the previously described design methodology has resulted in on-time delivery of specified components, optimized efficiency, and provided progression transparency for multiple parties. The design is currently on step six, fully validated two of the seven subsystems, and approximately a week ahead of schedule.
A novel heat exchanger for enhancing heat recovery in buildings

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Residential gas furnaces are known to reject a considerable amount of heat through exhaust ducts. The purpose of this project is to design and analyze a rotary heat exchanger that uses this waste heat to preheat the return air entering the furnace. The heat exchanger design focuses on using phase change process as the heat transfer mechanism. Phase change material has the ability to store large amounts of latent heat when in a liquid state and then release the heat during solidification. The design tasks were divided among team members under these topics: thermal calculations, shaft and bearings, movement system, CAD and CFD, and flow separators. First, the overall size must allow the device to be small enough for one person to handle. The overall dimensions of the final product have a width of 18.5 in. and a height of 26 in. The performance requirement assumes the heat exchanger is built to retrofit a two-ton unit. This requires the volume flow rate of both the supply and return air to be approximately 1000-1200 CFM. Finally, the thermal performance expectation of the heat exchanger sets the heat output at 1-2 kW. The chosen phase change material (PCM) is an inorganic salt with 34°C as the melting temperature. The calculations consider the furnace exhaust gas as the supply air, which has a temperature at approximately 100°C. The return air, which solidifies the PCM, is initially assumed to fall in the 21-24°C range. An inorganic salt was chosen over a paraffin-based wax because the thermal conductivity of the salt is found to be two times higher than that of most paraffin PCM. The PCM is contained in 120 aluminum tubes. The tubes are evenly spaced on five circular patterns on a thin carbon steel tube sheet. The tube sheet is suspended in the center of the heat exchanger on a shaft allowing the tube sheet to rotate between both the exhaust and return ducts giving the final mechanism for the heat transfer. The phase change time, limited the rotational velocity of the tube bank. This required velocity, 0.16 RPM, limits the use of most common electric motors and the solution was to use a stepper motor turning in 1.8° increments. The motor is controlled with a USB controller to operate the motor at the desired speed. Two centrifugal fans, both having a volume flow rate set at 1000 CFM, were used to simulate the supply and return air of a 2-ton unit. A propane torch provided heat, functioning as exhausting flue gas. Temperature at various locations were monitored with seven thermocouples. Since the tube bank rotates, wireless temperature sensors were necessary to measure the PCM temperatures. Useful data were collected to prove the concept and verify the calculations. The final outcome of the testing proved the concept of the design by showing the return air to have a 5.5°C increase in temperature by transferring approximately 1 kW of heat. With the tube bank thermocouples showing a complete phase change, the final goal was met using PCM to store large amounts of latent heat and making the otherwise wasted heat useful. The tests found the heat transfer coefficient to be, on average equal to 143.5 W/m²·K. The average log-mean temperature difference was found to be 5.5°C.
Robots Taking Risks

Michael Bernico, Matthew Luby, Matthew Rentz, and Nathan Sinclair
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EXTENDED ABSTRACT

The 2011 IEEE SoutheastCon hardware competition challenges students to simulate autonomous robots taking risks in lieu of rescue workers in the wake of natural disasters. In effort to save more lives, the rescue processes must be hastened, but expediting the rescue process has disadvantages. Currently, search speed is limited by the number of personnel involved in the effort. Increasing the speed of the search introduces a greater number of people to the risk of falling debris, chemical spills, or radiological hazards.

The competition uses models to simulate victims, debris, and potential hazards to rescue workers. Victims will be represented by a plastic plumbing cap with a light-emitting diode (LED) that will depict health status and an electromagnetic signal that can be used to locate the victim. Debris will be modeled with sections of lumber that must either be avoided or traversed. Finally, the radiological hazard will be simulated by a coil beneath the course that will emit an electromagnetic signal. The challenges presented by this competition are to detect and report the location and status of victims and hazards while navigating over and around obstacles.

The design team was selected from Citadel Electrical Engineering students based on abilities. Michael Bernico is responsible for circuitry and aiding with assembly. Matthew Luby is responsible for programming and robot positioning. Matthew Rentz is the developer of victim detection scripts and an assembly plan. Nathan Sinclair is developing the overall code structure and is accountable for autonomous navigation.

The robot uses a variety of sensors that are interpreted by a PIC32 microprocessor that issues control commands to motors and indicators using instructions written in the C++ programming language. Infrared and ultrasonic sensors are used to aid with navigation and obstacle avoidance, while antennae are used to detect the presence of victims and hazards. In the event that a victim is found, a camera determines its status using the victim’s LED. Infrared rangefinders then determine the location. Victim status and location data is then provided to the indicators in text and audio formats. Similarly, when a hazard is detected, the robot will provide audio and text indication of the location of the hazard.

Over the course of two semesters, the team has met the individual needs as described by the rules of the competition. The robot has traversed and avoided obstacles, has discriminated between victims and hazards, and has provided location data. The robot is capable of interpreting victim status and providing visual and audible confirmation of victim and hazard data. These results provide promise that autonomous rescue robots may one day be saving lives while protecting the lives of their human counterparts.
Designing a Remotely Accessible Computer Networking Technology Lab

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Department of Technology
Elizabeth City State University

EXTENDED ABSTRACT

The purpose of this project was to design and develop remotely accessible computer networking lab that allows 24/7 access to laboratory equipment housed in the Networking Engineering Technology lab within the Department of Technology at Elizabeth City State University. The accessibility to current networking lab, equipped with the state-of-the-art industrial grade networking devices, is limited to classroom hours. While progressing through the computer networking program students were met with a number of problems when trying to access the lab beyond classroom hours, when projects exceed the capabilities of the devices at hand, and when device life spans were severely shortened by improper upkeep. The project design team solved these problems by implementing remote laboratory around NETLAB, an online solution that encompasses virtualization, remote access, and lab device maintenance. The remote laboratory consists of a VMWARE server, the NETLAB network appliance, APC power management devices, and numerous routers and switches. Our current implementation houses one routing pod that has three interconnected routers and four virtual PCs, and a switching pod that has one router, two switches, and three interconnected virtual PCs. Each of these pods can be accessed from anywhere in the world via a Internet-enabled browser interface, be powered ON when in use, and OFF when unused, and gives instructors many teaching tools to enhance their capability to deliver fully online computer networking program.

Implementation

To implement this solution each student took a specific portion of the multifaceted project (virtualization, device configuration, cabling, testing) and worked through a schedule aimed to conclude in four weeks. The virtualization and configuration of the network appliance and other networking devices were tackled first. The VMWARE server hosts seven cloned virtual machines connected to the routers and switches for network analysis and testing. The network appliance acted as the Internet’s gateway into the lab and the networking devices therein. Networking technology concepts such as application access security, IP addressing scheme, device communication, and virtual local area networking (VLAN) configuration were applied in successfully implementing the project. Each feature from virtual PC access to lab reservation/scheduling and remote device shutoff was thoroughly tested.

In summary, the remote networking lab will allow for hosting real lab equipment, real software applications and curriculum on the Internet for blended distance learning, instructor led training, student team and individual student equipment access. Resources can be scheduled, automated, and accessed remotely, allowing Academies to maximize their investment in equipment and software.
Design and Analysis of Biosand Filtration with Added Copper as a Disinfectant

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Mercer University School of Engineering - Environmental Engineering

EXTENDED ABSTRACT

Biosand filtration is a prominent means of providing clean drinking water to residents in developing countries where access is limited or nonexistent. Aqua Clara International (ACI) is a nonprofit organization whose sole purpose is to provide cheap, clean water to families in such countries through the use of biosand filters. These filters are designed for a 20 L/day holding capacity and include a brass alloy placed in a single layer between the fine and coarse sands for disinfection. A small-scale study was conducted in order to determine if the filters would perform in the same manner with a 0.5 L/day holding capacity and copper shavings, rather than the brass alloy. Five filtration columns were constructed to compare two different amounts and arrangements of the copper shavings as well as a control. Column 1 had no copper while Columns 2 and 3 contained 4.7 g of copper and Columns 4 and 5 contained 2.35 g. The copper was placed in a single layer, like that of the ACI filters, in Columns 2 and 4, and was mixed uniformly throughout the fine sand in Columns 3 and 5. In order to determine the best placement for the copper, each of the five columns had to remove at least 95% of fecal coliform present in the influent water. One-half liter of water collected from the Ocmulgee River in Macon, GA was diffused into each column every day for approximately 30 days. The columns were then allowed to sit for 24 hours, after which the filters were drained and their effluents collected. In addition to HACH plate counts for fecal coliforms, the pH, turbidity, TSS, COD, and BOD were monitored for each effluent and compared with that of the influent. After 30 days of testing, the results indicated an average removal efficiency of 97.5% for fecal coliforms in Column 5, the highest of all five filters. Columns 1 – 4 attained removal efficiencies of 96.5, 93.9, 97.4, and 95.4%, respectively. This suggests that copper works extremely well as a disinfectant. Since the goal was to determine the best arrangement of the copper in the filters by the removal efficiency of fecal coliforms, Column 5, which contained 2.35 g mixed throughout the fine sand layer, was chosen for further testing. A single, full-scale filter was then constructed, with 94 g of copper being mixed into the fine sand layer. The testing process was repeated, but for a longer time period and without monitoring BOD. Compared to the previous results, the full-scale filter attained an average removal efficiency of 96.5% for fecal coliforms. Therefore, it can be concluded that copper may be considered as an alternative to the brass alloy for disinfection in a biosand filter. However, the results of the fecal coliform testing suggest that mixing the copper within the fine sand layer provides a better removal efficiency than placing it in a single layer between the fine and coarse sands.
Airport Threat Mitigation System
Russell Snyder, Brandon Breuil, and Benjamin O’Brien
Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

Introduction
The FAA has reported over 79,000 wildlife strikes since 2000 resulting in hundreds of millions of dollars in damage, and injuring and killing numerous individuals\(^9\). Over 90% of these strikes occur at low elevation during landings, take-offs, and associated procedures. Several systems exist today to reduce the potential for wildlife strikes at airports, but are either very costly or require extra personnel to operate. The need exists for a low-cost, low-impact system to deter wildlife threats from airports operable at small to mid-sized airfields with limited budgets.

Design and Technologies
The Airport Threat Mitigation System (ATMS) is a semi-autonomous system composed of three major components: the vision subsystem, the unmanned ground vehicle (UGV) subsystem, and a ground control station (GCS). The vision subsystem uses monocular vision to detect, classify, and localize threats within the airport environment. The architecture of the vision subsystem supports multiple cameras so that the area covered can be appropriately scaled based upon the size of the airport. Each camera is also equipped with a pan/tilt unit which provides an increased field of view. The image processing software detects potential threats using a background subtraction algorithm that uses a Bayesian decision framework to segment foreground objects (potential threats) from background objects\(^{10}\). Once a threat has been detected, it is then classified into one of the following categories: bird, human, vehicle, or unknown using a feature-based categorization algorithm. The threat’s position is then calculated by projecting the threat’s 2D image coordinate into the 3D coordinate space. The GCS is notified of all threat information, and computes priorities for each threat based upon their classification, location, and proximity to runways, taxiways, and ground vehicles. UGVs are deployed by the GCS to navigate to the threats and activate available deterrence mechanisms, which include lights and predator sounds. The UGVs use A* path planning to avoid runways and taxiways.

Results
The system requires human interaction in safety-critical situations. In order to cross runways and taxiways, a UGV requests permission from an operator. The operator can manually pan-tilt the camera to track a threat. The UGV can also be driven remotely, and its deterrence systems can be manually activated.

Initial system tests have shown the designs viability in detecting, identifying, and deterring potential threats to aircraft on a simulated airport facility. With development costs under $1,500, this highly portable and expandable system is an affordable solution for airports of all sizes to effectively reduce the risk of wildlife collisions for all types of aircraft.

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\(^{10}\) Foreground Object Detection from Videos Containing Complex Background, Liyuan Li, Weimin Huang, Irene Y.H. Gu, and Qi Tian, ACM MM2003
Natural User Interface for Controlling and Operating Real Equipment (NUI CORE)

John R. Lindsay and Eric Roberts
Senior Design Engineer / Team Leader

Extended Abstract

Purpose

This paper discusses a possible alternative approach for human interaction with machines. The design project was undertaken to demonstrate that more natural methods of human interface can be developed between people and machines using currently existing touchscreen technologies. Additionally, the research attempts to establish that touchscreen input devices allow for easier, more efficient, and more intuitive control of machines and computers than do switches, keyboards, mice, joysticks, steering wheels and the array of other traditional methods of input and control historically used by humans for the same purpose.

This design project was conducted as the capstone electrical engineering project of a four-person team of undergraduate engineering students. The team had an array of talents and skills at its disposal, with team member possessing complementing technical abilities. The array of skills included software development, mechanical fabrication, electrical and electronic design, and an understanding of microcontrollers and photo-optic applications.

Method

In order to achieve the team’s goals, a console was designed and built that has the capability to monitor multiple, simultaneous hand and finger touches from the human operator. Physical contact between the operator’s hands and the console’s touchscreen are detected and interpreted by a computer containing the machine’s control software.

The touchscreen technology consists of an acrylic surface with peripheral edges surrounded by infrared light emitting diodes. The light is constrained within the acrylic until the panel’s surface is touched by an operator, refracting the light from the acrylic into the console. The refracted light is observed by an infrared sensing webcam that communicates the position of finger touches on the acrylic glass to a desktop computer. This multi-touch sensing method is called Frustrated Total Internal Reflection (FTIR). The multi-touch events can be interpreted by the computer, through a set of software algorithms, as specific control commands. This allows the computer to generate the necessary commands to control a real world machine.

A commercial off the shelf radio controlled vehicle was chosen as the device to be controlled. Feedback from the controlled device to the operator is provided in the form of a video image from a wireless color camera mounted on the vehicle platform. The image from the wireless camera is projected onto the touchscreen display. This allows the operator to have situational awareness for the remotely controlled vehicle. Communication between the desktop computer at the FTIR console and the RC vehicle is established by wireless radio frequency communication. Essentially, on the touchscreen console the operator observes the video of the vehicle mounted camera, and is then be able to input control instructions to the vehicle based on the observed video, via the multi-touch display console. The multi-touch events are interpreted by computer software and control instructions are generated and sent to the vehicle platform by radio frequency communication.

Conclusion

Though multi-touch display has been constructed and is being currently used to remotely control the vehicle platform as described. Work is continuing to refine the touch interface to fully test the contention that such control is actual more natural in at least this one instance.
Analysis of Bench Scale Dual-Chambered Microbial Fuel Cell  
Luke Bragg, Malerie Sherrod and Matt Tribby  
Mercer University School of Engineering

EXTENDED ABSTRACT

The objective of this project was to design and construct a dual-chambered Microbial Fuel Cell (MFC) which will allow the observation of electrical output potentials and influent degradation rates based on variable influent characteristics.

A microbial fuel cell is a device that takes advantage of the natural metabolic processes of microorganisms to simultaneously generate electrical current and treat wastewater. For a dual-chambered MFC, a batch reactor scenario is employed to process wastewater. This wastewater contains microorganisms, as well as the organic matter, which serves as the microbial substrate. Microorganisms metabolize the organic substrate and release electrons. These electrons are conducted through an anode/cathode circuit, producing electrical current. As the wastewater is degraded, hydrogen ions are released and travel through a semi-permeable material to the air cathode chamber. Within this chamber, the hydrogen ions combine with ambient oxygen to produce pure water. The anodes were composed of three reticulated vitreous carbon (RVC) panels. A single graphite rod served as the cathode, and a 5 µm pore size polyethylene tube served as the semi-permeable material surrounding the cathode. As a result of preliminary lab research, an influent consisting of two liters of mixed liquor suspended solids and four liters of nutrient broth was used in the batch reactor.

Various standard water testing methods were employed to assess the treatment efficiency of the proposed MFC design. These testing methods include: chemical oxygen demand, biochemical oxygen demand (BOD), and solids analyses. In addition, electrical output was continuously monitored through the use of a Campbell Scientific CR23X data logger. Data from the digital analyzer will allow electrical voltage to be plotted over time.

Over the testing period, soluble chemical oxygen demand (SCOD) and BOD were reduced by 53.6 % and 60.6 %, respectively. Output voltages peaked at 433 mV and closely resembled the microbial growth curve.
Performance Analysis of Composting Systems for Small Scale Use

Elizabeth Lee, James Waldron, and Jared Wozny
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EXTENDED ABSTRACT

The objective of this analysis was to evaluate small-scale composting performance using large-scale standards. Results will determine functionality of small-scale system as an approach to solid waste management.

The testing of and analysis was completed on four systems, varying restrictions of air availability and turning of the compostable material. Specifically, these four systems were dynamic flow-through, dynamic closed, static flow-through, and static closed composting systems. The efficiency of using macro-organisms to accelerate the degradation of compostable materials was also tested and analyzed using a vermi-composting system. Parameters used for the evaluation of these systems were moisture content, temperature, pH, electro-conductivity, and visual analysis. A thermometer was used to measure compost temperatures, and a slurry was developed to determine each system sample’s moisture content, pH, and electro-conductivity values.

The systems tested in this experiment did not yield satisfactory results in consideration with large scale composting standards for several composting parameters. Temperatures correlated greatly with the surrounding temperature instead of rising to an expected range of 37-60°C for effective composting processes. Also, most systems has moisture content levels above the necessary 25-40% to compost under effective aerobic conditions. Visually, certain systems, such as the static flow-through composting unit, showed homogeneity among the solid waste and most closely resembled stable compost. Small-scale composting methods may follow different guidelines for creating mature compost than large-scale processes. These systems may be effective, but not by using current composting standards as a benchmark for success.
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