2013

Tennessee Tech University
Cookeville, Tennessee

E4 Efficient Effective Engineering Education

MARCH 10-13, 2013

ASEE
Southeastern Section Annual Conference

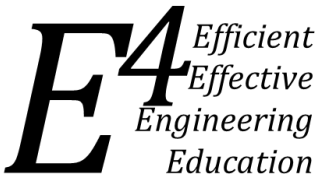
TENNESSEE TECH UNIVERSITY

College of Engineering

ASEE 2013 Conference Schedule At-A-Glance			
Sunday, March 10			
9:30 AM	5:00 PM	Registration	Prescott Hall Lobby
10:00 AM	5:00 PM	Workshops	Prescott Hall/Oakley STEM Center Classrooms
2:30 PM	5:00 PM	Executive Board Meeting	Prescott Hall Dean's Conference Room
5:00 PM	5:15 PM	Load Buses for Reception	Prescott Hall Parking Lot
6:00 PM	8:30 PM	Welcome Reception	Appalachian Center for Craft
Monday, March 11			
7:30 AM	8:00 AM	Breakfast	Oakley STEM Center Lobby
8:00 AM	8:30 AM	Division & Unit Meetings	Oakley STEM Center Lobby
8:30 AM	8:45 AM	Walking Time	
8:30 AM	5:30 PM	Registration	Prescott Hall Lobby
8:30 AM	10:20 AM	Student Poster Setup Time	Oakley STEM Center Classrooms
8:45 AM	10:05 AM	Welcome & Keynote	Prescott Hall Auditorium
10:05 AM	10:20 AM	Break	Prescott Hall Lobby
10:20 AM	11:40 AM	Technical Session 1	Prescott Hall Classrooms
10:20 AM	11:40 AM	Student Poster Judging	Oakley STEM Center Classrooms
11:40 AM	11:55 AM	Walking Time	
11:40 AM	12:30 PM	Student Poster Session	Oakley STEM Center Classrooms
12:30 PM	1:30 PM	Lunch	Oakley STEM Center Lobby
1:30 PM	2:00 PM	Presentation	Oakley STEM Center Auditorium
2:00 PM	2:15 PM	Walking Time	
2:15 PM	3:35 PM	Technical Session 2	Prescott Hall Classrooms
3:35 PM	3:50 PM	Break	Prescott Hall Auditorium
3:50 PM	5:10 PM	Technical Session 3	Prescott Hall Classrooms
5:15 PM	5:30 PM	Load Buses for Banquet	Prescott Hall Parking Lot
6:00 PM	9:00 PM	Reception & Awards Banquet	DelMonaco Winery & Vineyards
Tuesday, March 12			
7:30 AM	8:00 AM	Breakfast	Oakley STEM Center Lobby
8:00 AM	8:30 AM	Division & Unit Meetings	Oakley STEM Center Lobby
8:30 AM	8:45 AM	Walking Time	
8:30 AM	10:30 AM	Registration	Prescott Hall Lobby
8:45 AM	10:05 AM	Technical Session 4	Prescott Hall Classrooms
10:05 AM	10:25 AM	Break	Prescott Hall Auditorium
10:25 AM	11:45 AM	Technical Session 5	Prescott Hall Classrooms
11:45 AM	12:00 PM	Walking Time	
12:00 PM	1:15 PM	Lunch and Business Meeting	Oakley STEM Center Lobby

ASEE SOUTHEASTERN SECTION ANNUAL CONFERENCE

MARCH 10-13, 2013



Tennessee Tech University
Cookeville, TN

Proceedings Editor:	Barbara Bernal Southern Polytechnic State University
Technical Program Chair:	Hodge Jenkins Mercer University
Site Coordinator:	Steven Click Tennessee Tech University

Table of Contents

Chapter 1: Conference Information.....1-0

University Welcome: Dean Joseph J. Rencis, Tennessee Tech University.....1-1

Conference Welcome: Tyson Hall, ASEE SE Section President.....1-2

Acknowledgements 1-3

ASEE 2013 Conference Schedule At-A-Glance. 1-4

Tennessee Tech University Campus Map 1-5

Parking and Transportation 1-6

Conference Meeting Rooms and Map – Prescott Hall (2nd and 3rd Floor).....1-7

Conference Meeting Rooms and Map – Millard Oakley STEM Center.....1-9

Sunday Night Welcome Reception – Appalachian Center for Craft 1-11

Keynote Speaker: Stacy Klein-Gardener, Ph.D 1-13

Director of The Center for STEM Education for Girls.

Monday Night Awards Banquet – DelMonaco Winery 1-14

Conference Meals, Welcome Reception and Award Banquet 1-15

WiFi Accessibility on Campus 1-17

Workshops At-A-Glance 1-18

Technical Session Information.....1-19

Conference Technical Sessions At-A-Glance.....1-20

ASEE SE Section Officers 2012-13.....1-22

ASEE SE Conference Participants 2013.....1-25

ASEE in Brief.....1-29

Call for Papers 2014.....1-30

Cookeville Area Attractions 1-31

Chapter 2: Conference Workshops 2-0

Chapter 3: Technical Session Extended Abstracts.....3-0

Chapter 4: Student Poster Session Abstracts 4-0

Chapter 5: Index 5-0

CHAPTER 1
Conference Information

University Welcome

TENNESSEE TECH UNIVERSITY

Office of the Dean • *College of Engineering*

Box 5005 • Cookeville, TN 38505-0001 • (931) 372-3172 • Fax (931) 372-6172

www.tntech.edu

March 10, 2013

Dear 2013 ASEE Southeastern Conference Attendees:

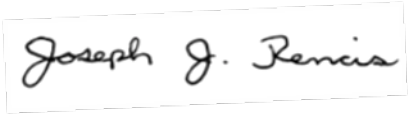
On behalf of the faculty, staff, and students of the College of Engineering and the entire Tennessee Tech University community, welcome to the 2013 ASEE Southeastern Section Conference. We are all very delighted about having you on our campus!

The theme for this year's conference is "E^4 Efficient Effective Engineering Education." In light of the current economic climate, this topic has become a challenge for engineering educators. Resources have declined since 2008; undergraduate engineering enrollment has grown 17% while the faculty has remained flat. This poses the question "How can we effectively, efficiently educate engineers in this environment?" I am looking forward to hearing about your innovative solutions throughout the conference!

Cookeville is home to roughly 30,000 people and is located in the scenic Highland Rim of the Cumberland Plateau. Tennessee Tech is the only technological university in the state, with an enrollment of 11,500 students. The College of Engineering has 2,500 students and is the second largest engineering program in Tennessee. The College offers BS, MS and PhD degrees in Civil Engineering, Chemical Engineering, Computer Science, Electrical Engineering and Mechanical Engineering, along with BS degrees in Computer Engineering and Engineering Technology. Our vision is "21st Century Renaissance Engineers Revolutionizing Engineering to Solve Societal Problems." The mission of 21st Century Renaissance Engineers is to use innovation in both problem solving and technology, making the world a better place to live. They carry new discoveries from basic scientific research into technological products, devices, systems and services that benefit society at the state, national and global levels. Learn more about our strategic plan at www.tntech.edu/engineering/strategicplan/.

Before I close, I'd like to thank each of you for attending this conference and bringing your expertise to our gathering. You, as engineering education leaders, have the vision, the knowledge, the wherewithal and the experience to help us pave our way into the future. You are truly our greatest asset today and tomorrow, and we could not accomplish what we do without your support and leadership. Throughout this conference, I ask you to stay engaged, keep us proactive and help us shape the future and the direction of engineering education. We look forward to relaxing, sharing and learning alongside you.

Best regards,



Joseph J. Rencis, Ph.D., P.E., F.ASEE, F.ASME

Dean of Engineering and Clay N. Hixson Chair for Engineering Leadership

Conference Welcome

Welcome to the 2013 ASEE Southeastern Section Annual Conference: *Efficient and Effective Engineering Education*. Amid an increasingly hostile political environment and seemingly constant fiscal belt tightening, engineering schools are still called upon to provide proof of continuous improvement and effectiveness within engineering education. While this dichotomy between reduced resources and increased demands may seem untenable for many of our colleagues, engineers are quite familiar with the tension between performance and cost. We have long been experts at finding efficiencies that yield systems that meet both performance and cost targets.

Thank you for joining your colleagues from around the Southeastern United States to discuss the efficiency and effectiveness needed in engineering education today. I trust that you will find workshops, presentations, discussions, and networking opportunities that stimulate new ideas for your classroom and that provide encouragement for your continued dedication to students and the learning process.

This conference is the result of long hours of planning and preparation on the part of many dedicated people. I especially thank the Conference Site Chair, Steven Click, and his TTU team for organizing the site logistics; the Technical Program Chair, Hodge Jenkins, and his team of division chairs, reviewers, paper authors, and moderators for providing an engaging technical program; the Workshop Coordinator, Stephen Canfield, and the workshop presenters for providing a wide variety of presentation topics; the Awards and Recognition Unit Chair, Richard Mines, and his team of award reviewers for recognizing outstanding contributions to engineering education in our section; the Research Division Chair, Tom Fallon, and his team of division officers, students, and faculty advisors for organizing and participating in the student poster session; the Campus Representatives Coordinator, John Brocato, and his team of camps reps. for promoting section activities within our universities; and the section officers and executive board for providing clear and informed leadership to our section.

The activities of the Southeastern Section are dependent on many volunteers joining together to tirelessly donate their time and expertise in support of engineering education. If you are a veteran member of our section, thank you for your involvement in division, unit, and section activities. If you are a newcomer, then I encourage you to join your colleagues by volunteering to work as a division officer in the area of your choice. During Monday morning's breakfast, cross-disciplinary divisions such as *Instructional*, *Administrative*, and *K-12* will meet to discuss areas of common interest, while at Tuesday's breakfast, discipline-specific divisions (*Civil*, *Mechanical*, *Electrical*, etc.) will meet.

Next year, the 2014 ASEE-SE Conference will be hosted by Mercer University in Macon, Georgia. Mercer's site host committee is already working hard to prepare for our visit. I look forward to seeing you again next year.

It has been a privilege and honor to serve as your 2012-2013 President. I thank each officer who has volunteered his or her time to support the Southeastern Section. The dedicated members in this section make service a pleasure, and I look forward to supporting the new President and officers during the upcoming year.

Tyson Hall
President, ASEE-SE

Acknowledgements

First, let me add my welcome to those on the previous pages. I hope you find the Conference activities to rewarding and enriching, and I hope that you have an opportunity to enjoy the Tennessee Tech campus, Cookeville, and its area attractions. We are so glad you are here.

Before this year, I really didn't understand the complexities associated with hosting a conference, but now I have a greater appreciation for all the hard work and devotion required of the host institution. I offer a belated "thank you" to the hosts of the past.

While my title may be "Site Coordinator," most of the actual work was done by others, the people who really made this conference possible. I would therefore like to express thanks to:

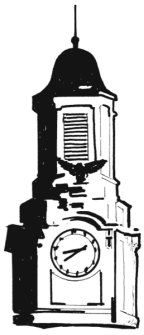
- Dean Joseph Rencis and former Interim Dean David Huddleston for demonstrating a commitment to excellence in engineering education by offering our campus as host institution and supporting this endeavor with time and resources.
- The College of Engineering, its Departments, Chairpersons, and Staff for supporting our conference goals by providing volunteers for work and support for faculty attendance.
- The Millard Oakley STEM Center and its Staff for supporting our conference by providing staff, coordinating registration, and providing access to their facilities.
- Our Conference Planning Committee, including Sally Pardue (STEM, Assistant Chair), Jessica Matson (CEE, Assistant Chair), Ken Hunter (BE), Pedro Arce (CHE), Robby Sanders (CHE), Martha Kosa (CSC), Omar Elkeelany (ECE), Stephen Canfield (ME), and Ismail Fidan (MIT), for their efforts in planning and directing the conference.
- The ASEE Southeastern Section leadership for their efforts in developing and maintaining an excellent annual conference, including all the resources and support needed by a host institution.
- All the participants in this year's conference – attendees, student poster competitors, authors/presenters, moderators, and reviewers. Without you, there would be no conference.

I would also like to extend a special word of thanks to a few individuals who helped keep me from being overwhelmed by this process: Melanie Hutcherson (who helped keep me from forgetting), Donna Smith (who helped manage the money), Ruby Anaya (who edited this book), Marbin Pazos-Revilla (who organized our tech support) and Beth Smith (who managed all the last-minute details).

It has been an incredible year of preparation here at Tennessee Tech, and I hope that the conference experience exceeds your expectations. If there's anything I can do to make your experience better, please let me know.

Steven M. Click
Site Coordinator

ASEE 2013 Conference Schedule At-A-Glance			
Sunday, March 10			
9:30 AM	5:00 PM	Registration	Prescott Hall Lobby
10:00 AM	5:00 PM	Workshops	Prescott Hall/Oakley STEM Center Classrooms
2:30 PM	5:00 PM	Executive Board Meeting	Prescott Hall Dean's Conference Room
5:00 PM	5:15 PM	Load Buses for Reception	Prescott Hall Parking Lot
6:00 PM	8:30 PM	Welcome Reception	Appalachian Center for Craft
Monday, March 11			
7:30 AM	8:00 AM	Breakfast	Oakley STEM Center Lobby
8:00 AM	8:30 AM	Division & Unit Meetings	Oakley STEM Center Lobby
8:30 AM	8:45 AM	Walking Time	
8:30 AM	5:30 PM	Registration	Prescott Hall Lobby
8:30 AM	10:20 AM	Student Poster Setup Time	Oakley STEM Center Classrooms
8:45 AM	10:05 AM	Welcome & Keynote	Prescott Hall Auditorium
10:05 AM	10:20 AM	Break	Prescott Hall Lobby
10:20 AM	11:40 AM	Technical Session 1	Prescott Hall Classrooms
10:20 AM	11:40 AM	Student Poster Judging	Oakley STEM Center Classrooms
11:40 AM	11:55 AM	Walking Time	
11:40 AM	12:30 PM	Student Poster Session	Oakley STEM Center Classrooms
12:30 PM	1:30 PM	Lunch	Oakley STEM Center Lobby
1:30 PM	2:00 PM	Presentation	Oakley STEM Center Auditorium
2:00 PM	2:15 PM	Walking Time	
2:15 PM	3:35 PM	Technical Session 2	Prescott Hall Classrooms
3:35 PM	3:50 PM	Break	Prescott Hall Auditorium
3:50 PM	5:10 PM	Technical Session 3	Prescott Hall Classrooms
5:15 PM	5:30 PM	Load Buses for Banquet	Prescott Hall Parking Lot
6:00 PM	9:00 PM	Reception & Awards Banquet	DelMonaco Winery & Vineyards
Tuesday, March 12			
7:30 AM	8:00 AM	Breakfast	Oakley STEM Center Lobby
8:00 AM	8:30 AM	Division & Unit Meetings	Oakley STEM Center Lobby
8:30 AM	8:45 AM	Walking Time	
8:30 AM	10:30 AM	Registration	Prescott Hall Lobby
8:45 AM	10:05 AM	Technical Session 4	Prescott Hall Classrooms
10:05 AM	10:25 AM	Break	Prescott Hall Auditorium
10:25 AM	11:45 AM	Technical Session 5	Prescott Hall Classrooms
11:45 AM	12:00 PM	Walking Time	
12:00 PM	1:15 PM	Lunch and Business Meeting	Oakley STEM Center Lobby



Tennessee Tech University Campus

Directions:

Coming directly to campus: From I-40, take **Exit 286** and turn north onto Willow Avenue.

From I-40W (from Knoxville), this will be a right turn.
From I-40E (from Nashville), this will be a left turn.

Go 3 miles on Willow Avenue and turn right onto University Drive. At the first four-way stop, Prescott Hall will be the building on your right at the intersection of University and Stadium Drives. Registration is in the lobby of Prescott Hall, located at 1020 Stadium Drive. To get to the Prescott Hall parking lot, please turn right on Stadium Drive, pass Prescott Hall, and the lot will be on your left.

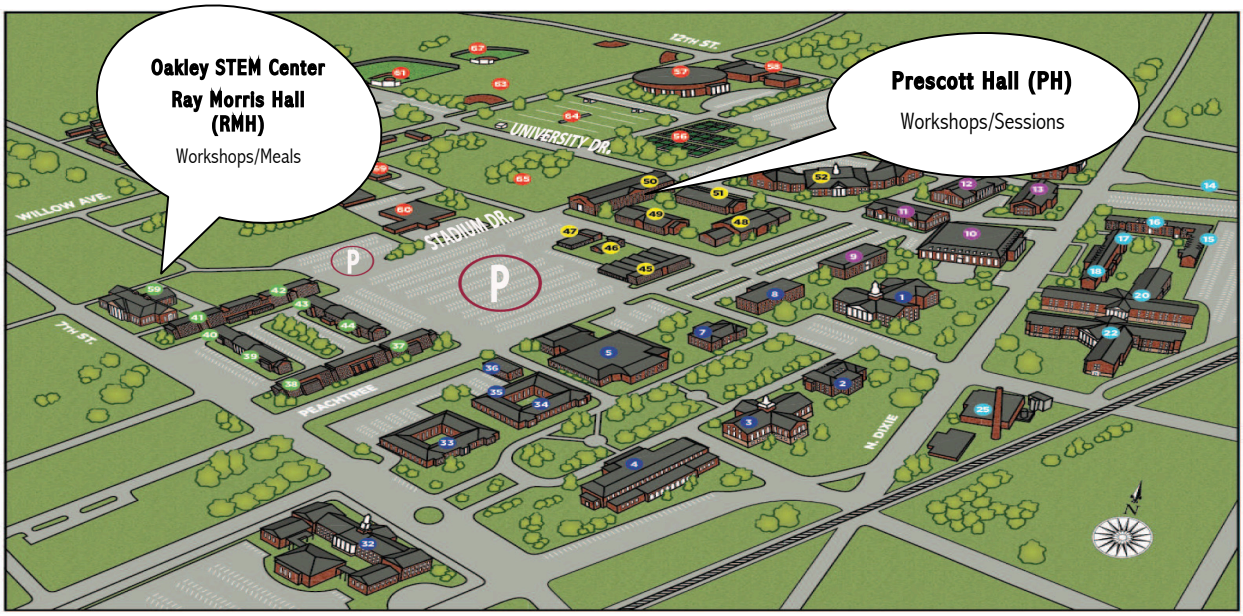
From the hotels:

If you are staying at the Baymont Inn or Holiday Inn Express, turn left onto Jefferson Avenue headed North. Turn left onto Interstate Drive, then right onto Willow Avenue at the second traffic light. Proceed North on Willow Avenue for 2.5m and turn onto University Drive.

If you are staying at the Clarion Inn or Best Western Thunderbird, turn left out of your hotel, and take an almost immediate right onto Interstate Drive. Take a right onto Willow Avenue at the second traffic light and proceed north on Willow Avenue for approximately 2.5 miles. Turn right onto University Drive.

Links to interactive and printable maps of TTU's campus can be found at http://www.tntech.edu/map

Parking & Transportation



Parking:

Participant parking is marked by a (P) on the Tennessee Tech University campus map above. There will also be signage to help you find your way once you are on campus. The Participant Parking Lot is on the side of Prescott Hall on Stadium Drive. If you have any problems with parking, please ask for the ASEE SE Site Coordinator or an assistant. You may park anywhere on campus, except handicap or emergency vehicle parking unless you are authorized to use these spaces. There is no plan for shuttles between campus and hotels.

Transportation:

Transportation for Sunday Evening: *March 10th – 6:00 - 8:30 pm*

Welcome Reception at Appalachian Center for Craft

***Bus transportation will be provided to and from the Welcome Reception. Please meet in the Prescott Hall Parking Lot at 5:00 pm, if you plan to use this option. It will leave the Appalachian Center for Craft at approximately 8:30 pm. Transportation time is 40 minutes each direction.**

Transportation for Monday Evening: *March 11th – 6:00 -9:00 pm*

Awards Banquet at DelMonaco Winery & Vineyards

***Bus transportation will be provided to and from the Awards Banquet. It will depart from Prescott Hall at 5:30 PM. Please meet in the Prescott Hall Parking Lot at 5:15 pm. It will leave DelMonaco Winery & Vineyards at approximately 9 pm.**

Prescott Hall (PH)

History:

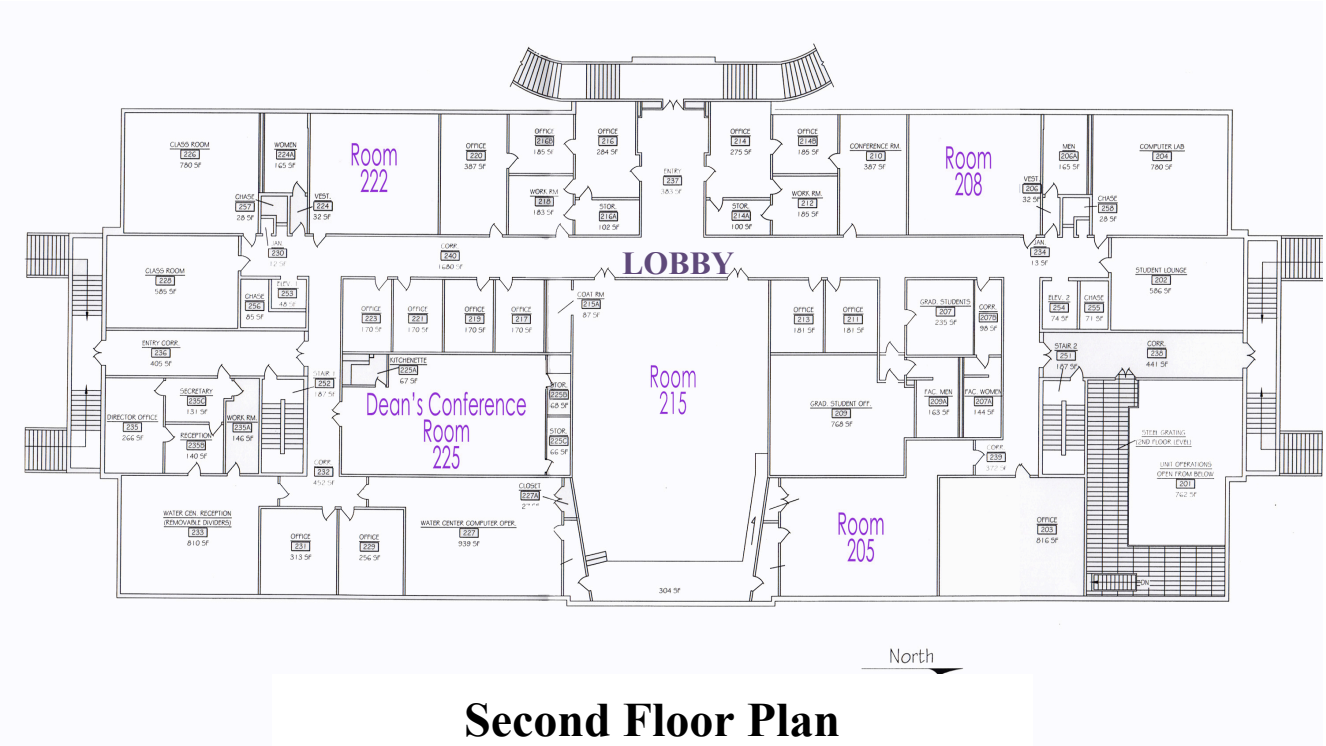
Prescott Hall was completed in 1969 during Dr. Everett Derryberry's tenure as Tennessee Tech University President. Designed by Steinbaugh, Harwood & Rodgers Architects and constructed by Sorrell Brothers, Prescott Hall was intended for occupancy by the Chemical and Civil Engineering Departments, which still reside therein. The building was named after Dr. Wallace S. Prescott.

Dr. Wallace S. Prescott, a 1946 alumnus, served Tennessee Tech for nearly 40 years as an educator, scholarly leaders, public servant and effective administrator. He was the University's chief academic officer for 21 years. He led in curricula development, faculty recruitment and major program accreditation. Two years after retiring, he returned to serve as Interim President. His wisdom, leadership skills, talents and energy were frequently sought outside the University. His many contributions resulted in his receiving the Distinguished Alumnus Award of Tennessee Tech in 1977, the Outstanding Civilian Service Award of the United States Army in 1983, and the Founders' Award of West Georgia in 1983. He was selected as a Tennessee Tech Engineer of Distinction in 1984.

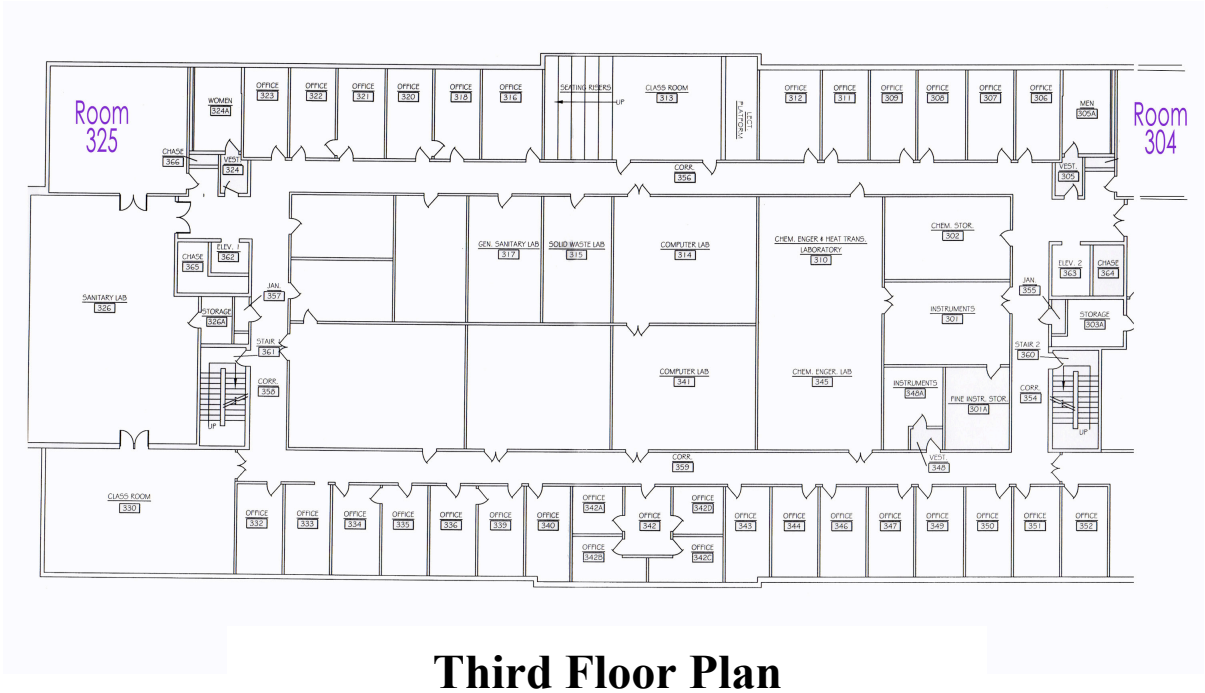
- **Registration in the Lobby**
- **Workshops and Sessions**
- **Bus transporation from this location to Reception and Banquet**
- **Participants Parking Lot is next to Prescott Hall (Stadium Drive)**

Prescott Hall Map

Registration, Workshops, Sessions and Transportation



Second Floor Plan



Third Floor Plan

Millard Oakley STEM Center

(Ray Morris Hall)

Enhancing the Teaching and Learning
of Science, Technology, Engineering and Mathematics
tntech.edu/stem

ABOUT THE MILLARD OAKLEY STEM CENTER

Tennessee Tech's Millard Oakley STEM Center for the Teaching and Learning of Science, Technology, Engineering and Mathematics supports a campus-wide initiative to develop new educational strategies in STEM-related fields. Located in Ray Morris Hall, the center actively promotes and provides quality STEM education outreach programs in the Upper Cumberland region and throughout the state of Tennessee.

TEACHERS & SCHOOLS

Professional Development for Teachers

The Millard Oakley STEM Center provides PreK-12th grade teachers throughout the Upper Cumberland region and the state access to hands-on workshops, cutting-edge resources, new technologies, and strategies for engaging their students in the STEM-based subjects of science, technology, engineering and mathematics.

STEM Center User Group Training & EXPEDITION Field Trips

STEM Center User Group Professional Development Training prepares teachers to use the learning laboratories, equipment and resources available at the Millard Oakley STEM Center. Their classes then attend a related EXPEDITION Field Trip. Students will experience two standards-aligned activities, the Virtual Theater, and more!

NASA Educator Resource Center

The NASA Educator Resource Center (ERC) in Tennessee Tech University's Millard Oakley STEM Center focuses on providing teachers information about and access to the National Aeronautics and Space Administration's vast STEM-education resources.

KIDS & FAMILIES

STEM FAB Fridays: Family-Centered Activities
Kids and parent/guardians can dive into interactive experiences in technology, use science and engineering equipment, enjoy interactive activities, explore the universe, and more!

STEM Safari Saturdays for Young Learners

Enjoy family-friendly, hands-on programs for Pre-K through 3rd graders. Experience a variety of engaging learning activities in the sciences and mathematics.

EXPLORATION Workshops

Build a robot, launch a rocket, dissect a shark, and more! Get them out of the house and into the laboratory to participate in hands-on, minds-on learning experiences. EXPLORATIONS available in the summer; grade levels and workshop topics vary annually.

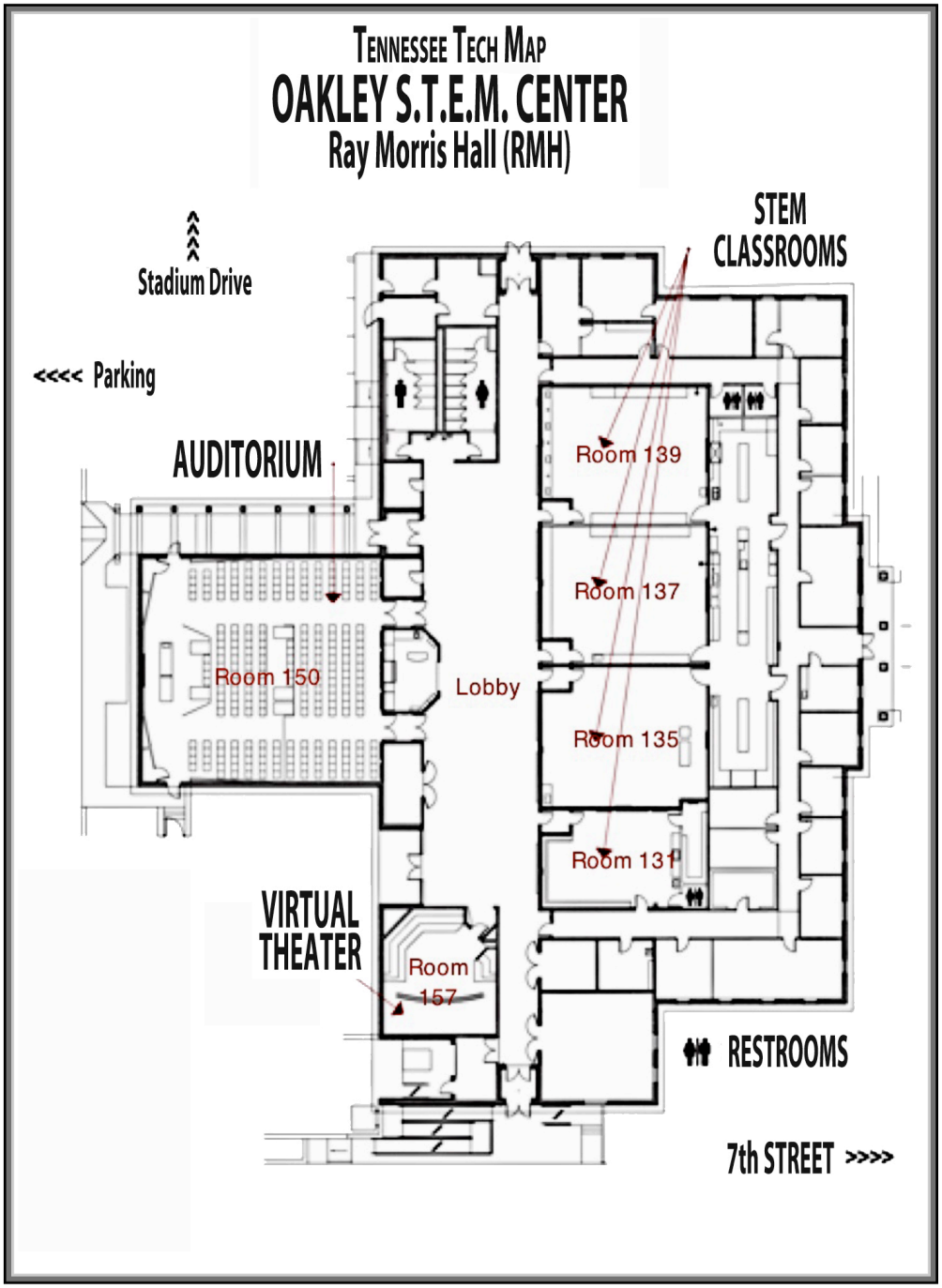
Virtual Theater Experience

Fly beyond the Earth in the state-of-the-art Virtual Theater and be wowed by the planetarium-like experiences. Perfect excursions for school groups, families and individuals wanting to know more about our world and changing universe.

Millard Oakley STEM Center Map

Ray Morris Hall

Workshops & Meals



Floor Plan

Appalachian Center for Craft

About the Craft Center

The Appalachian Center for Craft, located near Smithville, Tennessee, is a satellite campus of Tennessee Tech University (TTU). The Craft Center offers Bachelor of Fine Arts degree concentrations in clay, fibers, glass, metals and wood, as well as non-degree Craft Certificate programs in the five craft media.

The Craft Center is an 87,000 sq. ft. facility located on more than 500 gorgeous, wooded acres overlooking Center Hill Lake in scenic Middle Tennessee. The facility includes spacious studios, a retail gallery, exhibition galleries, administrative offices, a library, a cafe, student housing, and meeting/audio visual rooms.

Everyone can enjoy this beautiful and inspiring facility throughout the year.

· Hands-on craft workshop sessions are available to the public in the summer.

· Enjoy shopping in the Craft Center's contemporary fine craft gallery. Open daily, 9am-5pm (CT)

· Experience world-class exhibitions of functional and sculptural fine craft throughout the year.

Admission is free. Open daily, 9am-5pm (CT).

· Annual Special Events include the Celebration of Craft each spring and the Holiday Festival in the fall.

Sunday Welcome Reception

Sunday, March 10, 6:00-8:30 PM

Appalachian Center for Craft

1560 Craft Center Drive
Smithville, TN 37166
www.tntech.edu/craftcenter

Sponsored by

Join us as we open the ASEE-SE 2013 Conference with a welcome reception at the Appalachian Center for Craft. You won't want to miss the opening reception! The evening will include fabulous food by award winning chef Chad Combs, a chance to peruse fine art by 100+ local and regional artists, guided tours of the studios by Craft Center students and artists, and live craft demonstrations.

Transportation:

*Transportation will be provided to and from the Welcome Reception. Please be in the Prescott Hall parking lot at 5:00 pm if you plan to use this option. The buses will depart from Prescott Hall at 5:15 pm. It will leave the Appalachian Center for Craft at approximately 8:30 pm. Transportation time is approximately 40 minutes each direction.

Directions:

The Craft Center is approximately 60 miles east of Nashville, 120 miles west of Knoxville, and only 25 miles west of TTU's main campus in Cookeville.

From Interstate 40: From I-40 take Exit 273 (Smithville/McMinnville), go south on Hwy 56 for approximately 6 miles. After crossing Hurricane Bridge over Center Hill Lake/Caney Fork River take an immediate left at the Craft Center sign. This drive leads to the Craft Center parking lot and facility

Keynote Speaker

Stacy Klein-Gardener, Ph.D.
Director, Center for STEM Education for Girls

Dr. Stacy Klein-Gardner took on the position of Director of the Center for STEM Education in April 2011 just as the Center began. An engineer by training and in her ways of thinking, she received a BSE in biomedical and electrical engineering from Duke University in 1991. She then earned her M.S. from Drexel University in 1993 and her Ph.D. in biomedical engineering from Vanderbilt University in 1996.

Dr. Klein-Gardner's career focuses on K-12 science, technology, engineering and mathematics (STEM) education, particularly as it relates to increasing interest and participation by females. Dr. Klein-Gardner serves as the Director of the Center for STEM Education for Girls at the Harpeth Hall School in Nashville, TN. Here she leads professional development opportunities in science, technology, engineering, and mathematics (STEM) for K-12 teachers and works to identify and disseminate best practices from successful K12, university and corporate STEM programs for females. This Center also leads a program for rising 9th and 10th grade girls that integrates community service and engineering design in a global context.

She continues to serve as an Adjoint Professor of the Practice of Biomedical Engineering, Teaching and Learning, and Radiological Sciences at Vanderbilt University where she partners with other universities in NSF-funded research to develop the Engineering Design Process Portolio Scoring Rubric. She ran an NSF-funded programs such as Research Experiences for Teachers (RET) for nine years. She has served as the Associate Dean for Outreach in the Vanderbilt School of Engineering from 2007-2010. She established the Metropolitan Nashville Public Schools (MNPS) engineering pathway from K-12 with Race to the Top funding in 2010-2011 and is working with the state of Tennessee on potential adoption plans for the new Next Generation Science Standards.

Dr. Klein-Gardner is also active alumna of the Duke Talent Identification Program (TIP) and Duke University's Pratt School of Engineering, where she serves on the Board of Visitors. In 2012 she received the Distinguished Service Award from Pratt. Dr. Klein-Gardner is also active in the American Society for Engineering Education, serving as the chair-elect of the 800+ member K12 division.

Monday Night Awards Banquet

Monday, March 11, 6:00-9:00 PM

DelMonaco Winery & Vineyards

600 Lance Drive
Baxter TN 38544

Hours:
Mon-Thurs 10-5pm • Friday-Saturday 10-7pm • Sunday 12-5pm
Free Tasting & Tours

What DelMonaco Winery & Vineyards Offers

- Free Tastings of our Award Winning Wines
- Free Tours of our Winery & Vineyards
- Rooms to host your special Events
- Wine Clubs with 3 levels of Membership
- Fun Events Open to the Public
- Gift Shop for the Connoisseur or Novice

Transportation:

*Transportation will be provided to and from the Awards Banquet. Please be in the Prescott Hall parking lot at 5:15 pm if you plan to use this option. The buses will depart from Prescott Hall at 5:30 pm.

Directions

Please head west on W. 7th Street toward N. Walnut Avenue, and turn left onto N. Willow Avenue. Turn right onto W. Broad Street. Continue onto TN-24 W/US-70N W/Nashville Highway. Turn left onto Lance Drive. Destination will be on the left.

Conference Meals and Receptions

Welcome Reception

Sunday, March 10, 6:00 p.m. – 8:30 p.m.

Tennessee Tech's Appalachian Center for Craft

1560 Craft Center Drive

Smithville, TN 37166

Enjoy perusing fine art by 100+ local and regional artists and explore the facility on a guided tours led by Craft Center students and artists, and watch live craft demonstrations in the studios.

Redbud Café

On site at the Appalachian Center for Craft

Dine on the delectable hors d'oeuvres by award-winning chef Chad Combs. Food and beverages will be available in both the Café and *the gallery*.

NOTE: Transportation will be provided to and from the Welcome Reception. Please be in front of Prescott Hall promptly at 5:00 p.m., if you plan to use this option.

Function-Related Division Meetings Breakfast

Monday, March 11, 7:30 a.m. – 8:30 a.m.

Oakley STEM Center Lobby

A full breakfast will be served beginning at 7:30 a.m. Please sit in the appropriate table cluster and talk with colleagues in the following ASEE-SE divisions:

- Administrative
- Instructional
- K-12
- Professional Skills
- Research

Each division will hold a brief meeting after breakfast, followed by a meeting of the Programs Unit.

Thomas Evans Award Lunch

Monday, March 11, 12:30 p.m. – 2:00 p.m.

Oakley STEM Center Lobby & Auditorium

After finishing lunch in the lobby, attendees will go into the auditorium for the presentation and award for the Thomas Evans Outstanding Instructional Paper.

Awards Banquet

Monday, March 11, 6:00 p.m. – 9:00 p.m.

DelMonaco Winery & Vineyards

600 Lance Drive

Baxter, TN 38544

Sample the specialty wines, enjoy the music, and feast on a fantastic dinner. The awards ceremony celebrating those who have made outstanding contributions to the field of engineering education will be immediately following.

NOTE: Transportation will be provided to and from the Awards Banquet. Please be in front of Prescott Hall promptly at 5:15 p.m., if you plan to use this option.

Discipline-Related Division & Unit Meetings Breakfast

Tuesday, March 12, 7:30 a.m. – 8:30 a.m.

Oakley STEM Center Lobby

A full breakfast will be served beginning at 7:30 a.m. Please sit at one of the table clusters and meet colleagues in the following ASEE-SE divisions:

Awards and Recognition Unit Divisions

- Bioengineering
- Civil Engineering
- Engineering Graphics
- Engineering Technology
- Industrial Engineering

Publications and Promotion Unit Divisions

- Chemical Engineering
- Computer Engineering
- Electrical Engineering
- Mechanical Engineering
- Software Engineering

Each division will hold a brief meeting after breakfast, followed by meetings of the respective units.

Section Business Meeting Lunch

Tuesday, March 12, 12:00 p.m. – 1:15 p.m.

Oakley STEM Center Lobby

Please plan to attend the ASEE-SE Business Meeting to visit with your present Section Officers and vote for those officers for the upcoming year. We will close with a recap of the conference activities and officially announce the site of the 2014 conference.

WiFi Accessibility on Campus

Tennessee Tech University Guest Access

Information:

The conference wifi account is available to you as guests from March 10-12, 2013. It is available from the hours of 7 am – Midnight each day of the conference.

Procedure:

- **Choose the wireless network called 'TTU–WLAN–Secure'**
- **When prompted, enter the password 'gottueagles'**
- **Open a browser window**
- **You should be redirected to the TTU Acceptable Use Page**
- **Review the terms and choose 'ACCEPT'**
- **On the Network Access Control Page, choose 'GUESTS WHO HAVE A TEMPORARY ACCOUNT', under 'GUESTS'**
- **In the EMAIL box, Enter "ASEE"**
- **For the password, enter "aseese"**
- **On the next page, enter your name and email address**
- **After a short progress bar, you will be notified that the connection is successful and be prompted to close and reopen your browser.**

You should be now connected to the TTU Wireless Network if you did all the procedure steps above.

You may receive an email regarding the lack of anti-virus software on your device. Please ignore that email.

Username: ASEE

Password: aseese

If you are having difficulty in accessing the WiFi on campus, please alert any ASEE SE officer.

Conference Workshops At-A-Glance

All workshops on Sunday will be held in Prescott Hall and Oakley STEM Center on the TTU campus.

#	Title	Lead Author	Time	Loc	Fee
1	**Screen Engineering**	Chris ORiordan-Adjah	10-12	SC 137	Free
	Screen Engineering – Bridging the gap between in class concepts and real life application in an entertaining way to improve theory effectiveness.				
2	**Introduction to Arduino**	Timothy Wilson	1-4	PH 215	Free
	This workshop presents the Arduino computing platform as a tool for instructional use across a number of engineering domains * Limit 10				
3	**A Framework to Predict Dissemination Success of STEM Educational Innovations**	Chetan Sankar	10:30 – 12	SC 139	Free
	Participants will be shown a framework leading to the successful implementation of engineering educational innovations and will be involved in discussion on this topic.				
4	**Screen Engineering Showcase**	Chris ORiordan-Adjah	1 - 5	SC Lobby	Free
	Posters will be on display that Showcase Screen Engineering				
5	**Engineering EFFECTs: Environments for Fostering Effective Critical Thinking.**	Charles E. Pierce	1-5	PH 304	Free
	Participants in the EFFECTs Workshop will explore teaching and learning methods that engage engineering students in critical thinking about real engineering problems, and the workshop will provide examples and tools that are used in the EFFECTs pedagogical framework to stimulate, document, and assess critical thinking.				
6	**K-12 Engineering Outreach Workshop**	Sally Pardue	1:30 - 4:30	SC 131,135 137,139	Free
	K-12 Engineering Outreach Workshop – The workshop is a 3-hour showcase of ten to twelve engineering activities and programs aligned with education standards and designed for use with K – 12 teachers and students in formal and informal learning environments.				
7	**Creating Hands-on Programming Experiences for Engineering Students**	Sheikh Ghafoor	1:00-5:00	PH 222	Free
	The workshop will present a method and tools to introduce programming to engineering students using microcontrollers. The method will allow freshman engineering students to learn programming while engaging with engineering hardware. The method can also be implemented into other engineering courses.				
8	**Developing the NAE 2020 Engineer**	Pedro Arce	1:00 – 5:30	PH 205	Free
	Workshop will train educators in approaches useful to develop the new NAE 2020 Model. One helpful prototype is the recent Renaissance Engineering Model adopted at TTU.				

SC = Millard Oakley STEM Center (Ray Morris Hall) and PH= Prescott Hall

Technical Session Information

Session and Presentation Timing

Sessions are scheduled for 4 presentations times. 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.**

	Session T1	Session T2	Session T3	Session T4	Session T5
Presentation #1	10:20	2:15	3:50	8:45	10:25
Presentation #2	10:40	2:35	4:10	9:05	10:45
Presentation #3	11:00	2:55	4:30	9:25	11:05
Presentation #4	11:20	3:15	4:50	9:45	

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. In the event that a presenter, who is not last in the hour, 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 Technical Sessions At-A-Glance

Monday, March 11, 2013

Technical Session 1 10:20 am – 11:40 am

10:20am – 11:40am	T1-A Prescott 208	T1-B Prescott 222	T1-C Prescott 225	T1-D Prescott 304	T1-E Prescott 325
Technical Session 1	Instructional Division I	K-12 Division I	Administrative Division I	Civil Eng. Division I	Mechanical Engineering Division I
Moderator:	*Shih-Liang (Sid) Wang*	*Atin K. Sinha*	*Donna Reese*	*Ken Brannan*	*Robert Choate*

Monday, March 11, 2013

Technical Session 2 2:15 pm – 3:35 pm

2:15 pm– 3:35 pm	T2-A Prescott 208	T2-B Prescott 222	T2-C Prescott 225	T2-D Prescott 304	T2-E Prescott 325
Technical Session 2	Instructional Division II	K-12 Division II	Administrative Division II	Engineering Technology Division	Mechanical Engineering Division II
Moderator	*Monika Bubacz*	*Sally Pardue*	*Atin K. Sinha*	*Jerry Newman*	*Don Van*

Monday, March 11, 2013

Technical Session 3 3:50 pm – 5:10 pm

3:50 pm - 5:10pm	T3-A Prescott 208	T3-B Prescott 222	T3-C Prescott 225	T3-D Prescott 304	T3-E Prescott 325
Technical Session 3	**Cancelled**	K-12 Division III	Computer/ Software Division	Research Division I	Professional Skills Division I
Moderator:		*Sally Pardue*	*Randy Smith*	*Gillian Nicholls*	*Adeel Khalid*

Tuesday, March 12, 2013

Technical Session 4 8:45 am – 10:05 am

8:45 am – 10:05 am	T4-A Prescott 208	T4-B Prescott 222	T4-C Prescott 225	T4-D Prescott 325
Technical Session 4	Engineering Graphics Division	K-12 Division IV	Mechanical Engineering Division III	Civil Engineering Division II
Moderator:	*Priya Goeser*	*Claire McCullough*	*Monika Bubacz*	*Michael Woo*

Tuesday, March 12, 2013

Technical Session 5 10:25 am – 11:45 am

10:25 am – 11:45am	T5-A Prescott 208	T5-B Prescott 222	T5-C Prescott 225
Technical Session 5	Instructional Division III	Professional Skills Division II	Research Division II
Moderator:	*Richard Mines*	*Richard Kunz*	*Gillian Nicholls*

ASEE SE Section Officers 2012-13

SECTION OFFICERS 2012-13

Past President:	Brent Jenkins	Southern Polytechnic State University
President:	Tyson Hall	Southern Adventist University
President Elect:	Priscilla Hill	Mississippi State University
Secretary-Treasurer:	Tulio Sulbaran	University of Southern Mississippi
Newsletter Editor:	Ken Brannan	The Citadel
Campus Rep. Coordinator:	Steven Click	Tennessee Tech University
Proceedings Editor:	Barbara Bernal	Southern Polytechnic State University

PROGRAM UNIT

Vice President Program Unit:	Scott Schultz	Mercer University
Vice Chair Program Unit:	Hodge Jenkins	Mercer University
Secretary Program Unit:	Jerry Newman	University of Memphis

AWARDS AND RECOGNITION

Vice President Awards Unit:	Richard O.Mines,Jr.	Mercer University
Vice Chair Awards Unit:	Hodge Jenkins	Mercer University
Secretary Awards Unit:	Paul Palazolo	University of Memphis

PUBLICATIONS AND PROMOTIONS

Vice President Publications Unit:	John Brocato	Mississippi State University
Vice Chair Publications Unit:	David Domermuth	Appalachian State University
Secretary Publications Unit:	Donna Reese	Mississippi State University

BIOENGINEERING DIVISION

Chair:	David Domermith	Appalachian State University
Vice Chair:	Sinjae Hynn	Mercer University
Secretary:	Jorge Bohorquez	The University of Miami

CHEMICAL ENGINEERING DIVISION

Chair:	Priscilla Hill	Mississippi State University
Vice Chair:	Holly Stretz	Tennessee Tech University
Secretary:	J. R. Sanders	Tennessee Tech University

CIVIL ENGINEERING DIVISION

Chair:	Tanya Kunberger	Florida Gulf Coast University
Vice Chair:	Joseph Coe	The Citadel
Secretary:	Chuck Newhouse	Virginia Military Institute

COMPUTER ENGINEERING & TECHNOLOGY DIVISION

Chair:	Ahmed Abukmail	University of Southern Mississippi
Vice Chair:	Donald Ekong	Mercer University
Secretary:	Omar Elkeelany	Tennessee Tech University

ELECTRICAL ENGINEERING DIVISION

Chair:	Zhaoxian Zhou	University of Southern Mississippi
Vice Chair:	Marcos Chu	Capella University
Secretary:	Tim Wilson	Embry-Riddle Aeronautical University

ENGINEERING GRAPHICS DIVISION

Chair:	Robert A Chin	East Carolina University
Vice Chair:	Lulu Sun	Embry-Riddle Aeronautical University
Secretary:	Michael Woo	The Citadel

ENGINEERING TECHNOLOGY DIVISION

Chair:	Jerry Newman	University of Memphis
Vice Chair:	Kenneth Hutnich	Fort Valley State University
Secretary:	Charles Wasson	Wasson Strategies, LLC

INDUSTRIAL ENGINEERING DIVISION

Chair:	Laura Moody	Mercer University
Vice Chair:	Cecelia Wigal	University of Tennessee at Chattanooga
Secretary:	John Usher	Mississippi State University

INSTRUCTIONAL DIVISION

Chair:	George Ford	Western Carolina
Vice Chair:	Paul Palazolo	University of Memphis
Secretary:	Priya Goeser	Armstrong Atlantic State University

MECHANICAL ENGINEERING DIVISION

Chair:	Monika Bubacz	Mercer University
Vice Chair:	Cindy K. Waters	North Carolina A&T State University
Secretary:	Hodge Jenkins	Mercer University

PROFESSIONAL SKILLS

Chair:	Willard Munger	Southern Adventist University
Vice Chair:	Claire McCullough	University of Tennessee at Chattanooga
Secretary:	Otsebele Nare	Hampton University

RESEARCH DIVISION

Chair:	Tom Fallon	Southern Polytechnic State University
Vice Chair:	Zhaoxian Zhou	University of Southern Mississippi
Secretary:	Thad Roppel	Auburn University

SOFTWARE ENGINEERING DIVISION

Chair:	Randy Smith	University of Alabama
Vice Chair:	Willard Munger	Southern Adventist University
Secretary:	Sarah Lee	Mississippi State University

K-12 DIVISION

Chair:	Sally Pardue	Tennessee Tech University
Vice Chair:	Beth Todd	University of Alabama
Secretary:	Danielle Thomas	Embry Riddle/Glades Middle

ASEE SE Conference Participants 2013

First Name	Last Name	Institution
John	Abbitt	University of Florida
Hassan	Alfadhli	University of North Texas
Delaina	Amos	University of Louisville
Adam	Anderson	Tennessee Tech University
Thomas	Anderson	University of Tennessee at Chattanooga
Athanasios	Athanason	The Citadel
Garcia Burgos	Axel	Embry Riddle University
Martin	Ayers	University of South Carolina-Charlotte
Amy	Barton	Mississippi State University
Alex	Beauboeuf	North Carolina A&T State University
Curtis	Beck	Clemson University
Barbara	Bernal	Southern Polytechnic State University
David	Bourrie	Auburn University
Matthew	Boynton	Virginia Tech
Michael	Bradshaw	WKU-Dept. of Engineering
Andrew	Brammer	University of Alabama
Kenneth	Brannan	The Citadel
Colin	Britcher	Old Dominion University
John	Brocato	Mississippi State University
Aidan	Browne	UNC Charlotte
Monika	Bubacz	Mercer University
Lisa	Bullard	North Carolina State University
Daniel	Bunei	University of Alabama
Chris	Byrne	Western Kentucky University
Juan	Caicedo	University of South Carolina
David	Calamas	University of Alabama
Cheryl	Carrico	Virginia Tech
Bruce	Carroll	University of Florida
Robert	Choate	WKU- Dept. of Engineering
Anthony	Choi	Mercer University
Marcos	Chu	Capella University
Steven	Click	Tennessee Tech University
James	Dally	University of Maryland

Maurice	Daniels	North Carolina A&T State University
Tania	Datta	Tennessee Tech University
Saama	Davies	University of Tennessee at Chattanooga
Maxwell	DeWees	Embry-Riddle Aeronautical University
Michael	Dickey	North Carolina State
David	Domermuth	Appalachian State University
Elliot	Douglas	University of Florida
Tabatha	Dye	University of Alabama
Omar	Elkeelany	Tennessee Tech University
Dr. Ahmed	Elsawy	Tennessee Tech University
Matthew	Eubanks	Western Kentucky University- Dept. of Engineering
Matthew	Faircloth	University of Tennessee at Chattanooga
Dennis	Fallon	The Citadel
Tom	Fallon	Southern Polytechnic State University
Ismail	Fidan	Tennessee Tech University
Brett	Fleury	University of North Carolina at Charlotte
George	Ford	Western Carolina University
Wesley	Ford	University of Tennessee at Chattanooga
James	Gibert	Clemson University
Patrick	Godfrey	University of Tennessee at Chattanooga
Priya	Goeser	Armstrong Atlantic State University
Ryan	Gott	Western Kentucky University
Marshall	Guillot	University of Tennessee at Chattanooga
Tyson	Hall	Southern Adventist University
David	Harris	University of Tennessee at Chattanooga
Justin	Hayes	Western Kentucky University- Dept. of Engineering
Craig	Henderson	Tennessee Tech University
Priscilla	Hill	Mississippi State University
Duong	Ho	Southern Polytechnic State University
Kenneth	Hunter	Tennessee Tech University
Joel	Ingram	Union University
Brent	Jenkins	Southern Polytechnic State University
Hodge	Jenkins	Mercer University School of Engineering
Connor	Johnson	University of Tennessee at Chattanooga
David	Johnstone	Virginia Military Institute
Gabrielle	Jordan	North Carolina A&T State University
Alfred	Kalyanapu	Tennessee Tech University

Adeel	Khalid	Southern Polytechnic State University
Stacy	Klein-Gardner	Center for STEM Education for Girls
Daniel	Kohn	University of Memphis
Tanya	Kunberger	Florida Gulf Coast University
Richard	Kunz	Mercer University
Laura	LeMire	Community College of Baltimore County
Victor	Lollar	University of Tennessee
Pete	Ludovice	Georgia Tech
Laura	Luna	Tennessee Tech University
Stephanie	Luster-Teasley	North Carolina A&T State University
Twanelle	Majors	Warren County High School
Jessica	Matson	Tennessee Tech University
Philip	McCreanor	Mercer University
Michael	McCreary	University of Louisville
Claire	McCullough	University of Tennessee at Chattanooga
Robert	McCullough	University of Alabama
Richard	Mines	Mercer University
Laura	Moody	Mercer University
Perry Willard	Munger	Southern Adventist University
Thomas	Murphy	Armstrong Atlantic State University
Otsebele	Nare	Hampton University
Charles	Newhouse	Virginia Military Institute
Jerry	Newman	University of Memphis
Gillian	Nicholls	University of Alabama at Huntsville
Adebayo	Ogundipe	James Madison University
Joshua	Olson	University of West Florida
Andrea	Otero	University of Central Florida
Danny	Overstreet	Knovel
Sally	Pardue	Tennessee Tech University
Charles	Pierce	University of South Carolina
Andrew	Potter	University of West Florida
Ulyana	Pugina	University of Tennessee at Chattanooga
Jeffrey	Ray	Southern Polytechnic State University
Donna	Reese	Mississippi State University
Joseph	Rencis	Tennessee Tech University
Mike	Renfro	Tennessee Tech University
Matthew	Robinson	University of Tennessee at Chattanooga

Katherine	Safford	Mercer University
Chetan	Sankar	Auburn University
Scott	Schultz	Mercer University
Randal	Schwindt	Union University
Joseph	Scobey	University of Tennessee at Martin
Paige	Sforzo	Mercer University
Matthew	Sheen	Clemson University
Atin	Sinha	Albany State University
Randy	Smith	University of Alabama
Laura	Sosa	Mercer University
Richard	Stansbury	Embry-Riddle Aeronautical University
Tulio	Sulbaran	The University of Southern Mississippi
Matt	Swenty	Virginia Military Institute
Amber	Thompson	Isothermal Community College
Devin	Tiernan	Clemson University
Beth	Todd	University of Alabama
Nicholas	True	University of Tennessee at Chattanooga
Violetta	Vylegzhanina	Vanderbilt University
Shih-Liang	Wang	NC A&T State University
Cindy	Waters	NC A&T State University
Joseph	Waters	University of Alabama
Andrew	Weems	Mercer University
Brian	West	Auburn University
Jesse	West	University of Tennessee at Chattanooga
Cecelia	Wigal	University of Tennessee at Chattanooga
Timothy	Wilson	Embry-Riddle Aeronautical University
Michael	Winn	University of Tennessee at Chattanooga
Virgil	Wong	Elsevier
Yung	Wong	Embry-Riddle Aeronautical University
Michael	Woo	The Citadel
Justin	Wood	Tennessee Tech University
Petros	Xanthopoulos	University of Central Florida
Tianyu	Yang	Embry-Riddle Aeronautical University
Paul	Yanik	Western Carolina University
Sun	Yi	North Carolina A&T State University
Zhaoxian	Zhou	University of Southern Mississippi

Inspiring Innovation. Advancing Research. Enhancing Education.

Engineering faculty face multiple stresses – teaching and classroom management, the push for tenure, pressure to get funding and do quality research, and finding time to write and publish. ASEE is the ***only professional society for engineering educators*** across all disciplines, and as such, we provide a range of resources to help engineering faculty succeed and manage these competing priorities.

Faculty want networking opportunities ➡ ASEE connects you with your peers

Upon joining, members can enroll in up to six of ASEE's 51 professional interest divisions, addressing all engineering disciplines, as well educational topics, social issues and industry interaction. Division members can meet and collaborate as often or as little as they wish, and form relationships across divisions.

Faculty want to learn from their colleagues ➡ ASEE facilitates learning

ASEE's premiere event is a four-day annual conference, attended by nearly 4,000 people. At the conference members interact with peers, learn about items crucial for their professional development—including grant writing and publishing—and learn from developments in other institutions. In addition, annual section meetings allow members to meet with others in their geographic regions.

Faculty want professional assistance ➡ ASEE provides research-based instructional advice

In conjunction with the annual conference, ASEE convenes the National Effective Teaching Institute meeting, providing hands-on practice in the elements of effective teaching--course planning, lecturing, active learning, assessment of learning. Beyond NETI, ASEE has instructional workshops around the country aimed at helping faculty to improve their teaching, research and administrative skills. In addition, membership comes with free online access to the *Journal of Engineering Education* (and a discounted subscription for the hardcopy version), a peer reviewed journal providing the latest developments in successful, research-supported instruction methods.

Faculty want to publish their research ➡ ASEE advocates on behalf of researchers

Through its Engineering Research Council, ASEE supports faculty with their professional research efforts. The ERC provides a forum for discussion of problems and exchange of information pertaining to the research activities; represents and speaks on behalf of research and its administration both externally and within ASEE; improves the effectiveness of research operations at ERC member institutions; and maintains relationships with other organizations concerned with research and its administration. With newsletters and publications, ASEE keeps members informed of news and events that impact their fields of expertise.

Membership in Brief

- Discounted registration at the premiere national conference focused on engineering educators
- Free subscription to the award-winning ASEE *Prism*
- Free on-line access to the *Journal of Engineering Education*
- Membership in one geographic section and six divisions
- Access to a members-only section of the website, where you can search the electronic membership directory, review classified ads announcing faculty, department head, and dean position openings and fellowship opportunities, and find discounts on such items as insurance and car rentals.

ASEE SOUTHEASTERN SECTION CONFERENCE

MARCH 30-April 1, 2014

Mercer UNIVERSITY
MACON, GEORGIA

PREPARING ENGINEERS FOR THE GRAND CHALLENGES OF THE FUTURE

Engineers educated now will be the catalyst of change and will propel society forward through new technologies for decades to come. Thus, it is the responsibility of engineering educators to prepare these engineers to meet the grand challenges facing them currently and in the future. Problems and opportunities will be mastered by those best prepared to learn new skills and adapt. Curriculums, courses, and other learning experiences that provide the engineering skills and mindset necessary to meet these future challenges are the focus of this conference.

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 will have first priority and may include topics related to the following:

- Innovative Curricula or Courses
- First Year Engineering Programs
- Organizational Structures to Promote Interdisciplinary Engineering
- Engineering Common Cores
- Teaching/Learning Practices: Past, Present, and Future
- Distance Learning in Engineering
- Ethics and Professional Practice
- Technologies for Efficient Learning
- Engineering K-12 Outreach Programs
- Engineering Learning Communities
- ABET Accreditation Projects
- Engineering Recruitment and Retention
- Partnerships
- Capstone Design Courses or Projects
- Engineering Professional Development

Authors may also address other topics of interest to the engineering education community. Guidelines for manuscript preparation are available via the Author Instructions at www.asee-se.org at the Conference page.

Papers will be accepted based on a peer review of manuscripts. Authors are expected to present their papers at the conference to facilitate the transfer of knowledge through discussion and debate. All accepted papers presented by a timely-registered author will be included in the conference proceedings. 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 conference proceedings.

An author/co-author can be associated with as many papers/presentations as is appropriate, but a registrant can serve as the presenter of record on a maximum of three presentations.

A poster session in which undergraduates discuss their experiences in engineering education (design projects, research, etc.) is anticipated. Information about this session will be available in the fall.

SCHEDULE FOR SUBMISSION OF PAPERS AND ABSTRACTS

Friday, October 4, 2013	Abstracts submitted by authors for consideration
Friday, October 11, 2013	Authors notified regarding acceptance
Tuesday, December 3, 2013	Manuscripts due from authors for review
Friday, January 10, 2014	Reviewed manuscripts returned to authors
Friday, January 31, 2014	Final manuscripts and extended abstracts due from authors
Friday, February 21, 2014	Deadline for presenters to register for conference

Submit a 250-300 word abstract in doc, docx, or pdf file format by October 4, 2013
Conference paper submission site will be announced at www.asee-se.org

CONTACTS

Jerry Newman, Technical Program Chair, (901) 318-5614, jdnewman@memphis.edu
Hodge Jenkins, Conference Site Coordinator, (478) 301-2831, jenkins_he@mercer.edu

Cookeville Area Attractions

You never need to worry about a lack of things to do in Cookeville! Stroll through history by visiting the quaint downtown retail center, the Cookeville History and Depot museums, or by viewing the beautiful historic architecture of our public and commercial buildings and residences throughout the city. Prepare to be charmed by the matchless mountains, rich historical heritage, art and cultural events, unique downtown shops, cosmopolitan cuisine and outdoor opportunities at many state and local parks and lakes. Just a few of the must-see's include:

Cookeville Depot Museum
Built in 1909, the Cookeville Depot is now home to the Cookeville Depot Museum. Visitors can view railway artifacts, memorabilia, numerous photographs of the railroad in Putnam County over the years and scale trains that run such an authentic 1913 Baldwin steam locomotive and two cabooses. It's open year-round, and admission is free.

Cookeville History Museum
This museum features an enormous collection of items, artifacts, photographs, special exhibits and more, covering the history of Cookeville from prehistoric times through the present. The museum is at 40 E. Broad St. across from City Hall.

Historic Courthouse Square
The Historic Courthouse Square has made shopping fun and easy with pedestrian walkways, streetlights and crosswalks. Enjoy browsing through a variety of unique stores that have made the historic square their choice location. While on the square, you may appreciate a visit to the Arcade Building to observe the beautiful stained glass panels on the ceiling of what was the first enclosed shopping mall of its kind in Cookeville.

West Side Shopping and Dining
Cookeville's West Side boasts a wonderful collection of specialty shops, local restaurants, antique stores, eateries and more, all within walking distance of the Cookeville Depot Museum, Cookeville Drama Center, Convention & Visitors Bureau, Chamber of Commerce, Farmers Market, Cookeville Regional Medical Center and Tennessee Tech University. As you make your way through the West Side district, take time to appreciate the restored storefronts and internal structures of these historic buildings.

Highlands Visitor Center: www.mustseecookeville.com
470-A Neal Street, Cookeville, TN 38501
Hours: 9 a.m.-5 p.m. every day
Phone: (931) 525-1575
Features include:
· Interactive displays of local attractions
· Fine arts and craft items from local and emerging artists
· Historical exhibits
· A 32-inch flat-screen TV showing scenes of the Highlands
· A wall-sized map that highlights points of interest in the Upper Cumberland

CHAPTER 2
Workshops

Conference Workshops At-A-Glance

All workshops on Sunday will be held in Prescott Hall and Oakley-STEM Center on the TTU campus.

#	Title	Lead Author	Time	Loc	Fee
1	**Screen Engineering**	Chris ORiordan-Adjah	10-12	SC 137	Free
	Screen Engineering – Bridging the gap between in class concepts and real life application in an entertaining way to improve theory effectiveness.				
2	**Introduction to Arduino**	Timothy Wilson	1-4	PH 215	Free
	This workshop presents the Arduino computing platform as a tool for instructional use across a number of engineering domains * Limit 10				
3	**A Framework to Predict Dissemination Success of STEM Educational Innovations**	Chetan Sankar	10:30 – 12	SC 139	Free
	Participants will be shown a framework leading to the successful implementation of engineering educational innovations and will be involved in discussion on this topic.				
4	**Screen Engineering Showcase**	Chris ORiordan-Adjah	1 - 5	SC Lobby	Free
	Posters will be on display that Showcase Screen Engineering				
5	**Engineering EFFECTs: Environments for Fostering Effective Critical Thinking.**	Charles E. Pierce	1-5	PH 304	Free
	Participants in the EFFECTs Workshop will explore teaching and learning methods that engage engineering students in critical thinking about real engineering problems, and the workshop will provide examples and tools that are used in the EFFECTs pedagogical framework to stimulate, document, and assess critical thinking.				
6	**K-12 Engineering Outreach Workshop**	Sally Pardue	1:30 - 4:30	SC 131,135, 137,139	Free
	K-12 Engineering Outreach Workshop – The workshop is a 3-hour showcase of ten to twelve engineering activities and programs aligned with education standards and designed for use with K – 12 teachers and students in formal and informal learning environments.				
7	**Creating Hands-on Programming Experiences for Engineering Students**	Sheikh Ghafoor	1:00-5:00	PH 222	Free
	The workshop will present a method and tools to introduce programming to engineering students using microcontrollers. The method will allow freshman engineering students to learn programming while engaging with engineering hardware. The method can also be implemented into other engineering courses.				
8	**Developing the NAE 2020 Engineer**	Pedro Arce	1:00 – 5:30	PH 205	Free
	Workshop will train educators in approaches useful to develop the new NAE 2020 Model: One helpful prototype is the recent Renaissance Engineering Model adopted at TTU.				

SC = The Millard Oakley STEM Center and PH= Prescott Hal

Workshop 1

Screen Engineering

Chris ORiordan-Adjah

Sunday, March 10, 10:00 am – 12:00 pm, Stem Center, TTU campus

"Screen Engineering" which started three years ago with my Engineering Analysis (Statics) class as an extra credit project has recently caught the attention of many engineering educators. In response to the article in September's issue of the Prism entitled "Lights, Camera, Engineering", a brief article (my response) was featured in the November issue entitled "Movies and Statics". I received emails from engineering educators who saw the article and started asking questions from "How I turned a dry and boring course to one that is entertaining and engaging" to "How effective and efficient is Screen Engineering".

The goal of this workshop is to answer these questions as well as give a detailed description of how "Screen Engineering" can be incorporated in any engineering course but specifically Engineering Analysis (Statics) to make it more effective and efficient. These goals will be illustrated using;

- Statistical Analysis & Results of student participants in "Screen Engineering".
- Detailed description of "Screen Engineering" including proposals, reports and presentations.
- Student testimonials.

Last but not least, it is not coincidence that the December issue of the Prism featured an article entitled "Wow the Audience" in which it stated that "many engineering students lack the communications skills they will need to succeed professionally. In "Screening Engineering" much emphasis is laid on presentation and it is a huge percentage of the project aimed at improving "communications skills". I have first handedly witnessed this "lack" coming from a professional background where it is almost an everyday activity ranging from in-house project meetings, proposal rehearsal to bid project meetings. This is why I have incorporated strict presentation rules in "Screen Engineering".

Workshop 2

Introduction to Arduino

Tim Wilson

Sunday, March 10, 1:00 pm – 4:00 pm, Prescott Hall, TTU campus

This workshop presents the Arduino computing platform as a tool for instructional use across a number of engineering domains. Arduino is a cheap, readily available, open-source microcontroller platform that interfaces easily with a variety of sensors and actuators. Its software development environment is easy to use, facilitating rapid development and prototyping of real-time systems. Arudino has been widely adopted by "makers"—from artists to engineers—around the world. Students increasingly use Arduino as the computing platform of choice in student projects.

This workshop is a hands-on introduction to Arduino for engineering faculty, with examples of its application in a variety of disciplines, not just electrical engineering and computer engineering. In the workshop, participants will learn how to:

- Use Arduino to actuate: turn on LEDs, make sounds, run motors, etc.; and
- Use Arduino to sense: get input from switches, potentiometers, strain gauges, ultrasonic sensors, etc.

Brief description of topics to be covered:

- Downloading the Arduino development environment;
- Connecting an Arduino board to the computer for the first time (installing drivers);
- What's on the Arduino board;
- "Hello, World" for Arduino;
- Getting data from sensors;
- Pulse-width modulation control of actuators;
- Voltage control of actuators;
- Using "shields" (special-purpose daughter boards); and
- Arduinos on the network.

Workshop 3

A Framework to Predict Dissemination Success of STEM Educational Innovations

Chetan Sankar

Sunday, March 10, 10:30 am – 12:00 pm, Stem Center, TTU campus

Workshop goals:

We have conducted a literature review and obtained experts' opinion on the important factors leading to the successful dissemination of educational innovations. We will discuss the results of this research and the framework that we have formulated to address this issue. Through this process, we expect participants to be better prepared to be either effective innovators or implementers of educational innovations.

Brief description of topics to be covered:

Over the past decade, organizations like the National Academy of Education (2009), National Academy of Engineering (2004, 2005), and National Science Board (2007) have recommended improvements in science, technology, engineering, and mathematics (STEM) undergraduate education. These recommendations have not resulted in the major systematic changes within engineering education that were originally expected (Eiseman & Fairweather, 1996; Fairweather & Beach, 2002; National Science Foundation, 2008). Feser et al., (2011) and Eiseman and Fairweather (1996) found in an evaluation of National Science Foundation CCLI and TUES projects that dissemination warranted a co-equal role to the development of new instructional materials. This evaluation asserted that academicians would benefit from a more detailed and empirically based set of information regarding which factors lead to the successful acceptance of innovations and the types of barriers that hinder the adoption of innovations. Catalyzing widespread adoption of empirically validated teaching practices is a key recommendation in the report Engage to Excel by the President's Council of Advisors on Science and Technology.

Based on a recent article by Olds et al., (2012), this workshop proposes to address the following questions:

- What are the barriers to implementation of educational innovations at student, faculty and administration levels, and how can those barriers be addressed?
- What are the important factors leading to the successful implementation of these innovations at student, faculty, and administration levels?
- Can a framework be developed to help faculty develop new innovations and others who wish to adopt new innovations?

We propose a framework to address this problem and will discuss the details of this framework and the results of our past research. We expect the participants of the workshop to benefit from this discussion and expect valuable comments from them that will refine the framework further.

Workshop 4

Screen Engineering – Poster Displays

Chris ORiordan-Adjah

Sunday, March 10, 1:00 pm – 5:00 pm, Stem Center, TTU campus

Posters will be on display that Showcase Screen Engineering

Workshop 5

Engineering EFFECTs: Environments for Fostering Effective Critical Thinking.

Charles E. Pierce

Sunday, March 10, 1:00 pm – 5:00 pm, Prescott Hall, TTU campus

The goals of the proposed workshop are as follows:

1) Explain the pedagogical framework for the Environments for Fostering Effective Critical Thinking (EFFECTs);
2) Demonstrate tools that facilitate the development, deployment, and assessment of EFFECTs;
3) Illustrate examples of decision worksheets and active learning exercises that have been used with EFFECTs;
4) Share faculty experiences with EFFECTs across all academic levels of engineering courses;
5) Guide participants through the design process of an EFFECT, leading each individual to draft a decision worksheet and at least one active learning exercise; and
6) Invite participants to join the Community of Practice, which will offer opportunities for continued support to further develop the drafted EFFECTs.

Brief Description of Topics:

The proposed workshop will be divided into the following chronological sessions:

1) EFFECTs Project – Introduction and Background
2) Pedagogical Framework
    a. Setting the Stage – Driving Questions and Decision Worksheets
    b. Engaging Students – Active Learning Modules
    c. How Do We Know That Students Are Learning? – Journals and Other Reflection Exercises
    d. Closing the Loop – The Final Product
3) Assessment of EFFECTs on Student Performance
4) Developmental Framework – How to Build Your Own EFFECT

Workshop 6

K-12 Engineering Outreach Workshop

Sally Pardue and Stacy Gardner

Sunday, March 10, 1:30 pm – 4:30 pm, Stem Center, TTU campus

K-12 Engineering Outreach Workshop – The workshop is a 3-hour showcase of ten to twelve engineering activities and programs aligned with education standards and designed for use with K – 12 teachers and students in formal and informal learning environments. Organizers will invite PIs and/or directors of SE regional K-12 outreach programs to showcase one of their activities – tried and "proven" with K-12 students

- #1 objective: engage the participants with demonstration of hands-on, standards aligned activity for a specific grade band of students
- #2 objective: curate a collection of the "best" activities in the SE – the activities will be collected into a single on-line location for participants to access afterwards
- Presenters can offer overview literature of full programming but primary intent to meet #1 objective
- Each presentation space will have xx tables and xx square footage to work with ~8 to 10 participants at a time for a 20 to 30 minute window of time

Workshop 7

Creating Hands-On Programming Experiences for Engineering Students

Sheikh Ghafoor

Sunday, March 10, 1:00 pm – 5:00 pm, Prescott Hall, TTU campus

Programming is an essential skill for engineering students, particularly in areas of mechanisms and robotics, mechatronics and design. Students receive formal programming training early on in the typical engineering curriculum, but generally demonstrate difficulty in implementing programming skills to solve engineering problems in later courses. This is due to a number of factors including a lack of cohesion in programming practice in the curriculum and improper context for introducing programing to engineering students. This workshop will introduce a hands-on programming toolkit to allow engineers to learn programming based on Microcontroller and associated hardware (sensors, motors, output devices) using either the Matlab or C programming environment. This toolkit is applicable to all levels of students, from freshman in their introductory programming course through senior and graduate students. This toolkit will be demonstrated for use in in freshman through senior year courses with specific examples in dynamics of machinery, robotics, mechatronics and controls.

In this hands-on toolkit, the MCU becomes the target for the program. Once programmed, the hardware runs independently and can readily implement outside of class or the lab. The primary method of programming an MCU is with C or C++. The toolkit supports C programming or Matlab programming using standard Matlab scripting language. One of the unique offerings of this toolkit is that it provides a way to program an MCU directly using Matlab.

The premise is that adding an MCU as a programming target, rather than simply a PC, may provide a more appropriate context for engineers to learn programming. In addition, the MCU target will offer a greater number of options for incorporating programming into the engineering curriculum.

This workshop will offer hands-on practice in the following areas to its participants:

Introduction to Hands-on programming toolkit

Programming a Microcontroller using Matlab script.

Demonstrated applications in engineering courses (dynamics of machinery, design, controls, mechatronics

Demonstrated applications in an introductory programming class

Demonstrated applications in dynamics of machinery, robotics, mechatronics and controls courses

Workshop 8

Developing the NAE 2020 Engineer

J.R. Sanders and Pedro Arce

Sunday, March 10, 1:00 pm – 5:00 pm, Prescott Hall, TTU campus

The USA-National Academy of Engineer has called for a different type of engineer that will be very effective in bringing the much needed solutions to the Grand Challenges identified by the Academy[1]. This style of engineer is a considerable departure of the current and traditional model more focused on repetition, maintenance, and routine types of operations and applications. While the strong analytical skills, high ethical standards, and practical ingenuity are 'invariants' attributed to the engineers, the NAE-2020 Model is also focused on innovation, creativity and entrepreneurship.

The NAE-2020 Model requires a new paradigm in engineering education; this paradigm needs to *develop* actively and collaboratively the fundamental knowledge in the students and, then, be able to bring a strong opportunity for them to *transfer* that knowledge in order to produce innovations. In short, the engineer in the making needs to learn and be trained on the process of creativity and innovation where a very effective transfer of knowledge towards the 'composer' rather than the 'conductor' style of professional that for years the engineering schools have been producing. [2]

The workshop will introduce and train participants with key elements of the new paradigm including: Cycles of Learning, in particular the "*Legacy Cycle*", extensively tested by the VANTH-ERC at Vanderbilt University[3], will be introduced and examples of its use in chemical engineering courses will be given. In addition, the "*Documentation Cycle*"[4] will be highlighted as part of a very effective student-centered approach to document concepts and monitor student learning. Participants will be introduced to the role of collaborative learning and the powerful principle of "*Group Genius*" as well the role of the student team within this environment.[5] "*Linear Engineering Sequences*" [6] (LES) as an effective and productive environment for creativity and innovation will be described and illustrative examples from two courses, i.e. biotransport and fluid-mechanics will be shared with the audience, describing the role of the instructor and finally, assessing tools use in the various courses will be offered.

---

[1] "The Engineer of 2020: Visions of Engineering the in the New Century", NAP 2005

[2] Pedro E. Arce, "New Paradigm of Engineering Education: The Composer vs. the Conductor Engineer", National Science Foundation (NSF) –Engineering Research Centers (ERC) Annual Meeting, Keynote Presentation, Washington DC, December 2009.

[3] https://repo.vanth.org/portal/public-content/star-legacy-cycle/star-legacy-cycle

[4] P. Arce-Trigatti et al, "The Documentation Cycle", ASEE-SE Annual Meeting, The Citadel, SC, 2010.

[5] See "The Group Genius" by Keith Sawyer (2007).

[6] Pedro E. Arce and Loren Schreiber, "Hi-PeLE, Journal of Chemical Engineering Education, Summer 2004.

CHAPTER 3
Technical Session
Extended Abstracts

Conference Technical Sessions At-A-Glance

Monday, March 11, 2013

Technical Session 1 10:20 am – 11:40 am

10:20am – 11:40am	T1-A Prescott 208	T1-B Prescott 222	T1-C Prescott 225	T1-D Prescott 304	T1-E Prescott 325
Technical Session 1	Instructional Division I	K-12 Division I	Administrative Division I	Civil Eng. Division I	Mechanical Engineering Division I
Moderator:	*Shih-Liang (Sid) Wang*	*Atin K. Sinha*	*Donna Reese*	*Ken Brannan*	*Robert Choate*

Monday, March 11, 2013

Technical Session 2 2:15 pm – 3:35 pm

2:15 pm– 3:35 pm	T2-A Prescott 208	T2-B Prescott 222	T2-C Prescott 225	T2-D Prescott 304	T2-E Prescott 325
Technical Session 2	Instructional Division II	K-12 Division II	Administrative Division II	Engineering Technology Division	Mechanical Engineering Division II
Moderator	*Monika Bubacz*	*Sally Pardue*	*Atin K. Sinha*	*Jerry Newman*	*Don Van*

Monday, March 11, 2013

Technical Session 3 3:50 pm – 5:10 pm

3:50 pm - 5:10pm	T3-A Prescott 208	T3-B Prescott 222	T3-C Prescott 225	T3-D Prescott 304	T3-E Prescott 325
Technical Session 3	**Cancelled**	K-12 Division III	Computer/ Software Division	Research Division I	Professional Skills Division I
Moderator:		*Sally Pardue*	*Randy Smith*	*Gillian Nicholls*	*Adeel Khalid*

Tuesday, March 12, 2013

Technical Session 4 8:45 am – 10:05 am

8:45 am – 10:05 am	T4-A Prescott 208	T4-B Prescott 222	T4-C Prescott 225	T4-D Prescott 325
Technical Session 4	Engineering Graphics Division	K-12 Division IV	Mechanical Engineering Division III	Civil Engineering Division II
Moderator:	*Priya Goeser*	*Claire McCullough*	*Monika Bubacz*	*Michael Woo*

Tuesday, March 12, 2013

Technical Session 5 10:25 am – 11:45 am

10:25 am – 11:45am	T5-A Prescott 208	T5-B Prescott 222	T5-C Prescott 225
Technical Session 5	Instructional Division III	Professional Skills Division II	Research Division II
Moderator:	*Richard Mines*	*Richard Kunz*	*Gillian Nicholls*

CHAPTER 3
TECHNICAL SESSION 1
EXTENDED ABSTRACTS

Monday, March 11, 2013

Technical Session 1 10:20 am – 11:40 am

10:20am – 11:40am	T1-A Prescott 208	T1-B Prescott 222	T1-C Prescott 225	T1-D Prescott 304	T1-E Prescott 325
Technical Session 1	Instructional Division I	K-12 Division I	Administrative Division I	Civil Engineering Division I	Mechanical Engineering Division I
Moderator:	*Shih-Liang (Sid) Wang*	*Atin K. Sinha*	*Donna Reese*	*Ken Brannan*	*Robert Choate*

T1–A: Instructional Division I **PRESCOTT HALL 208**

175 - Engineering of Beer: Hard Work of Too Much Fun? 3-6
Monika Bubacz, Philip McCreanor, Hodge Jenkins

177 - The New Frontier of Education: The Impact of Smartphone Technology in the Classroom 3-7
Jessica L. Buck, Elizabeth McInnis, Casey Randolph

*178 - The Role of a Freshmen Programming Course for Engineers on Student Success 3-8
Priya T. Goeser, Wayne M. Johnson and Delana A. Nivens

131 - Sustainable development: Understanding How Things Break 3-9
Robert R. McCullough, Beth A. Todd, J. Brian Jordon

T1–B: K-12 Division I **PRESCOTT HALL 222**

*137 - Engineering Conceptual Design Approach for Pre-College Students 3-10
Otsebele Nare, Ziette Hayes, Michael Reynolds, and Shannon Davis

141 - Science Technology Engineering Program (STEP) Summer Camp for K-12 Students 3-11
Atin Sinha and Wanjun Hu

*169 – Structures and Natural Disasters 3-12
Andrew T. Brammer, Beth Todd, and J. Brian Jordon

170 – Solar Ovens 3-13
Joseph L. Waters an, Beth A.Todd

T1–C: Administrative Division I **PRESCOTT HALL 225**

159 - Ten Years Experience with a Multi-University Collaborative Graduate Education Program 3-14
Colin P. Britcher, Bernard M. Grossman

142 - The Use of a Fundamentals of Engineering Course to Enhance the Capstone Experience *3-15*
David W. Johnstone, Charles D. Newhouse

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

136 - The Future of Course Work: Customizing Community College Curricula to Meet Industrial Needs 3-16
Amber C. Thompson, William L. McDaniel, Jo James, Chester Peeler, Steve Hollifield

130 - Impact on Retention from a Change In Undergraduate Computing Curricula 3-17
Donna S. Reese, T.J. Jankun-Kelly, Lisa Henderson and Sarah Lee

T1–D: Civil Engineering Division I **PRESCOTT HALL 304**

183 - Logistical Impact of Intermodal Facilities 3-18
Tulio Sulbaran, MD Sarder

134 - Confessions of a novice Class Room Technology (CRT) user - Through the eyes of a new faculty member 3-19
Alfred Kalyanapu

106 - The Impact of Non-Traditional Laboratory Report Formats on Student Performance of Course Objectives 3-20
T. Kunberger

192 - Using the Toolbox Approach with Mathcad Prime 2.0 in a Computer Applications Course 3-21
Kenneth P. Brannan, Kaitlin H. Marley, John A. Murden

T1–E: Mechanical Engineering **PRESCOTT HALL 325**

*195 - Introducing Statistical Analysis in Experimental Data Collection in an Undergraduate Fluid Mechanics Laboratory 3-22
Bruce Carroll, John Abbitt

138 - Reynolds Transport Theorem Applied to Classical Thermodynamics 3-23
David Calamas, Alan Hewitt, John Baker and Beth Todd

*114 - Determination of Building Envelope and Duct System Integrity through the Quantification of Air Flow Leakage Rates 3-24
Justin Hayes and Robert Choate

151 - Simple Demonstrations in Basic Mechanics Courses 3-25
Richard Kunz

175 - Engineering of Beer: Hard Work of Too Much Fun?

Monika Bubacz, Philip McCreanor, Hodge Jenkins

School of Engineering–Mercer University

EXTENDED ABSTRACT

It is human nature to give very little attention to available staple foods and drinks and their industrial production. That, unfortunately, is especially true for malt beverages. Beer, an example of such, is one of the oldest known and widely consumed by man. During the brewing process grains are converted through fermentation to produce desirable and distinct sensory characteristics. Since as early as 500 BCE, beer making involved many scientific disciplines including agriculture, chemistry, biology, pharmacology. Initially, scientific contributions were at then empirical level but at the end of the 19th century beer production became the subject of analytical research. As customer demand rose and subsequently mass production increased, the brewing industry applied a whole spectrum of new technical, biochemical, microbiological, and genetic inventions boosting the involvement of the scientific world.

It has been said 'Brewing is one of these things that can keep a curious mind very interested and very active.' Then, why not bring it to the engineering classroom and make our students the envy of their peers? A modern brewing engineering education would expose students to principles of fermentation sciences, systems design and many areas of engineering, and would also involve discussion of social, cultural, and ethical implications of food and beverage production. The brewing process is energy intensive and uses large volumes of water. It also produces vast amounts of waste, both liquid (wastewater) and solid (spent grains, hops, yeast). Spent grains are generally used as compost and livestock feed but could also serve as petroleum alternative or be burned and turned into heat or electricity to power machinery.

Aspects of many engineering courses (fluid mechanics, heat and mass transfer, materials, process design, process control, power, machine design, statics, engineering economics, pollution control, optimization, etc.) can be brought to bear in the evaluation of the brewing process. These specialties could be used in conjunction with sustainability and green design concepts to optimize design and operation of brewery. Moral and religious concerns with the production of alcoholic beverages could be an interesting focus for a module on ethics and social concerns.

Food engineering (of which brewing engineering is a part) continues to be a stable and growing area of employment for engineers. It is clear from the previous listing of the major brewing industry challenges that the topic of beer brewing is a rich area of multi-disciplinary design problems. In each of the seven areas discussed, several engineering and science disciplines are required to work together. Brewing can be a fertile area for true multi-disciplinary senior design projects. Engineering a product where taste is a paramount attribute, adds to the challenge. The topics associated with brewing engineering can be translated to many other food products and processing associated with their production.

This article outlines the steps used in beer brewing process and discusses various topics that could be easily integrated into an engineering curriculum.

177 - The New Frontier of Education: The Impact of Smartphone Technology in the Classroom

Jessica L. Buck, Elizabeth McInnis, Casey Randolph

Jackson State University

EXTENDED ABSTRACT

The modern classroom has taken on numerous forms. It expands beyond the traditional brick and mortar walls. The modern classroom can be accessed from homes, work, places of leisure, and more. Technology is integral in providing access beyond four walls Smart phone technology allows the 21st Century student to engage in a learning environment while being mobile. Educational applications (i.e. apps) assist students in accessing interfaces to virtual classrooms, researching specific subject matter, studying flash card notes, and much more. This method of learning appeals to the various learning styles of students, and it allows students to have autonomy and ownership in their learning process. Smartphone technology and applications also encourages educators to develop more creative pedagogy to reinforce subject matter content, and serve as a useful instructional aide. This paper will examine how smart phones are used for both secondary and post-secondary students, and how smart phones positively impact pedagogy and student comprehension.

*178 - The Role of a Freshmen Programming Course for Engineers on Student Success

Priya T. Goeser, Wayne M. Johnson and Delana A. Nivens

Associate Professor, Engineering Studies Program, Armstrong Atlantic State University / Associate Professor, Engineering Studies Program, Armstrong Atlantic State University / Assistant Dean and Professor of Chemistry, College of Science and Technology, Armstrong Atlantic State University

EXTENDED ABSTRACT

Computing for Engineers (ENGR1371) is a 3-credit hour course taken by engineering majors and as a computing course requirement by mathematics and applied physics majors at Armstrong Atlantic State University. The main objective of the course is to introduce students to the foundations of computing with an emphasis on the design and analysis of algorithms and the design and coding of programs for solving engineering problems. ENGR1371 is taught using MATLAB since it is a well suited programming language for engineers. This course is the first exposure to programming for most students. Hence, it is viewed as a collection of abstract concepts, rules and methods that are difficult to understand and apply to engineering problems. This contributes to the challenge of maintaining a high level of interest, understanding and information retention among the students. It is proposed that this challenge can be addressed through the use of MatLab Marina: a Virtual Learning Environment dedicated to the improvement of student learning of programming concepts using MATLAB.

This work presents an investigative study and analysis of a control group of students constructed by propensity scoring approximately 300 students from ENGR1371 (current and previous semesters). Scores are generated based on Math SAT, race, gender, and other factors to allow tracking of student progress and successes in ENGR1371 and subsequent courses with the objective to understand the following pertinent questions:

- What role do courses such as ENGR1371 play in influencing and preparing freshmen engineering students to continue in the engineering program?
- Is there a statistically significant difference in student performances in ENGR1371 for any particular grouping of students?
- What impact do supplements such as MatLab Marina have on student learning, performance and student success?

Further details including assessment results and recent developments in MatLab Marina will also be presented.

131 - Sustainable Development: Understanding How Things Break

Robert R. McCullough, Beth A. Todd, J. Brian Jordon
University of Alabama–Department of Mechanical Engineering

EXTENDED ABSTRACT

As our nation's economy and the overall global market continue to expand and develop, an understanding of the ability of our planet's natural resources to support our needs is imperative for students preparing to enter the workforce. Sustainability is essential to this understanding as it focuses on an understanding of the boundaries and limitations of those natural resources. For an engineer, it is vital to be able to effectively describe the performance and behavior of materials to better understand their potential applications, a process referred to as characterization. Understanding characterization allows for the optimization and minimization of the quantity of material used, selection of suitable materials for a given application, and determination of the life span of a design.

As structured, this module should be performed in two 50 minute sessions. The first section will contain a talk going over the introduction and background of the course material, including the definition of sustainability, and how a sustainable development mindset is integral to society as a whole. To enable enhanced student interaction, a in-class activity has been developed that allows for the class to be divided into groups of 2-3 and given the assignment of designing and building a set of laminate cantilever beams to test under bending loads.

The focus of these teams will be to observe the improvements that can be made in material performance based off of integrating multiple types of materials into a variety of laminar orientations to form various composite structures. Key to the construction of each team's beam (s) is optimizing the design based on quantity of materials and individual material performance The conclusion of the module will be the testing of the completed beams and the creation of short written summaries of the results. These summaries should contain a discussion on the testing results and an analysis of the correlation between each team's performance estimates and the experimental results.

The end goal of this module is for the students to develop a better understanding of the importance of sustainability in improving design, manufacture and implementation of systems through such practices as material optimization. The student should also have an idea of the importance of balancing composition of components within a design to get the most effective output performance and resource consumption. As conceived, this module will be tested in 8th grade science classrooms. The students will be surveyed and class work will be documented and analyzed for lesson and activity effectiveness and clarity..

*137 - The Economics of Electric Microgrids: An Engineering Conceptual Design Approach for Pre-College Students

Otsebele Nare, Ziette Hayes, Michael Reynolds[2], and Shannon Davis

Hampton University / [2]Thomas Nelson Community College

EXTENDED ABSTRACT

Various STEM pre-college programs have been developed throughout the United States as a motivation tool for students to study the respective subjects in college. However, many students leave some of the programs without an understanding of engineering and how engineering differs from other fields of study. In a two-week summer program, ninth-grade students were challenged to design an electric microgrid integrated with renewable resources for a university campus as a case study problem designed to introduce them to engineering. This paper reports on an approach that uses the microgrid case study to introduce students to engineering by teaching different aspects of the microgrid such as energy cost, energy capacity, renewable energy, etc. As a result, the student's case study designs were based on the knowledge that they obtained from various project activities in the program such as: the home energy simulation, the solar and wind energy prototyping, and ElectroCity® simulation. For example, the students started exploring engineering concepts of design and testing system operations using simulation tools. The home energy simulator software was used to introduce the concept of energy cost and effectiveness of using renewable energy. The students were able to simulate usage of various appliances and lights in a residential unit throughout a 24 hour time span with and without the use of solar panels. After a simulation was run on the home, with and without the solar panels, the students were able to compare their total energy generated, the average amount of energy used, and the energy cost savings. This work showed how the economics of energy was used as the focus to introduce students to how engineers solve problems and make decisions based on design constraints. The approach was applied by the students in designing their case study project.

In this session, we'll report on the initial implementation of this new curriculum and share details of the design courses. We'll report on successes and challenges to date and share our vision for advancing this unique curriculum past the start-up phase.

141 - Science Technology Engineering Program (STEP) Summer Camp for K-12 Students

Atin Sinha and Wanjun Hu

Albany State University

EXTENDED ABSTRACT

The Albany State University located in rural south Georgia started a summer camp in 2008 for K-12 students to attract them in computer programming at an early age as an effort to combat falling enrollment in that disciplines across the country. The weeklong summer program introduced students to the basics of computer programming through the Mindstorms Nxt programmable robots, various computer games and animation software such as Alice and Scratch. Each of the activities was covered in about a day to day and half. The equipment for the first camp was acquired from the seed money received from NSF as part of a grant to Georgia Institute of Technology.

In the following years, the camp activity was expanded to include programming in CNC machine, wind tunnel demonstration and part design in commercial CAD software including 3D printing to expose students to engineering subjects also. Though in the first year the camp participants were chosen from both high and middle schools, in the following years, enrollment was restricted to the middle school students only, as they were thought to be more receptive of new ideas. Pre and post survey questionnaire completed by the students during the initial years showed increased level of interest and confidence in computer programming, specifically in programming robots.

Demographically, most participants in the first few years were white; however, the camp held in past summer was attended overwhelmingly by African-American students. Though this time the camp did not make any dramatic change of mind for most of the participants regarding career choice, but pre and post assessment showed a significant increase in percentage of students who wanted to be scientists or engineers as a result of attending the camp.

The summer camps were funded primarily by a continuing grant from NASA's STEM engagement, Office of Education, though during the initial years the camp participants were charged a nominal fee.

*169 - Structures and Natural Disasters

Andrew T. Brammer, Beth Todd, J. Brian Jordan
University of Alabama, Department of Mechanical Engineering

EXTENDED ABSTRACT

Topics in the 4th-6th grade curriculum look at the effects of natural disasters as they study the dynamic earth. This module covers disasters and the effects that they have on the buildings around us. Topics including force are introduced, and the hands-on activity gives students the opportunity to practice creative thinking. The main activity in this module involves challenging groups of students to build a simple structure out of 200 index cards and 1 roll of tape with no instruction beforehand to influence potential designs. Then working with the class to determine what strengths and weaknesses are present in the various designs and why those are strengths and weaknesses under situations that occur in natural disasters. This will lead to a low level introduction to ideas such as tension, compression, torsion, and buckling. In a subsequent class the students will be challenged to build a new structure as a class that can outperform all of the various designs that were originally created.

170 - The Conversion of Energy to Heat

Joseph L. Waters and Beth A. Todd
University of Alabama–Departments of Electrical and Mechanical Engineering

EXTENDED ABSTRACT

Based on the current consumption of energy and the ever growing population, the world is bound to eventually run out of resources. One major reason is the high rate of consumption and decreasing rate of natural resources. Learning to use renewable resources such as solar power is one way to counteract this. Solar ovens are one of many devices that can be used to capture the sun's energy to heat foods. An activity was developed to stimulate high school chemistry students on the topics of energy, material science and solar power. During this lesson plan, the students will learn the properties behind temperature, the law of conservation of energy and the transfer of energy into food. The students will build a solar oven to test the amount of heat absorbed in different food substances in order to cook them. This paper provides a detailed description of multiple lessons used to successfully build a solar oven and how to use it in practical chemistry applications such as calculating the heat absorbed.

159 - Ten Years Experience with a Multi-University Collaborative Graduate Education Program

Colin P. Britcher and Bernard M. Grossman

Old Dominion University / Virginia Tech

EXTENDED ABSTRACT

The National Institute of Aerospace (NIA) was founded as a non-profit research and educational institution located in close proximity to NASA Langley Research Center (LaRC). NIA's academic member institutions are Georgia Tech, Hampton University, North Carolina A&T, North Carolina State, the University of Maryland, Virginia Tech, the University of Virginia, Old Dominion University and the College of William & Mary, supplemented by the AIAA Foundation. A core component of NIA's mission from the outset has been a relatively unique collaborative graduate education program, wherein a graduate student from one of the member institutions can take up to 50% of their coursework from other member institutions, while pursuing research alongside NASA engineers and scientists. Faculty advisors may be in residence at NIA (as distinguished Langley Professors, regular, or adjunct faculty), or at the student's home campus. The cross-registration model avoids the complexities of multiple institutional registrations by the use of "ghost" courses at the student's home campus. In nearly ten years of program operation, 119 students have successfully completed their programs, about two-thirds at the Masters level and one-third PhD. Many graduates have gained employment at NASA LaRC or its support contractors. The paper presents background, objectives, statistics on the program and addresses successes, failures, and lessons learned..

142 - The Use of a Fundamentals of Engineering Course to Enhance the Capstone Experience

David W. Johnstone, Charles D. Newhouse

Virginia Military Institute

EXTENDED ABSTRACT

All civil engineering students at the Virginia Military Institute (VMI) are required to take the Fundamentals of Engineering (FE) exam and pass a capstone design course prior to graduation. The FE exam tests the students' ability to retain the fundamental knowledge obtained throughout their bachelor's degree; whereas the capstone design course utilizes problem-based learning to combine the knowledge and skills acquired to solve engineering problems. In the past, the capstone design course was offered during the spring semester of the students' senior year and acted as a primary assessment of progress and knowledge. The shortcoming to this approach, however, was that less emphasis was placed on passing the FE exam which is the first step in becoming a professional engineer. In an attempt to combat this deficiency, a senior-level course covering the fundamentals of engineering was offered in the fall of the senior year as an additional component to the capstone design course. The success of this course has been overwhelming as VMI pass rates on the FE exam for first-time test takers increased significantly since the introduction of this course. Similarly, enrollment and enthusiasm has escalated with over 90% of current seniors electing to enroll in this course. These numbers indicate the need and desire for implementation of an FE review course in the curriculum. More importantly, the class has further enhanced the capstone experience. By offering a course in the fundamentals of engineering, the students gain valuable knowledge of subject matter not extensively covered throughout the curriculum and have the opportunity to clarify additional subject matter in question. In doing so, the students may then be accurately assessed on both the fundamentals and design of engineering practice.

136 - The Future of Course Work: Customizing Community College Curricula to Meet Industrial Needs

Amber C. Thompson, William L. McDaniel, Jo James, Chester Peeler, Steve Hollifield

Isothermal Community College/ Western Carolina University

EXTENDED ABSTRACT

Modern industry is requesting more from potential employees by way of third party skill-related credentials. Community colleges are now learning to supplement their courses with these outside credentials. Program instructors in applied sciences and technologies are faced with an additional teaching load above the required state course descriptions and expected learning outcomes.

A case study is presented on how a small rural community college in the foothills of western NC has strived to meet new local industry needs and help its service area overcome the devastation of thousands placed on unemployment in the last decade due to low-skilled job loss. The case study explores examples of actual strategies for implementation, best practices based on learning experience, and ways to approach financial and administrative barriers. This study also includes discussion on future research and practices in customized training and development on a broader level.

Findings show that with proper support channels, community colleges can focus in on training that is feasible and applicable to their region without overtaxing their resources. Employers and granting agencies are favorable to short term training that gets individuals back into the workplace faster. Certificate programs that can be finished in one semester matches this modular approach preferred by employers. The approach also provides a way for students to continue a college education and obtain stackable credentials at the same time.

130 - Impact on Retention From a Change In Undergraduate Computing Curricula

Donna S. Reese, T.J. Jankun-Kelly, Lisa Henderson and Sarah Lee

Mississippi State University

EXTENDED ABSTRACT

Mississippi State University (MSU), like many other institutions across the country, has seen a significant decline in the number of computing majors since the early 2000's when the dot com crash caused many students to shy away from majors involving computing. In addition, the diversity of the students who have remained in the field has decreased, particularly with female students making up a smaller and smaller percentage of majors in these fields. In the 2008-09 year a significant effort was made to re-design the introductory programming sequence in the Computer Science and Engineering Department. This introductory programming sequence is taken by students in computer science, software engineering, computer engineering and electrical engineering.

Implementation

Two major changes that were introduced into the curriculum were a change in the programming language used in the introductory programming sequence and the introduction of a course for first semester students that overviews the computing professions. The language in the introductory sequence was changed from C++ to Python. C++ is introduced in the second course so that students continue to have exposure to this important language. The introductory course introduces the students to teamwork skills, overviews the profession, and exposes them to the broader specializations within computing so that they understand computing professions are more than just programming.

Findings

The failure rates in the introductory programming classes have dropped significantly (from ~45% to ~25%) in the time the new courses have been in place. In addition, the first to second year retention within the major has climbed from ~62% to ~74%. We will continue to evaluate these courses and their impact on student success in the follow-on courses in our curricula.

183- Logistical Impact of Intermodal Facilities

Tulio Sulbaran, and MD Sarder
The University of Southern Mississippi

EXTENDED ABSTRACT

In today's growing global economy, intermodal facilities have become increasingly popular as a method of increasing efficiency and decreasing costs across the entire spectrum of supply chain operations. In order for a facility to be considered intermodal it must be accessible by more than one mode of transportation such as truck, rail, ship, or plane. Five primary functions are performed in intermodal facilities: transfer of cargo between modes of transportation, freight assembly in preparation of transfer, freight storage, logistical control and distribution of product flows (Slack 1990). These activities are centralized in order to concentrate critical operations in one location thereby providing opportunities for economies of scale. The increased focus on efficiency and cost reduction is a product of current shipping trends. According to the US Department of Transportation Statistics, the typical freight shipment "traveled nearly 40 percent farther in 2002 than in 1993 (Bureau of Transportation Statistics, 2004, p 4)." Increased distance traveled for freight implies that the cost associated with shipping has also increased. Intermodal facilities provide a number of advantages to companies. Thus, this paper presents the state-of-the-art on the logistical impact of intermodal facilities. This is important because strategically placed intermodal facilities within a supply chain provide flexibility to decision makers. These facilities allow operators to select the most efficient method of shipment for each freight container. Increased efficiency implies that less time is wasted on non-value adding activities.

134 - Confessions of a Novice Class Room Technology (CRT) User - Through the Eyes of a New Faculty Member

Alfred Kalyanapu

Department of Civil & Environmental Engineering– Tennessee Tech University

EXTENDED ABSTRACT

Advances in computers and technology has made it imperative for a need for engineering faculty to embrace classroom technology or instructional technology (IT) for the classroom. Specifically for beginning faculty, the knowledge about the frontiers of research in CRT and IT is crucial for gaining understanding on balancing traditional instructional methods with advances in information and technology. This is a self-study of my learning and assessment of using classroom technology (CRT) as a beginning faculty in the Civil and Environmental Engineering Department at Tennessee Technological University (TTU). The idea of this self-study exercise originated after I was introduced to CRT at TTU including WACOM® interactive display, Camtasia Relay® and an online learning resource called iLearn. As a part of this exercise, I assess my experience on using the CRT, following the conclusion of each class period for the courses I taught in fall 2012 semester. As the semester progressed, an informal student assessment was conducted to assess the benefits of CRT on improving student learning and briefly discussed here. The paper aims to highlight advantages and any limitations of implementing CRT, from a new or early career faculty's perspective and intend to provide recommendations to future faculty in adapting to newer teaching tools.

To test the effectiveness of CRT implementation in my Fall 2012 courses, students were requested to fill out a mid-term assessment survey of the effectiveness of the CRT for my two courses. From this preliminary qualitative assessment, it is observed that integrating CRT for both undergraduate and graduate level courses is found to be useful for the students in their review of classes for working on homework assignments and preparing for mid-term exams. The future of this work is to continue to monitor the effectiveness of these three CRT in my undergraduate and graduate classes and gather more student feedback on these CRT. A higher number of student participation will improve the assessment of CRT and also will improve any quantitative assessment of student learning and performance that can be done through questionnaire and quizzes.

106 - The Impact of Non-Traditional Laboratory Report Formats on Student Performance of Course Objectives

T. Kunberger

Florida Gulf Coast University

EXTENDED ABSTRACT

Numerous engineering courses include a laboratory component to augment comprehension of a given topic, with a lab report serving as a typical measure of student learning for these activities. Often times these laboratory reports are standardized across a course, or possibly even across a series of courses or curriculum and provide students with an established format and clear set of expected deliverables. The reports can ultimately serve as assessment of not only knowledge gained, but also the ability to communicate; albeit more often than not on a group basis. This paper investigates the theory that a complete lab report may not be necessary to achieve the desired course outcomes, but rather a series of non-traditional laboratory report formats may serve the same purpose, while keeping students engaged and appealing to a wider range of learning styles. The approach was undertaken in a Junior level Geotechnical Engineering I class, which includes approximately ten different laboratories over the course of the semester. These lab activities are standardized not only from semester to semester, but also compared to established testing methods, such as ASTM, typical of a traditional lab experience. Lab reports range from a complete standard report or select sections (such as an abstract and appendices only) of a standard report to less established methods of submission such as a poster presentation (on a standard 8.5" x 11" sheet of paper) or a pecha kucha, which is a PowerPoint presentation limited to 20 slides with each slide being shown for only 20 seconds. Results over three semesters show student performance on course objectives are independent of the type of report submission, suggesting that extended reports are not necessary for topic comprehension. Details on the various report formats, student performance on associated assessment measures, and instructor perspective on benefits and limitations associated with non-traditional report formats will be presented.

192 - Using the Toolbox Approach with Mathcad Prime 2.0 in a Computer Applications Course

Kenneth P. Brannan, Kaitlin H. Marley, John A. Murden

The Citadel

EXTENDED ABSTRACT

In the mid-1990s, the Department of Civil and Environmental Engineering selected Mathcad as its programming language for a computer applications class. Mathcad offers a comparable programming capability to previously used languages with additional advantages. These advantages include the ability to produce well-documented solutions, perform routine calculations, generate quality graphs with ease, and incorporate units as part of a computation. Since Mathcad's introduction, instructors have worked to improve the learning environment to increase student enthusiasm and enhance understanding by team teaching, active learning, frequent tests and assignments, flowcharting, pseudocode, debugging features, and clickers. Recently, Mathcad released a new software version, Mathcad Prime 2.0. This version offers many new features that greatly simplify learning in the Mathcad environment. The instructors of the course chose to take advantage of the new version, and at the same time, worked to advance the overall course again. After extensive discussion with students, the instructors identified that students often struggled to distinguish between content that should be memorized and content that should be adapted to various situations. To address this difficulty, the instructors chose to introduce the idea of a TOOLBOX. This TOOLBOX served as a representation of exactly what must be memorized in order to be successful in the course. Additionally, the active learning component of the course was strengthened to build interest in mastering course goals. Finally, a lifetime learning module was added to promote continued learning beyond the engineering classroom. This paper discusses the integration of Mathcad Prime 2.0, the TOOLBOX, the other changes in the course, and the positive outcomes that resulted. The substantial restructuring of the computer applications course appeared to improve attitudes toward Mathcad and improve motivation to solve problems in Mathcad. This observation is based on a comparison of surveys completed by students who took the restructured class in the fall of 2012 and by students who had taken the original course earlier. Survey responses of students who took the restructured course averaged 2.69 (mostly positive, based on Negative = 1, Neutral = 2, and Positive = 3) and responses of students who took the original course averaged 1.69 (slightly negative) on their attitudes towards solving problems in Mathcad. On the question, "How motivated did you feel in the course to solve problems using Mathcad?" those taking the restructured course averaged 4.06 out of 5 (with 5 representing very motivated) and those taking the original course averaged 2.14 out of 5. This paper discusses the details associated with restructuring the course and presents in more detail the results of the survey.

*195 - Introducing Statistical Analysis in Experimental Data Collection in an Undergraduate Fluid Mechanics Laboratory

Bruce Carroll, John Abbitt

Department of Mechanical & Aerospace Engineering, University of Florida

EXTENDED ABSTRACT

As a result of an internal ABET outcome assessment, it was decided that statistical analysis of experimental data required additional coverage in our undergraduate curriculum. We determined that the most appropriate place to do this was in the first lab of our senior level Fluid Mechanics laboratory course. We re-designed our existing Pipe Loss lab apparatus, and instrumented it with four pressure transducers and corresponding analog gages, three electronic flow meters of various flow ranges along with an analog gage, and a thermocouple. The data acquisition system was designed to allow the students to select sampling rates, sample size, and acquisition time. During the experimental planning stages, students are tasked with establishing a data collection plan that will provide results within prescribed uncertainty error bounds. This requires students to estimate errors in individual measurements and to consider error propagation to the final computed result. By adjusting sample sizes, students can utilize signal averaging strategies to reduce uncertainty. Establishing cost factors for various measurement approaches (both analog and digital transducers) students are asked to arrive at an efficient solution to meet the defined experimental goals.

138 - Reynolds Transport Theorem Applied to Classical Thermodynamics

David Calamas, Alan Hewitt, John Baker and Beth Todd

Department of Mechanical Engineering–The University of Alabama

EXTENDED ABSTRACT

The Reynolds Transport Theorem is often used in undergraduate fluid mechanics courses to transform governing equations from a Lagrangian to an Eulerian coordinate system. As such, it is a useful tool for developing control-volume based expressions for the momentum and conservation of mass equations. Traditional undergraduate thermodynamic texts present the laws of thermodynamics for open systems in a manner that does not directly link them to the original expressions for a closed system. Three recent undergraduate level thermodynamics texts as well as three fluid mechanics texts have been reviewed to form an opinion on the traditional approach to closed and open systems. This paper is intended to further student appreciation of the direct connection between the statements of the First and Second Law of Thermodynamics for closed systems and the corresponding statements for open systems. The Reynolds Transport Theorem will thus be utilized to develop expressions for the First and Second Laws of Thermodynamics for open systems. The goal of the paper is to present an alternative approach to teaching thermodynamics that is more closely aligned to instructional methods in fluid mechanics courses. By reconciling the two approaches, it is hypothesized that students will gain a better understanding of the laws of thermodynamics and the subtle differences between open and closed systems. It is believed the use of the Reynolds Transport Theorem as applied to the First and Second Law of Thermodynamics in undergraduate thermodynamics curriculum would help to unify the use of Reynolds Transport Theorem as applied to the continuity and momentum equations in undergraduate fluid mechanics curriculum.

*114 - Determination of Building Envelope and Duct System Integrity through the Quantification of Air Flow Leakage Rates

Justin Hayes and Robert Choate

Western Kentucky University–Mechanical Engineering Program

EXTENDED ABSTRACT

To encourage and increase undergraduate student research, Western Kentucky University began an internal grant program called Faculty - Undergraduate Student Engagement (FUSE) Grants in academic year 2012-2013. These grants are designed to support undergraduate students' intellectual development by fostering active engagement in the areas of research, creative and scholarly activities, and/or artistic performances. The student researcher/first author was funded through this initiative.

The focus of this research was on developing power law relationships between differential pressure and leakage rates based on aperture geometry with the intent of applying the study to better model leakage in building envelopes and conditioned air distribution systems and in an attempt to better quantify and understand energy loss associated with leakage phenomena. Air leakage, through apertures or cracks in building envelopes and ducts, is of growing concern to the HVAC industry as energy resources continue to become more expensive. These inadequacies, in building envelope construction and maintenance, can have devastating impacts on the overall efficiency of an HVAC system and overall residential and commercial energy consumption.

This effort creates relationships between: differential pressure, series of geometrically diverse openings, and overall air leakage flow rate. These geometrically diverse openings are used to model various flaws that may be introduced into the building envelope during construction or due to various aging factors. Functional representations between differential pressure and leakage rate through individual openings were created to help understand the relationship between the crack geometry and its leakage characteristics. These power law relationships can then be used to model more complex building and duct systems, and to predict either flow rate based on known crack characteristics, or to predict crack characteristics based on a measureable flow rate at a given differential pressure.

This presentation will include the design decisions and challenges, as well as the benefit of allowing a student to collaborate with faculty to design, build, and test a system. This presentation will also detail faculty - student observations and project outcomes.

151 - Simple Demonstrations in Basic Mechanics Courses

Richard Kunz

Mercer University

EXTENDED ABSTRACT

At Mercer University, as at many engineering schools, the basic mechanics courses of Statics, Dynamics, and Mechanics of Materials are taught in a traditional lecture format with no laboratory component. Students are typically exposed to abstract concepts such as forces, moments, rigid body kinematics, stress, kinematics of deformation, strain, and stress-strain transformations through sketches, mathematical derivations, and equations. They often struggle with connecting the mathematical representation of these concepts with the physical world and with their own intuition.

Instructors in these courses have long recognized the difficulties that our students face and have sought to augment traditional chalkboard lectures with supplementary material to give physical meaning to abstract concepts. Computer animations have come to be a popular approach, but today's students are accustomed to sophisticated computer graphics; unless really well-done, animations can seem cartoonish and lacking in reality. To many students, understanding of physical concepts is most effectively achieved through physical artifacts.

In devising in-class demonstrations, the instructor is constrained by time, space, cost, and simplicity. The author's classroom experience has indicated that students tend to respond best to simple physical demonstrations that illustrate concepts that are difficult to grasp otherwise. A broad survey of demonstrations developed and used by the author and colleagues are discussed. A few detailed examples are presented that deal with rigid body kinematics, kinematics of deformation, and transformation of strain. All can be (and have been) made from commonly available materials requiring minimal cost and skill. The presentation is made in the spirit of sharing with the larger educational community what seems to work.

CHAPTER 3
TECHNICAL SESSION 2
EXTENDED ABSTRACTS

Monday, March 11, 2013

Technical Session 2 2:15 pm – 3:35 pm

2:15 pm–3:35 pm	T2-A Prescott 208	T2-B Prescott 222	T2-C Prescott 225	T2-D Prescott 304	T2-E Prescott 325
Technical Session 2	Instructional Division II	K-12 Division II	Administrative Division II	Engineering Technology Division	Mechanical Engineering Division II
Moderator	*Monika Bubacz*	*Sally Pardue*	*Atin K. Sinha*	*Jerry Newman*	*Don Van*

T2–A: Instructional Division II **PRESCOTT HALL 208**

115 - Improving Student Interest in Engineering Curricula – Exciting Students about their Classes 3-29
Adeel Khalid

117 - Teaching Adult Engineering Learners – Ease and Challenges 3-30
Adeel Khalid and Beth Stutzmann

*200 - Transforming Undergraduate Laboratories for Sustainable Engineering – Expanding the use of case studies and project based learning in laboratory courses 3-31
Stephanie Luster-Teasley and Cindy Waters

152 - The Final Exam – To Have or Have Not 3-32
Hodge Jenkins and Scott Schultz

T2–B: K-12 II **PRESCOTT HALL 222**

*162 - Using Engineering, Science and Literacy to Improve Math Understanding 3-33
Cecelia M. Wigal, Kay Cowan, Louis Elliott, Betsy Darken

202 - Teaching Physical Properties of Water using Hydraulics 3-34
Tabatha Dye, Beth Todd, and Pauline Johnson

203 - Using College Student Competitions to Recruit Middle-School Students to Engineering: The Visual Display Competition at the ASCE 2011 Southeast Student Conference 3-35
Steven M. Click

*225 - Overview of Next Generation Science Standards for K-12: What impact on K-12 Engineering Outreach? 3-36
Sally Pardue

T2–C: Administrative Division II **PRESCOTT HALL 225**

160 - Novel First Year Engineering Summer Session 3-37
Gail D. Jefferson, Sally Steadman, Tom G. Thomas, Kuang-Ting Hsiao

161 - Transfer Student Retention 3-38
Gail D. Jefferson, F. Carroll Dougherty, Sally Steadman, Tom G. Thomas

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

116 - Advising Engineering Students – Demands and Challenges 3-39
Adeel Khalid, Jessica Williamson

*166 - Math Requirements and Expectations for Lower Division Engineering 3-40
Christopher D. Wilson

T2–D: Computer Engineering and Technology Division **PRESCOTT HALL 304**

174 - Newsvendor Problem Simulation of Operations 3-41
Hassan Alfadhli and Leticia H. Anaya

199 - Engaging Students in Electromagnetics Through Hands-On Skills and Computer Simulation 3-42
Zhaoxian Zhou

102 - Implementing the Design-Build-Instrument-Test Approach for Curriculum Integration in Engineering Technology 3-43
Paul M. Yanik and Aaron K. Ball

179 - Building a Community of Successful Technology Scholars 3-44
Laura E. LeMire

T2–E: Mechanical Engineering Division II **PRESCOTT HALL 325**

111 - Residential emergency solar power in western North Carolina 3-45
George Ford and Sung Joon Suk

120 - Using Animations to Enhance Understanding of Energy System Concepts 3-46
B. K. Hodge and Govinda Mahajan

103 - Biovolatilization, a Different way to Gasify Biomass 3-47
David Domermuth

171 - Process Analyzing of the Vortex Tube and The Teaching and Learning of Energy Efficiency and Sustainability 3-48
Don Van, Joel Ingram, Kenneth Mayo and Kian Jost

115 - Improving Student Interest in Engineering Curricula – Exciting Students about their Classes

Adeel Khalid

Assistant Professor, Systems and Mechanical Engineering Department,
Southern Polytechnic State University

EXTENDED ABSTRACT

In this paper, we explore what events, activities, and teaching styles invoke student interest in engineering courses. The research is based on inputs from some of the best and award winning faculty members across disciplines. The activities that professors use to keep students engaged are highlighted. Similarly, the actions that professors take to turn students away are discussed. As engineering educators, it is not hard to observe that often time's students take a lot more interest in certain engineering courses than others. There are courses that students wait to enroll in, the classes fill up quickly and there is often a waiting list. Most of the class sessions are well attended. Students often stay back after the classes and pursue the professor to proactively learn the material. Student performance in these classes is often reflected in their grades. On the other hand, there are classes in which students enroll only because those classes are required for the degree they are pursuing. Those classes usually do not fill up, students often skip sessions, and the poor performance is reflected in the grades. In this study, the author explores what makes some classes so appealing while the others are often perceived as dull and tedious. The research is based on feedback received from some of the best professors in various disciplines. It is observed that professors who go an extra mile can make just about any class interesting. An engineering class can be made interesting and enjoyable by engaging students in activities beyond those required in a typical class. These engaging activities include but are not limited to inviting guest speakers, taking students on field trips, showing related documentaries, involving students in laboratory work, involving students in research projects, having students develop laboratory apparatus and involving them in writing grants and research papers. By using these and other activities, professors not only earn respect in the eyes of the students but also make the discipline of engineering a worthwhile field of study.

117 - Teaching Adult Engineering Learners – Ease and Challenges

Adeel Khalid[1], Beth Stutzmann[2]

[1]*Assistant Professor, Systems and Mechanical Engineering Department, Southern Polytechnic State University*

[2]*Instructor, Southern Polytechnic State University*

EXTENDED ABSTRACT

In this paper, the faculty and student perspectives of the challenges faced by adult students are highlighted. Data is collected through various interviews. It is observed that adult students may experience certain challenges e.g. being out of touch with technology and feeling isolated from other students in class. Despite these challenges, adult students bring experiential knowledge into the classroom, which can add tremendous value to the educational experience for all students, if the faculty members are open to leveraging that knowledge. The overall objective of this study is to make faculty members aware of the needs of adult students, acknowledge and appreciate the students' presence and their contributions in the classroom.

Adult learners are referred to as non-traditional students who are returning to school to earn their education at an older age. These students are typically not in the 18-21 year age group and have work and life experiences. Due to lack of experience with technology, non-traditional students may feel intimidated when returning to college. They are usually in the minority when surrounded by younger students. In some cases, they may also have a professor that is younger in age. This creates an awkward position for the non-traditional student (and the professor). These adult students may bring to class much knowledge about the subject matter or they may have forgotten the pre-requisite material. Having worked in their field, they may have a difficult time relating classroom theory to the practical applications. In this paper, the authors explore challenges faced by the adult students; highlight what faculty can do to accommodate their adult students; and review, through a series of interviews, how faculty members make their adult students comfortable in their classes.

*200 - Transforming Undergraduate Laboratories for Sustainable Engineering – Expanding the Use of Case Studies and Project Based Learning in Laboratory Courses

Stephanie Luster-Teasley and Cindy Waters

College of Engineering–North Carolina A&T State University

EXTENDED ABSTRACT

This educational research seeks to develop novel laboratory modules by using *Case Studies* to introduce sustainability and environmental engineering concepts to 21st century learners. The increased interest in "going green" has led to a surge in the number of engineering students studying sustainable engineering concepts in their courses. This educational research project has worked to improve critical thinking and transfer of lab concepts to tangible real world applications for students. A total of four case study lab modules have been developed for a junior level, Environmental Engineering Laboratory course. The case modules focus on providing (1) the contextual case-study or problem based learning modules that link engineering topics to real world sustainable engineering issues and (2) hands-on experiences for students that are designed to address new areas in sustainable engineering. This educational study consisted of assessing student learning using the Index of Learning Styles (ILSS) and using case studies as a method to target these differing learning styles. Pre- and Post-assessments indicate students demonstrate increased understanding, interest, and comprehension of lab topics.

Results

Feedback from the student interviews suggested they felt the case studies and problem-based methods used in the course were more engaging compared to their traditional laboratory classes they had taken during their education. The students particularly enjoyed the real world approaches and seeing how they could expect to apply course lab skills to their real jobs after graduation. They felt some aspects of the labs were similar to the traditional lab format, yet the problem based learning and real-life scenarios added a new spin on the topics that made them more interesting. From a faculty perspective, the PBL and case study method required more initial faculty preparation time for the projects and the case studies selected for the lab. Implementation in the course required a very organized approach to guiding the students and maintaining a schedule to accomplish course objectives. The amount of interest the students demonstrated in their designs was exciting to observe because the students were engaged and actively participated in the discussions for their projects. Due to the amount of time the case study/PBL method needed, it was difficult to implement all four modules during the semester therefore the course schedule was vital. We are interested in identifying other faculty interested in the case studies in Sustainability as a method to test the modules and to improve the modules for laboratory courses to use this method.

152 - The Final Exam – To Have or Have Not

Hodge Jenkins and Scott Schultz

Mercer University

EXTENDED ABSTRACT

The time honored tradition of final examinations has long been a standard assessment tool to evaluate student performance, and to provide a means for students to potentially improve their grades. Students must demonstrate knowledge, critical thinking, and competence through these examinations. While most courses have several components for assessing student proficiency of knowledge and understanding, the cumulative final is typically regarded as the best measure of retained knowledge in a subject area. However, knowledge retention and future application by students is unknown, but truly the desired result of learning.

In many engineering courses student work and assessment includes homework, quizzes, projects, 1-hour exams, papers, class room participation, in addition to a final exam. Of these the final is usually weighted the heaviest. While it has been long recognized that students have different learning styles, little attention has been focused on how best to assess the imparted and retainable knowledge and learned abilities of students. Examinations are intended to do just that. However, does the student who crams for the final exam have more knowledge and ability, months after the course than the student who studied all semester and missed the mark on the final? Is other coursework (homework, projects) by students a better tool for assessing a higher level of learning the application of course knowledge? Or, does having several short exams throughout the semester better predict student performance?

This paper reviews two common engineering subject areas and investigates different means of assessing student learning and the effect of final exams on student grades. Results indicate that the final exam scores correlate well with the other course assessment tools. Thus, assessment components based on activities for which students spend large amounts of their time may yield the same results without the necessity of a final exam. (Students may not remember what was on their final exams within a short time period of the final examination; however, they more likely will always remember projects and papers they created.) While not the goal of this study, it is conceivable that project work alone may be a better means of assessment, however, the final exam has and remains the easiest means to review and score.

In conclusion, student grades analyzed from two different engineering subject areas (Statics, Engineering Economy) over a ten-year period show a similar effect, the final exam does little to change the majority of student grades.

*162 - Using Engineering, Science and Literacy to Improve Math Understanding

Cecelia M. Wigal, Kay Cowan, Louis Elliott, Betsy Darken

The University of Tennessee at Chattanooga

EXTENDED ABSTRACT

Over the last year individuals (engineers, physicists, and staff) in the College of Engineering and Computer Science at the University of Tennessee at Chattanooga (UTC) teamed with UTC math and education professors to work with middle school math and science teachers to help them tie math with engineering, science, and literacy to improve student learning of mathematics. The program, titled Technology, Engineering and Literacy + Math Understanding (TELMU) Academy is supported by Tennessee First to the Top funds under an initiative to increase Science, Technology, Engineering, and Math (STEM) applications in Tennessee schools. TELMU's goal was to use (1) projects successful at the middle school and 9th grade levels in introducing students to engineering principles, (2) technology that engages the students and assists the teacher in building and administering activities, and (3) proven pedagogy for strengthening literacy for both the student and teacher in general and with regards to STEM application to improve mathematics understanding and thus mathematics learning.

The Academy kicked off in January 2012 with a one day introductory workshop. The Academy continued in the summer with a two week nonresidential workshop that introduced the participants to student STEM activities that include engineering, science, and literacy components requiring applications of math. The summer workshop was followed by two one day workshops in fall 2012 where the participants reviewed with their peers lessons they used in the classrooms.

This presentation provides a review of the activities of the TELMU Academy and their outcomes to summarize the effectiveness of the program. Specifically discussed are those outcomes that were not anticipated but emerged and those that were envisioned but did not emerge. Of particular discussion is the divide between what the K-12 teachers and the higher education professors see as (1) technology and (2) the role of technology in student learning.

202 - Teaching Physical Properties of Water Using Hydraulics

Tabatha Dye, Beth Todd, and Pauline Johnson

The University of Alabama

EXTENDED ABSTRACT

This paper describes an activity for the second grade that will teach students about liquid properties, force and pressure. The lesson is to teach the students about how water or liquid can be moved or pushed. The objective is for the students to better understand the physical characteristics of water. A discussion of how water guns and pistons work is included as background material. The students will make their own water gun out of plastic cups, drinking straws, and other materials. Then they will discuss how it is different if air, a solid, or another liquid is put in the water gun. The paper will discuss how the topics are covered including pre and post activity lectures and questions, how the water gun is built, and a list of the necessary supplies. The paper includes useful tips to help the teacher be prepared for a full second grade class. Also included is a one-page handout that is useful as reference during the activity. The lesson will be taught to a second grade class and evaluated on the level of knowledge learned and how much the student enjoyed the activity via a question period. Specific topics learned by the students over the course of the lesson are included. The specific Alabama Department of Education Science learning objectives for second grade that are included in this lesson are indicated.

203 - Using College Student Competitions to Recruit Middle-School Students to Engineering: The Visual Display Competition at the ASCE 2011 Southeast Student Conference

Steven M. Click

Tennessee Tech University

EXTENDED ABSTRACT

The process of recruiting students to engineering fields in general – or to any university in particular – now requires advanced contact with students. Gone are the days of college fairs for graduating high school seniors. The best students are making their choices much earlier than their senior year. Perhaps more importantly, if students have not discovered and interest in engineering fields before entering high school, they are unlikely to take the advanced math courses needed to help them succeed in a college engineering program. In a continuing effort to recruit students to engineering fields, many entities including ASEE have started programs, which provide or encourage outreach to middle school students, hoping to spark an interest, which will lead to a future in engineering… and to proper selection of high school courses.

This paper provides information about a recent Visual Display competition at the ASCE 2011 Southeast Student Conference. Teams of civil engineering students were challenged to create a visual display which would teach an engineering design or problem-solving process to middle school students in a career-fair atmosphere. Of the twenty-six schools attending the conference, sixteen entered the visual display competition. During the conference, middle schools from the surrounding area were invited to come and view the displays.

Included in the paper is information regarding the competition rules, judging and scoring, brief descriptions of some of the displays, and anecdotal comments from both college and middle school participants.

*225 - Overview of Next Generation Science Standards for K-12: What impact on K-12 Engineering Outreach?

Sally Pardue

Tennessee Tech University

EXTENDED ABSTRACT

The Next Generation Science Standards (NGSS) are in development and are expected to be released in final form in later Spring 2013. Many states are considering the adoption of the NGSS once the final form of the standards is released. In the coming years, school systems will be working to implement these new standards. Higher education engineering schools and programs should pay careful attention to how their partnered K-12 systems will be accommodating a shift to the new standards. Faculty involved with K-12 engineering outreach programs, whether directed at teachers, students, or both, will need to be highly engaged in understanding what key features of the new standards are and how these features can be leveraged to enhance engineering education.

Preceding the standards, the National Research Council released a publication in 2012 titled "A Framework for K-12 Science Education" which serves as the foundation for the writing of the NGSS. Within the Framework document is a detailed description of three dimensions regarding science education: 1) science and engineering practices, 2) disciplinary core ideas, and 3) cross-cutting concepts. This presentation will offer an overview of the three dimensions and an orientation to the structure of the NGSS so that engineering educators are informed and can seek further information from the resources provided.

160 - Novel First Year Engineering Summer Session

Gail D. Jefferson, Sally Steadman, Tom G. Thomas, Kuang-Ting Hsiao

University of South Alabama

EXTENDED ABSTRACT

Retaining students in engineering programs is a national problem that has been addressed in many, varied ways. The University of South Alabama has implemented a novel program to increase retention in engineering, especially among high achieving students. A pilot program was conducted last summer with extremely successful outcomes. Funding for the program was provided through NSF EPSCoR, so there were no costs to the participants.

Students spent two weeks immersed in interdisciplinary engineering topics ranging from robotics to composite materials. LabVIEW programming was integrated into each topic. The students explored instrumentation, sensors, and control using Lego Robots. They also used LabVIEW to investigate material properties and behavior for metals, polymers, and composites. Each topic was introduced by a series of short lectures followed by hands-on interactive laboratory sessions, culminating in an open ended design project.

An accompanying thread for the program was critical thinking. Following a brief exposure to basic concepts of the affective and cognitive principles and strategies essential to critical teaching, the students took an on-line test to evaluate their critical thinking skills before beginning the workshop activities. The same test was administered as a post test, with an average increase of 10 % in their skills.

The research activities were conducted in a team environment, hence the students had strong teaming experiences and will be able to work more effectively and collaboratively in their coursework. The students also interacted one-on-one with undergraduate and graduate engineering students who shared their enthusiasm for engineering.

Highly motivated, inquisitive incoming freshmen were identified for the program, based on ACT scores, high school GPAs and completed high school coursework (math, chemistry, and physics). Admissions decisions were based on academic achievement and interest (demonstrated through an essay). The program was offered to 60 students (27% of the freshman class) and 12 were accepted for the program. Due to cost constraints and unknown demand, the program did not include a residential component which would suggest that most of the participants would be from the local area. However, half of the students came from distant cities and moved into their rooms on campus or stayed with relatives.

Formal assessment of the program is underway. Preliminary results are extremely positive, with both faculty and students highly satisfied with the program activities. FREE participants were genuinely excited about learning new things – and they were able to quickly pick up concepts. It is obvious that the program ignited interest in engineering for the students.

161 - Transfer Student Retention

Gail D. Jefferson, F. Carroll Dougherty, Sally Steadman, Tom G. Thomas

University of South Alabama

EXTENDED ABSTRACT

Many students are not adequately prepared for the transfer from a two-year college to an engineering curriculum at a four-year institution. A comprehensive program has been developed at the University of South Alabama to address issues associated with the transfer process. This student success initiative, USA-LINK, is an NSF funded program that stimulates enrollment, enhances retention in engineering programs at the university, and increases the technical workforce. Important lessons have been learned during the early stages of the program.

A key component of the program is a seminar that assists in the transition process. The USA-LINK seminar includes student support activities designed to enhance the academic success of transfer students. Academic success skills (such as time management and study skills) are introduced in the seminar. The students explore engineering majors through problem-based applications, gaining essential experience with engineering problem solving. The seminar also focuses on social involvement and interpersonal skills. Students are introduced to careers and research/internship opportunities and to job placement skills so they are well prepared to enter the technical workforce.

An important factor in student retention is the sense of community that a student develops, which is enhanced through the seminar. The USA-LINK program incorporates a community-building model to build a cohort among the participants. Each USA-LINK student is assigned a Peer Mentor and a Faculty Mentor. These triads meet regularly to assist in the student's transition to and involvement in the university.

Preliminary results indicate that the program has been successful in recruiting and retaining transfer students and that the seminar is a key component. A focus group is held with the USA-LINK students at the end of the first semester. Several issues have been identified: advising, faculty approachability, homework and exam frequency, campus resource availability, as well as personal/family problems. Some of these issues can be addressed by better advising. Hence we have identified a specific advisor in each department to deal with all transfer students; these advisors are also better equipped to handle personal/family problems. Other issues can be addressed in the seminar so transfer students are more aware of university procedures and resources. We have recommended that all transfer students be offered the opportunity to take the seminar.

We are also working with area community colleges to address these issues. These schools can provide orientation session(s) for students transferring to 4-year schools. Community college faculty need to be better acquainted with curricula for each engineering degree, so students are better prepared for the transition.

116 - Advising Engineering Students – Demands and Challenges

Adeel Khalid[1], Jessica Williamson[2]

[1]*Assistant Professor, Systems and Mechanical Engineering Department, Southern Polytechnic State University*

[2]*Academic Advisor, School of Engineering, Southern Polytechnic State University*

EXTENDED ABSTRACT

The role of an academic advisor is emphasized in this study. There is only one academic advisor in the School of Engineering at the Southern Polytechnic State University (SPSU). The academic advisor addresses the advising needs of more than 1,200 engineering students. The importance of professional advising and the need for higher advisor-student ratio is highlighted. Both advisor and student perspectives are addressed in this paper.

Many high school students will realize early on that they want to become an engineer of some sort for various reasons. These reasons include but are not limited to; excelling at mathematics, prompting by teachers or parents, expressing a great deal of curiosity, enjoying taking things apart and putting them back together, or a combination of these factors. Even though many students are drawn to the field of engineering, most are not clear when it comes to choosing a specific engineering discipline. Sometimes they may become confused or frustrated with their chosen program of study and end up changing to another discipline. To retain these curious minds, it is important that proper advice is given to them so they not only choose the sub-specialty that is right for them but also stay interested and engaged. After having decided on their major and sub-specialty, students often need further advice on what classes to take within their discipline. Over the years, engineering disciplines have become vast and deep. There are numerous sub-specializations available. It can be expected that these sub-areas of specializations will continue to increase in number, giving students a multitude of choices. The academic advisor's job is crucial in helping students make the important decisions in determining their major. This task is as essential as that of a parent or a professor. Making key decisions such as choosing a major can affect not only the student's future career goals, but also, in some cases, the course of their lives. In this study, we explore some of the common questions that students need help with while seeking academic advisement. We also analyze the central role academic advisors play in helping retain students. Retention is crucial to a University's growth. Academic advisors try to keep students interested and engaged by building a successful rapport with them. This allows students to feel comfortable in an academic setting and they tend to be motivated to follow through and progress to graduation with degrees in engineering. The passion they possess about their field helps to fuel their desire to continue, despite the challenges they face, and these students end up as successful individuals.

166 - Math Requirements and Expectations for Lower Division Engineering

Christopher D. Wilson

Department of Mechanical Engineering–Tennessee Tech University

EXTENDED ABSTRACT

The math requirements for ABET-accredited engineering programs are generally satisfied through two semesters of single-variable calculus, one semester of multivariable calculus, one semester of matrix algebra and one of ordinary differential equations. Many engineering programs also include computer programming, statistics, numerical methods and engineering analysis. These addition courses are often taught outside of the math department. In addition, some students actually will take other math and statistics courses depending on their technical interests.

Many engineering students start their academic careers in pre-calculus if their math placement warrants it. Therefore, these students are often one semester behind schedule from the very beginning of their students. An engineering math course developed at Wright State University has been developed and adapted at several universities and community colleges as an alternative to placement into pre-calculus. For students having already taken pre-calculus in high school, this model has been very successful in promoting retention and persistence.

This presentation reviews the actual math requirements for lower division engineering courses as surveyed by the faculty at Tennessee Tech University. The following courses were considered: engineering graphics, computer programming, calculus-based physics (two semesters), statics, dynamics, a first-course in electric circuits and mechanics of materials. The actual math requirements are then compared to full list of math topics in the required set of courses. For completeness algebra and trigonometry concepts are also included. This comparison is followed with a discussion of the expectations of engineering faculty and of math faculty regarding the subject matter. The presentation continues with a recommendation to modify the so-called Wright State Engineering Math Model to better synchronize the expectations of both engineering and math faculty.

174 - Newsvendor Problem Simulation of Operations

Hassan Alfadhli and Leticia H. Anaya

University of North Texas

EXTENDED ABSTRACT

This paper covers the design project of a Labview simulated modeling of a five station production assembly line with stations rearranged both in a series and in a parallel format. In this assembly line, each station behaves as a characteristic news vendor problem. Under this scenario, production and demand are random variables and associated with these variables, a trade-off exists between excess inventory costs due to overproduction and opportunity costs associated with not meeting the needed demand. In the simulation, production levels for each station are forecasted to meet expected demand and demand is an unpredictable variable that affects the customer service level that the manufacturing operation can provide. Here, service level is defined as the proportion of time that the assembly line can meet the customers' needs. In this research, the opportunity costs and the excess inventory costs are to be investigated as a function of the service level of the final product for both a five station production assembly arranged in a series format and in parallel format. This research will explore the relationships between production, demand, profit and opportunity costs associated with a manufacturing operation to determine the variables that will optimize the service level. In the process of investigating these relationships, statistical process control techniques will be used to analyze and compare the performance of both the in series and the in parallel format assembly lines. The contribution of this research is that the expected conclusions will allow manufacturing operations to cope better with forecast errors and maximize the service level that these operations can provide while minimizing both excess inventory costs and opportunity costs.

199 - Engaging Students in Electromagnetics Through Hands-On Skills and Computer Simulation

Zhaoxian Zhou

School of Computing, University of Southern Mississippi, Hattiesburg, MS

EXTENDED ABSTRACT

Electromagnetics has always been among the most difficult courses in electrical engineering and physics, and consequently, innovative teaching techniques are necessary to change the way teachers teach and students learn. The electronics engineering technology program in the University of Southern Mississippi has been offering an optional applied electromagnetics course as well as imbedding electromagnetics concepts into lower level electronics courses for several years. The students' interest in electromagnetics has increased through new teaching and learning styles. This paper introduces in detail a new practice where students learned electromagnetics through projects. Particularly, in one of the projects, students designed and implemented an electromagnetic can crusher. In addition to hands-on skills, theory and computer simulations were also involved. Students worked in a group to construct an electromagnetic can crusher, while the instructor introduced the theory and computer simulation process.

This paper gives details about the theoretical aspect of the lecture, including derivation of necessary formulas used for computer simulation. A survey was conducted to ascertain the reactions of the students towards this mode of teaching and learning. Results showed that students learned by cooperating and interacting with each other and participated actively in their own learning process. Students also learned to cultivate teamwork, communication, management and interpersonal skills.

102 - Implementing the Design-Build-Instrument-Test Approach for Curriculum Integration in Engineering Technology

Paul M. Yanik and Aaron K. Ball

Western Carolina University

EXTENDED ABSTRACT

Rapid changes in engineering design and instrumentation have caused Engineering Technology programs to look constantly for innovative methods to deliver quality education that provides students with the skills necessary to enter engineering careers. As Engineering Technology programs have historically taken the direction of engineering applications (as opposed to engineering science) in traditional instruction, they have tended to create islands of applications for new technology within the curriculum. Western Carolina University has long sought to provide a more integrated approach, and thus, continuity across targeted subject areas within the engineering technology program. This paper presents background on the importance of curriculum integration as a means of enhancing both learning and retention in an undergraduate program in Engineering Technology. A method is discussed which demonstrates the interdependence between subject areas by providing students with opportunities to apply the design-build-instrument-test approach to the engineering process.

Instructional Approach

This paper presents a project conducted through a pair of undergraduate courses which covers the design, fabrication, instrumentation and testing of a working (pneumatically driven) steam engine. In a junior-level course in Rapid Tooling and Prototyping, students were tasked with generating 3D computer models of a candidate design from published drawings. The course addressed skills needed to produce these models in a planned lecture sequence. The best model was selected as a master for generation of CNC machining programs and subsequent fabrication by student teams. A senior-level class in industrial automation then utilized the fabricated project as a platform for instrumentation, data collection, and analysis of the working design. Using LabVIEW®, students created a virtual instrument which captured, logged and graphically displayed data associated with system pressure and angular crankshaft position of the engine. With this instrument, students were able to perform analysis of the engine and to correlate changing pressure with the valve position caused by the moving crankshaft.

Summary and Conclusions

Using an integrated curriculum focusing on design-build-test-analyze approach to teach engineering applications, knowledge gained in individual courses may be carried forward and applied in a logical sequence to enable a more concrete understanding of concepts. Essential topics are addressed in a cohesive manner that offers tangible and rewarding outcomes. This may facilitate student learning, retention, and improved quality across the Engineering Technology curriculum.

179 - Building a Community of Successful Technology Scholars

Laura E. LeMire

Engineering Coordinator and Associate Professor, Community College of Baltimore County

EXTENDED ABSTRACT

T4: Technology Training for Today and Tomorrow (T4-STEM) is a project that provides educational opportunities to low-income, academically talented, community college students through scholarships and student support services to promote full-time enrollment and degree attainment in STEM technology disciplines - specifically Engineering, Networking, Information and Multimedia Technology. Over the past two years, a community has been formed comprised of the scholars and faculty mentors. A total of 84 *T4-STEM* scholarships have been awarded over 4 semesters to 40 different students (39% women) with at least a 2.8 GPA. Minority groups historically under-represented in STEM fields are well represented among the awardees where 56% were Black/African-American/Multiple Races and 3% were Hispanic/Latino. The scholarship budget increased each year to make funding available for new awardees while funding eligible returning scholars, including those that transferred to four-year institutions.

To increase their likelihood of success, T4-STEM scholars worked with a mentor and attended workshops. These workshops included icebreaker activities and team building exercises that strengthened bonds between the students helping to develop a "technology community." In addition, faculty and other guest speakers gave presentations on careers and job seeking skills, which provided the students with tools for future success in school and career. As the number of awardees grew, the number of professors acting as mentors for the *T4-STEM* scholars increased from 5 to 17. By enlisting additional faculty, mentors were able to spend more time with their students and focus on their situation and needs. Surveys conducted each semester found between 80% and 100% of the scholars: 1) did not consider a *T4-STEM* major until college, 2) said the scholarship was instrumental to their staying in a *T4-STEM* program, 3) affirmed that participation in the workshops influenced them to remain in a *T4-STEM* program, and 4) believed that having a mentor was important to their success. All confirmed they would continue in their *T4-STEM* major.

111 - Residential Emergency Solar Power in Western North Carolina

George Ford and Sung Joon Suk

Western Carolina University

Extended Abstract

This paper provides a discussion of the costs, configurations and capabilities of small solar PV systems to provide lighting and minimal power for other uses during winter storm events in western North Carolina. Costs and benefits are compared to gasoline emergency generator systems. The paper identifies that it is affordable to combine solar photovoltaic panels with an automotive battery, suggesting an alternative to back-up electrical generators.

In western North Carolina, installation of solar photovoltaic (PV) arrays is becoming more popular for private homeowners. State and federal tax rebate programs currently allow North Carolina homeowners to recoup 65% of initial capital costs, and grid connected systems can even provide an income stream for owners. Even with these rebates and income streams, many systems do not have an acceptable rate of return. Finding a suitable site for PV arrays in the Smokey Mountains of western North Carolina is often a challenge for many home owners. Mountain and vegetative shading causes significant reductions in power output potential in PV systems eliminating acceptable financial benefits of a given system. In addition to avoiding electricity costs, non-grid connected solar PV may be used to provide emergency power for lighting. In North Carolina's mountainous, rural regions during the winter months, power outages are common, especially during heavy snows.

120 - Using Animations to Enhance Understanding of Energy System Concepts

B. K. Hodge and Govinda Mahajan

Mississippi State University

EXTENDED ABSTRACT

Traditional engineering education presentations use static pictures/illustrations to visualize/demonstrate various concepts, some of which can be quite involved. In many instances, the sequence of static pictures is interspersed with explanations to deepen understanding of the physical concepts. Since animation software and animation development are becoming less expensive and more common, animations that will reduce lecture time devoted to a topic and enhance student understanding are becoming more affordable. Animations permit salient features of phenomena to be combined in a readily visible fashion for understanding. This paper will explore the effectiveness of an animation example taken from an energy systems design course and examine in detail the water hammer animation since it is a good example that illustrates many facets of water hammer. All of the salient features of water hammer can be shown on a static illustration/diagram, but the animation in more effective in demonstrating the scope of the water hammer phenomena. Cognitive issues for enhancing animation effectiveness are examined. Student survey results and instructor anecdotal experiences comparing the effectiveness of the animations as compared to traditional static coverage are discussed. Student survey results confirm that the water hammer animation was successful in enhancing understanding.

103 - Biovolatilization, a Different way to Gasify Biomass

David Domermuth
Appalachian State University

EXTENDED ABSTRACT

Biovolatilization is a method of converting biomass to useful products. Biomass is broken down into solid, gas, and liquid using heat, I.E. pyrolysis. This is the third paper, in a series, that describes the efforts of our local university (not named) to convert lignocellulose to useful products. The research has progressed to specific tests, including energy and mass balances and an overall evaluation of the process. An economic analysis of the process and products is included. The system has six potential revenue streams and promises to be the best of the pyrolysis conversion techniques. Biomass, usually chipped wood, is volatilized to release the hydrocarbons as fuel gas and smoke. The six potential revenue products are, waste stream elimination, biochar production, biocrude production, heat, carbon sequestration, and fuel gas. The project focus for this research is small scale application, home, farm, and community. The goal is the creation of a viable method of augmenting building heating while producing useful products from pyrolysis. The work has been sponsored by and EPA, P3 grant.

Houston-based KiOR Inc. received a term sheet for a loan guarantee from the U.S. DOE to support a $1 billion-plus biofuels project. Part of this money, $222 million, was used to build a bio-crude oil conversion plant in Columbus Mississippi, that will produce 12 million gallons of biofuel per year. The billion dollars is one of the largest investments in bio-crude conversion; and there are numerous smaller ventures ranging up to $70 million for research and smaller refineries. The US imports a billion dollar of conventional crude oil that each day. The conversion of lignocellulose to gasoline is one way to offset some of our energy trade imbalance but this process is not easy. Biomass has roughly one third the energy density of conventional liquid fuels; and the energy extraction can be very inefficient. These two factors make biomass, alternative energy research challenging. The ongoing research efforts reported in this paper are the culmination of four years of testing and improvements.

171 - Process Analyzing of the Vortex Tube and The Teaching and Learning of Energy Efficiency and Sustainability

Don Van, Joel Ingram, Kenneth Mayo and Kian Jost

Union University

EXTENDED ABSTRACT

Vortex Tubes (also known as "Ranque Vortex Tube", "Hilsch Tube", "Ranque-Hilsch Tube" and "Maxwell's Demon") produce hot air and cold air from a high pressure air source using no moving parts. It is possible to get a two-hundred and ten degree Fahrenheit difference between the hot and cold exits [4]. Vortex Tubes have been used in industry for spot cooling machines [2] as well as for mine cooling [Jianggang, 3]. Previous research has shown that Vortex tubes are not efficient at all when compared to standard air-conditioning units, a standard air-conditioning system will have a coefficient of performance up to thirty-four times greater than the coefficient of performance of a Vortex tube [Newton, 4]. Although the efficiency is not stellar compared to standard air-conditioners, they do have the advantage of being simpler and using air directly, instead of a refrigerant. Since Vortex Tubes are simpler designs than standard air-conditioners, there is less maintenance required [Swing, 5]. How does this fit in the realm of energy sustainability and environmental responsibility? This paper will show an analysis of the operation of the vortex tube with regard to the relevant conversion of energy. Experimental data will be used to quantify the efficiency of the device as a function of compressed air inlet. Teaching and learning of energy efficiency and sustainability will be shown using the analyses conducted using this device. A feasibility study will be presented with regard to a potential use of a vortex-tube based air-conditioning system.

CHAPTER 3
TECHNICAL SESSION 3
ABSTRACTS

Monday, March 11, 2013

Technical Session 3 3:50 pm – 5:10 pm

3:50 pm - 5:10pm	T3-A Prescott 208	T3-B Prescott 222	T3-C Prescott 225	T3-D Prescott 304	T3-E Prescott 325
Technical Session 3	**Cancelled**	K-12 Division III	Computer/ Software Division	Research Division I	Professional Skills Division I
Moderator:		*Sally Pardue*	*Randy Smith*	*Gillian Nicholls*	*Adeel Khalid*

T3–A: Cancelled

T3–B: K-12 Division III **PRESCOTT HALL 222**

*119 - K-12 STEM Outreach Pilot: Autonomous Quadcopter Assembled and Tested By Middle School Students 3-52
Jamil Anaguano and Yosef Allam

127 - Understanding Barriers to Engineering as a Career Choice for Appalachian Youth: Investigating the "heart" of the Region 3-53
Matthew Boynton, Cheryl Carrico, Marie Paretti, and Holly Matusovich

147 - A Strategic Case of Infusing Sustainability and Integrative Education in a Korean High School Pre-Engineering Course 3-54
Yonghan Ahn and Hyuksoo Kwon

148 - Research Trends and Priorities in K-12 STEM Outreach 3-55
Twanelle Majors, Jennifer Meadow, Laura Luna, Hyuksoo Kwon

T3–C: Computer/Software Division **PRESCOTT HALL 225**

193 - Formulation and Development of the Wasson Systems Engineering Process Model 3-56
Brittany Luken, Susan Hotle, Laurie Garrow, Christopher Cappelli, Lauren Jones, Stefanie Brodie, Margaret-Avis Rabah Aoufi

112 - Use of Facebook Group Feature to Promote Student Collaboration 3-57
Anthony Choi

172 - A Multi-Level Curriculum in Digital Instrumentation and Control based on Field Programmable Gate Array Technology 3-58
Omar Elkeelany and Mohamed Abdelrahman

T3–D: Research Division I **PRESCOTT HALL 304**

143 - Positive and Negative Motivators and Their Effect on Engineering Student Success 3-59
S. Michael Wells, Sabrina D. Wells

150 - Encouraging Undergraduate Engineering Students to Generate Research and Design Publications 3-60
Philip T. McCreanor, Laura W. Lackey, Hodge Jenkins, Michael Leonard, Sinjae Hyun

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

186 - Analyzing Time to Student Course Withdrawal Patterns for Predictive Modeling 3-61
Gillian M. Nicholls

T3–E: Professional Skills Division I **PRESCOTT HALL 325**

135 - Introducing Technical Communication through Science Fiction: A Freshman Seminar 3-62
Amy Barton

*188 - Ethics and Biomedical Informatics: a Research Experiences for Undergraduates Program at the University of Tennessee at Chattanooga 3-63
Claire L. McCullough and Yu Cao

156 - An Ethical Approach to Hydraulic Fracturing 3-64
Andrew Potter and M. H. Rashid

* Special Session: ASEE Initiatives and Activities and the Challenges Facing Engineering Educators

*119 - K-12 STEM Outreach Pilot: Autonomous Quadcopter Assembled and Tested By Middle School Students

Jamil Anaguano and Yosef Allam

Graduate Student / Assistant Professor–Freshman Engineering Department, Embry-Riddle Aeronautical University

Embry-Riddle Aeronautical University (ERAU) has many ongoing K-12 science, technology, engineering, and mathematics (STEM) outreach efforts from College of Engineering student design project teams, as well as other university-level STEM outreach efforts. In an effort to mentor local K-12 students through community outreach and instruction in the areas of STEM, CARABO team, and STEM Outreach Club from ERAU, combined efforts to inspire a group of five outstanding students from Campbell Middle School in Volusia County, Florida.

This K-12 STEM outreach pilot project is distinct from previous institutional efforts in that local, traditionally underrepresented sixth and seventh grade students are able to assemble, test, and fly a hands-on quadcopter unmanned aerial vehicle (UAV) kit. The project took place on Saturdays during the 2012 Fall Semester. Operated from the ERAU Daytona Beach Campus, and consisting of a truly multinational student team, both CARABO Project and the STEM Outreach Club combined knowledge of Aerospace, Mechanical, Systems, and Software Engineering as well as other disciplines which are used to inspire the next generation and strengthen the ranks of up and coming STEM professionals.

Students from Campbell Middle School got exclusive hands-on experience while assembling a new quadcopter kit as the first stage of the three-stage project. The next stages involved running flight simulations, and testing the final UAV. The software, tools, processes, and techniques used by the sixth and seventh grade project participants were same as those used by CARABO team. The project had three systems to engage students – airframe, propulsion, and controls. Students were actively involved in all three project stages and UAV systems under the supervision of the team members of both CARABO and STEM Outreach Club.

To gauge the impact of the project experiences on the students throughout the Saturday sessions, an open-ended survey to query participants' knowledge, interest, and self-efficacy was used before, and after the project. Specifically, students were asked to describe engineering and tell all they knew about engineering, engineering careers, aspects of engineering that most interest them, and the difference between engineering versus science and mathematics. This term-length hands-on K-12 outreach impact study is an attempt to report on K-12 students' conceptualizations of engineering and issues related to studying and pursuing engineering before and after engaging in engineering-related hands-on project activities. Experiences from this study will be used to provide descriptive step-by-step process to guide future K-12 hands-on STEM outreach projects at the university.

127 - Understanding Barriers to Engineering as a Career Choice for Appalachian Youth: Investigating the "HEART" of the Region

Matthew Boynton, Cheryl Carrico, Marie Paretti, and Holly Matusovich

Virginia Tech Engineering Ed.

EXTENDED ABSTRACT

Literature provides common barriers students may face related to entry and success into engineering and STEM fields. Students within the Appalachian region of the United States often experience a lack of exposure to STEM fields, role models, below average economic conditions, and other factors that limit their full range of career options. Research specific to Appalachia can inform relevant interventions by taking geography and culture into consideration which in turn can help students gain a full understanding of engineering career pathways. As part of a National Science Foundation (NSF) grant, the authors will conduct a three phase mixed method project to research influencing factors specific to Appalachia. This paper provides background on the research project and reasons for beginning the project in the Central Appalachian region. In particular, information on, education, economics, and population migration patterns within the Central Region of Appalachia, as defined by the Appalachian Region Commission(ARC), is provided to show the uniqueness of the region.

The ARC divides the Appalachian into the northern, southern, and central regions. Within these regions differences in economic growth, educational attainment, and population changes exist. Understanding these variables, how they compare within the different regions of Appalachia, and how they compare, on average, to the United States is a necessary first step to understanding the uniqueness of the region.

147 - A Strategic Case of Infusing Sustainability and Integrative Education in a Korean High School Pre-Engineering Course

Yonghan Ahn and Hyuksoo Kwon
Tennessee Tech University / West Carolina University

EXTENDED ABSTRACT

Sustainable development brings many potential benefits to our society and the environment. Therefore, on both the global and national level, many educational communities have taken efforts to accept and implement the concepts of sustainability in K-12 classrooms. Recently the Korean government announced an educational policy emphasizing integrative efforts among STEM (Science, Technology, Engineering, and Mathematics) subjects. This study was started with the intent to deliver contents related to sustainability concepts and integrating their STEM contents into the K-12 classroom. This study investigated a case of infusing sustainability and integrative education in a high school classroom. In this case, systematic course development was conducted in three steps: preparation, development, and improvement. In addition, this study implemented sustainability through the systematic course development process. One semester pre-engineering course for 10^{th} grade students was developed and delivered to 127 high school students in four classrooms. A self-reporting instrument was administered to the participants regarding their administered to the participants regarding their academic motivation toward science and technology school subjects and their attitude toward engineering. Data collected from the instruments and interviews were analyzed qualitatively and quantitatively. The research findings included: 1) High school students' learning motivation toward science and technology subjects was significantly improved through this pre-engineering course and 2) Their attitudes toward engineering were significantly improved through this pre-engineering course. These findings provide sound evidence supporting integrated sustainability concepts delivered through the STEM framework into K-12 educational settings.

148 - Research Trends and Priorities in K-12 STEM (Science, Technology, Engineering, & Mathematics) Outreach

Twanelle Majors, Jennifer Meadow, Laura Luna, Hyuksoo Kwon

Tennessee Tech University

EXTENDED ABSTRACT

K-12 STEM (Science, Technology, Engineering, and Mathematics) education is enjoying full attention in both national policy discussions and funding opportunities. This attention for K-12 education area has been increased due to the significance and benefits related to the implementation of K-12 STEM education. A great concern has arisen on the insufficient number and preparation of K-12 STEM teachers and low academic achievement of K-12 students toward STEM subjects in the U.S. K-12 STEM teachers and practitioners have suggested that informal STEM learning opportunities are as important as formal K-12 STEM learning. The goal of this study was to investigate contemporary research trends and priorities of STEM education, especially for informal settings. Our team followed three stages: (1) Preparation, (2) Analysis, and (3) Presentation. At the preparation stage, this study reviewed relevant prior studies investigating K-12 STEM education in informal settings and established a sound foundation on identifying STEM education research and practices. The analysis sought to obtain data such as project goals (objectives), concentrated disciplines, outreach institutes, research subjects (grade, gender, race, etc.), and their expected outcomes for all the abstracts of NSF (National Science Foundation) funded projects. Targets for these analyses were limited to searchable prior research papers (Advancing Informal STEM Learning (AISL) under the NSF DRL division: Research on learning in formal and informal setting). At the presentation stage, this study communicated the key research trends and priorities in K-12 STEM outreach research and practice. This study can provide an outline for designing K-12 STEM outreach related research and projects.

193 - Formulation and Development of the Wasson Systems Engineering Process Model

Rabah Aoufi
DeVry University

EXTENDED ABSTRACT

Some Colleges are beginning to create what they call "Entrepreneur Centers", where students from Business, Technology and Medical programs are teamed up to collaborate on a "killer application" type project. After graduation, participants go on to either market the idea on their own through a startup or within an existing company that they join. The key ingredient to make this endeavor a success idea consists of, not only teaching engineering students timely subjects but also cultivating creativity and innovation to bring the entrepreneurship college experience to another level. This paper gives a comprehensive view showing how developing state of the art mini-projects used in my microcontroller class, helps students innovate new products to solve societal problems. The three projects described are 1) RFID-based Prohibitive Texting and Driving system: When a simulated GPS signal, indicating the car is moving, is received by the cell phone, all form of texting and browsing for outgoing and incoming transmissions using the device are disabled. Only the voice function is still enabled. Two RFID readers are installed in the back of the two front vehicle seats and one reader is installed under the glove compartment. Each passenger's phone is equipped with a RFID tag. The RFID reader, at proximity to the passenger only location in the vehicle, will turn on the mobile phone data and texting functions. The driver compartment lacking such a reader will leave these functions disabled only on the driver's mobile phone and thus, preventing the driver from using the phone functions other that voice, while driving. 2) RFID-based Voting system: A registered voter would cast a tagged ballot by dropping it in a slot box equipped with a RFID reader. The system tabulates the votes and sent them to a secured database. In case of a contested election outcome, similar to the year 2000 in the Florida presidential election debacle, all the casted ballots in a particular ballot box can be re-read and re-tabulated instantly without having to be moved out of the box. Finally, 3) RFID-based Self Check Out system: While in the shopping cart, packages and boxes with RFID tags are read directly, without a line-of-sight, by the readers installed at the checkout counters. All these three projects used the HCS12 microcontroller-based Dragon Board from Wytec and the RFID reader from Parallax..

112 - Use of Facebook Group Feature to Promote Student Collaboration

Anthony Choi

Electrical and Computer Engineering, Mercer University

EXTENDED ABSTRACT

This paper presents the experiences of implementing Facebook Group feature to promote student collaboration and learning in an introductory programming class in Mercer University School of Engineering. Facebook group has built in features and infrastructure to support class collaboration and settings to deal with privacy issues. Facebook has many advantages over other mediums. Key advantage is that almost all of the students are actively using Facebook for social communication. It is a natural extension for them to extend their preferred method of communication for academic purposes. This experiment was highly successful for the faculty and the students involved. Facebook groups have great potential to enhance student learning and student collaboration. The conclusions are supported by student comments and by quantitative results of a survey in multiple class sections.

In the context of this study, a Facebook group was an overwhelming success in promoting collaboration among students. Student satisfaction is evident in the very positive comments concerning their experience during the semester. Common comments from students were fast response, access to other students, access to help at odd hours, opportunity to discuss and observe another students mistakes and solutions.

Students are heavily active on Facebook. By leveraging their preferred method of communication, academia can benefit greatly by using Facebook groups to enhance student collaboration.

172 - A Multi-Level Curriculum in Digital Instrumentation and Control Based on Field Programmable Gate Array Technology

Omar Elkeelany and Mohamed Abdelrahman

Electrical and Computer Engineering, Tennessee Tech University /Texas A&M University

EXTENDED ABSTRACT

Digital Instrumentation and Control (I&C) plays an increasingly essential role in monitoring, control and protection of modern industry. Modern industry in the USA is in the process of replacing aging analog systems with digital I&C. Digital I&C technologies are known for high processing capabilities, which allow them to perform intelligent on-board computing that supports functionality such as self-checking. They also provide for improved accuracy, flexibility and easy calibration. However, digital I&C pose some challenges for sensitive environments such as nuclear power plants, or biomedical applications. Such challenges require special skills, and awareness from engineers in the design, operation and maintenance.

In this paper, we present how we can enhance the students' design experience and competencies in digital I&C using FPGA and System-on-Programmable Chip (SoPC) Technology, and increase the awareness among Engineering Educators of the design of digital I&C using the state of the art FPGA SoPC design techniques. We aspire to enhance the robustness of such systems and their applicability in sensitive (*Safety Critical*) environments such as nuclear power plants or biomedical applications. Thanks to the advances in FPGA technology and the initiatives taken by the FPGA industry, more FPGA-based educational components can be developed.

Our innovative idea is to effectively combine digital I&C with FPGA design course using hardware description language. This will be accomplished using multidisciplinary multi-step integrated curriculum components, with industrial collaborative linkages, offered at appropriate points starting from sophomore level, and extending to senior levels.

143 - Positive and Negative Motivators and Their Effect on Engineering Student Success

S. Michael Wells and Sabrina D. Wells

Tennessee Tech University

EXTENDED ABSTRACT

In this era of increasing global competition we as educators are continually looking for ways to better attract and retain quality students. In the long term our success will be a large factor in the future of our country. Other nations are gaining on the United States; and our prestige as the number one world power is at risk. Many of us in engineering education see capable young people who could succeed at engineering if only they had adequate motivation. The question arises as to what types of motivating factors are effective at driving students to succeed? Are students who enter engineering because it is their parents' wish just as likely to succeed as those students motivated by the financial reward expected in the engineering field?

Given a choice, most people would prefer positive motivators over negative ones; it is more pleasant to perform a task to earn a reward rather than to have to perform a task in order to avoid a loss. Even so, it may be that negative motivators can actually be more powerful and effective. We at Tennessee Tech have just implemented a Student Success Center to help students stay motivated in engineering. If there are general weak motivator types that can be determined, and the students are willing to discuss their own motivation with the staff of the Success Center, it might be possible to better identify and assist those students at risk.

To possibly identify positive or negative motivator types that may predict student success, nearly 300 freshmen engineering students at Tennessee Tech University were given a survey during the first week of fall semester 2012 classes. The survey listed five positive motivating factors and five negative ones, and the students were asked to rate the significance of each factor. The academic averages of the students at the midterm of the semester was then analyzed to see if there were any trends regarding motivator type and student success up to that point.

The findings were that a significant plurality of the students indicated the primary reason they were studying engineering was for the joy of working in a field related to science and mathematics. There were no strong correlations, however, between any one type of motivator and student performance up to the midterm of the semester. It was concluded that *intensity of motivation*—not *type*—along with other possible factors are what apparently play the more key roles in student success.

150 - Encouraging Undergraduate Engineering Students to Generate Research and Design Publications

Philip T. McCreanor, Laura W. Lackey, Hodge Jenkins, Michael Leonard, Sinjae Hyun

Mercer University

EXTENDED ABSTRACT

Approximately sixty students in Mercer University's School of Engineering published design and/or research work at the 2010 through 2012 ASEE-SE Annual Conferences. These publications include twenty posters, one podium presentation, and four proceeding papers with podium presentations. The same two female students presented at all three of these conferences. Undergraduate efforts in the Environmental Engineering Department and Engineering Honors Program are primarily responsible for these student publications. However in 2012, the School of Engineering's Fall 2011/Spring 2012 senior design course sequence generated several posters. In the Environmental Engineering Department, students in the Senior Environmental Engineering Laboratory (Fall semester course) conduct an open-ended experiment on a lab-scale system. One of the final deliverables for this course is a poster with the expectation that an abstract will be submitted to the ASEE-SE Student Poster Competition. Undergraduate environmental engineering students conducting independent research are typically required to develop a poster for the ASEE-SE Student Poster Competition. The Engineering Honors Program is structured around independent research projects with yearly, public presentation requirements. The primary deliverable for Sophomore Engineering Honors II (Spring semester course) is a publication at the ASEE-SE Student Poster Competition. The potential for leveraging the research and design work associated with the capstone senior design sequence into publications at the ASEE-SE Student Poster Competition was explored successfully in the Spring of 2012. This paper provides extended details on the courses and initiatives generating student publications at the ASEE-SE Conference as well as Mercer University's on campus Engineering Exposition event which is being used to provide opportunities and enthusiasm for students to present their research and design efforts. Logistics, financial commitment, and administrative support required to provide these opportunities are described.

Recommendations for programs looking to increase undergraduate publications and presentations include:

- Re-considering structure and deliverables in upper-level laboratory courses to identify research and publication opportunities
- Initiating an in-house undergraduate poster symposium, and
- Identifying and targeting a regional student poster symposium for a group trip

186 - Analyzing Time to Student Course Withdrawal Patterns for Predictive Modeling

Gillian M. Nicholls

The University of Alabama

EXTENDED ABSTRACT

The University of Alabama in Huntsville has a generous policy course withdrawal policy that permits any student to withdraw from a course until approximately one month before the end of classes for that semester. As a result, many students will register for a course, attempt it for one to two months, and then withdraw if they are not doing well. A course withdrawal does not affect a student's academic record other than appearing on the transcript as a "W". Other than the expense of paying for a class without receiving academic credit, there is no penalty for not completing the course. The disadvantage to the university is that student throughput is hampered and course resources are not fully utilized.

The undergraduate Engineering Economic Analysis course has a high rate of students registering and then withdrawing. In Fall 2011, 29 of the 179 students (16.2%) that registered for the class withdrew from it. Another 3 students functionally withdrew by remaining enrolled in the class while ceasing all participation in it after the second or third exam. These figures do not include students that dropped the class in the first two weeks. This course is in heavy demand as it is often the first class taken by engineering students transferring in for their junior year after completing the first two years at a community college. Year round, each section quickly reaches full enrollment, yet a persistently large percentage do not complete the course and must retake it later. Engineering Economy is a required class for most of the engineering majors and students must achieve a C or better to use it as a pre-requisite.

A study was done to collect data about the students' gender, academic backgrounds, transfer student status, major, homework grades, exam grades, and whether students were taking the class for the first time. The Course Management System (CMS) was used to collect attitudinal, experiential, and environmental variables from the students. Homework assignment submission and exam-taking were used to establish a date during the 100 days of the semester at which students stopped actively participating in the class. Students that remained actively participating throughout the end of the semester were treated as censored data since the event of interest (course withdrawal) did not occur. The time to event data was analyzed with Kaplan-Meier life tables and hazard functions to identify significant factors predicting withdrawal.

Gender and transfer student status were statistically significant predictors at the start of classes. Transfer students were at a much higher risk of withdrawal as early as Exam 1. Female students were at a higher risk of withdrawal than their male counterparts regardless of transfer status. Although females were only 24% of the class they were 45% of those who withdrew. Once variables showing academic performance within the course such as Exam 1 and 2 scores became available, gender and transfer status become less valuable predictors.

135 - Introducing Technical Communication Through Science Fiction: A Freshman Seminar

Amy Barton

Bagley College of Engineering–Mississippi State University

EXTENDED ABSTRACT

First-year seminars allow freshmen to adjust to university life and the scope of academic options available to them. This is particularly true of subject-specific seminars, as students considering a particular major can learn about career possibilities and the demands of a curriculum in an engaging, informal environment. Mississippi State University (MSU) encourages faculty to teach "one for fun," emphasizing the importance of making the one-hour seminar as unique and interesting as possible so freshmen can appreciate the passion the instructor has for the discipline rather than just absorbing a general introduction to a major. This paper describes an attempt to introduce freshman engineering majors to the principles of responsible, clear communication in a way that would interest even those resistant to a traditional writing/speaking course. The freshman seminar "Ignorance is NOT Bliss" examines communication about science and technology through the history of science fiction movies, which often represent the ignorance and fear of a public subjected to misleading information. Topics discussed include galvanism and Frankenstein's monster, the atomic age, the Cold War's effect on the space race, and pandemics. Students analyze examples of misleading communication and contrast those with samples of clear, objective writing and speaking. To practice the strategies presented, students prepare a paper and presentation on a topic in their field. The primary goals of the course are to help students define clear technical communication, learn to be discerning consumers of information, and embrace their ethical responsibilities as future experts. A secondary goal is to demonstrate that analyzing communication techniques is a pursuit both worthwhile and enjoyable.

*188 - Ethics and Biomedical Informatics: a Research Experiences for Undergraduates Program at the University of Tennessee at Chattanooga

Claire L. McCullough and Yu Cao

University of Tennessee at Chattanooga

EXTENDED ABSTRACT

The University of Tennessee at Chattanooga, in collaboration with biomedical researchers and healthcare practitioners from the University of Tennessee: College of Medicine Chattanooga and Erlanger Health System, has conducted the first iteration of a three-year Research Experiences for Undergraduates program on Biomedical Informatics, with a special emphasis on ethics as related to the student projects. Potential impact of research activities in the area of bioinformatics on the practice of medicine is great. These impacts include enhanced and supported decision making and data mining tools for clinicians and biomedical researchers, new computing resources for biomedical research platforms and telemedicine, and new protections against potential security breaches, which can lead to improvements in patient privacy and safety. Because of the ethical implications of all of these areas, this project has added a special emphasis on ethics. The ethics activities included lectures, combined with a heavy emphasis on discussion of current events related to ethics in Biomedical Informatics and computer fields. One of the primary goals of this ethics component is to introduce fundamental theory and practices on the ethical and social issues facing the healthcare and biomedical research industry as it adopts information technologies to provide safer, faster health care service with lower cost, while preserving patient privacy, and eliminating the possible consequences of misuse of personal medical information. This paper discusses the specific bioinformatics projects begun in the first year of the program, the details of the ethical emphasis and activities, results of initial program assessments, and plans for the remaining years of the program.

156 - An Ethical Approach to Hydraulic Fracturing

Andrew Potter and M. H. Rashid

University of West Florida

EXTENDED ABSTRACT

The following discourse will attempt to weigh the ethical issues concerning hydraulic fracturing. The current technology will be reviewed, along with its impacts on the public. Workable solutions will be offered and each weighed in order to find a solution that is acceptable to both the oil and gas industry and the concerned public.

Hydraulic fracturing involves injecting millions of gallons of water, chemicals, and particulate down a drill shaft to fracture the shale below. The fractured rock will release any gas stored within the formation.

Hydraulic fracturing or fracking has been in existence since the 1940s but has only recently become economically feasible. Global demand for petroleum and the resulting price increase has made hydraulic fracturing more profitable. New York has issued a moratorium on all hydraulic fracturing of the Marcellus shale formation with the state borders until the process and its effects on the environment are understood. Only after intensive study can proper regulations be implemented to protect the populations living near drill sites and the watersheds that could suffer damage.

The balance must be struck between the interests of industry and the quality of life of communities near drill sites. Utilitarian principles combined with Respect for Persons allows for a creative middle ground solution that can be implemented on the state and town level.

The key to successfully extracting the shale gas is careful regulation. Any new regulations proposed by New York should protect the three assets most impacted by gas drilling; the watershed, the land, and the communities nearby. The regulations need to specify minimum distances from drill sites to water sources, plans for disposing of used water from hydraulic fracturing, testing routines of aquifers before and after drilling, and approve chemical mixtures used in fracking fluid.

Hydraulic fracturing of wells is a resource intensive process. Millions of gallons of water are needed, toxic chemicals are used and generated during the process, and there is a potential to contaminate nearby water supplies. While hydraulic fracturing sounds like a process best left alone, it has the potential to unlock a large supply of gas to help ease the reliance of the U.S. on foreign energy supplies. When the industry is regulated properly and rules established that clearly define how the process can be completed safely, the public and the gas and oil companies will benefit. The creative middle ground between no regulation and over regulation will allow the Marcellus shale to be developed for the benefit of all stakeholders

CHAPTER 3
TECHNICAL SESSION 4
ABSTRACTS

Tuesday, March 12, 2013

Technical Session 4 8:45 am – 10:05 am

8:45 am – 10:05 am	T4-A Prescott 208	T4-B Prescott 222	T4-C Prescott 225	T4-D Prescott 325
Technical Session 4	Engineering Graphics Division	K-12 Division IV	Mechanical Engineering Division III	Civil Engineering Division II
Moderator:	*Priya Goeser*	*Claire McCullough*	*Monika Bubacz*	*Michael Woo*

T4–A: Engineering Graphics Division **PRESCOTT HALL 208**

144 - An Interactive Tool for Visually Presenting Conic Sections to STEM Students 3-68
Matthew K. Swenty, Gregory N. Hartman, David W. Johnstone, Daniel S. Joseph, Troy J. Siemers, and James C. Squire

181 - Pilot: Extra Credit-Incented Collaborative Learning & Reflection in an Engineering Graphics Course 3-69
Yosef Allam

T4–B: K-12 Division IV **PRESCOTT HALL 222**

105 - Engineering Summer Camp for High School Students from Underserved Communities 3-70
T. Kunberger, K. Csavina, and L. Zidek

*104 - Engineering Education – Past, Present and Future Outcomes 3-71
Marcos Chu

187 - Real-World Design Challenges - A Crucial Component of STEM Teaching and Learning 3-72
Rebecca Jaramillo and Colin Britcher

129 - Using Future Engineers Camps to Advance STEM in Western North Carolina 3-73
William L. McDaniel and Sidney G. Connor

T4–C: Mechanical Engineering Division III **PRESCOTT HALL 225**

182 - An Engineering Elective on Energy Resources 3-74
Shih-Liang (Sid) Wang

128 - Novel Design for the Total Replacement of Finger and Toe Joints 3-75
Andrew Weems

165 - Shaft Deflection—A Very, Very Long Example 3-76
Christopher D. Wilson and Michael W. Renfro

*205 - Integrating a Design Project into an Undergraduate Mechanics of Materials Course 3-77
Joseph J. Rencis and Hartley T. Grandin, Jr.

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings.

T4–D: Civil Engineering Division II **PRESCOTT HALL 325**

153 - Compressive Strength Analysis of Mortar Mixes Consisting of Recycled Plastics 3-78
John W. McDonald , Charles D. Newhouse

145 - Modeling Groundwater Flow Experiment 3-79
Daniel Bunei, Beth Todd

185 - A Case Study Comparing the Container Shipping Industry in the US and Panama 3-80
Tulio Sulbaran, Ph.D ; Matt Gathof

144 - An Interactive Tool for Visually Presenting Conic Sections to STEM Students

Matthew K. Swenty, Gregory N. Hartman, David W. Johnstone, Daniel S. Joseph, Troy J. Siemers, and James C. Squire

Virginia Military Institute

EXTENDED ABSTRACT

Studies show students in Science, Technology, Engineering, and Mathematics (STEM) fields are particularly at-risk of changing majors when they are enrolled in introductory mathematics courses. The use of visuals and interactive lessons has been shown to keep students' interest in courses but can be challenging to implement. A technology combining these techniques into one tool could help students grasp concepts more efficiently and effectively. We have developed software that provides a simple and practical visual tool for use by professors and students alike in their exploration of the mathematics behind conic sections.

Conic sections provide fertile ground to develop mathematically-interesting questions for undergraduates and the proper computer tools let them visually and interactively assess the geometry behind their mathematical reasoning. Yet there exists no simple tool to efficiently display the generalized quadratic formula $Ax^2+Bxy+Cy^2+Dx+Ey+F=0$. Most software packages plot curves defined by implicit functions by finding the intersections of surfaces and planes. This is computationally intensive and it is not uncommon for numerical inaccuracies to appear. Students are often discouraged when computers "struggle," perceiving this to mean that the mathematics is "too hard." Other packages can solve the problem symbolically, but this is typically slow and these packages tend to be expensive.

This paper describes a new method that finds a one dimensional parametric solution for the implicit quadratic function using only linear algebra that is both accurate and fast. This permits development of smoothly-animated interactive software, such as one we developed that demonstrates the continuity of solutions among parabolas, ellipses, and hyperbolas by allowing a user to click and drag five control points while the conic section that connects them is computed and shown in real time. Demonstrations such as this enhance traditional teaching methods by showing the connection among the different conic sections in a visually-compelling way.

181 - Pilot: Extra Credit-Incented Collaborative Learning & Reflection in an Engineering Graphics Course

Yosef Allam

Assistant Professor, Freshman Engineering Department–Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

EGR 120: Graphical Communications students were assigned to peer groups of two members or more per group to complete optional missing line and missing view exercises together outside of regular class time for extra credit such that teammates collaborate to complete problems and visualize solutions. Students also completed self-reflection writing assignments regarding their level of understanding on various engineering graphics concepts at the point in the semester during which the extra credit assignment was given, and answered questions about their meta-knowledge of the topics covered in the course.

The pilot implementation has encouraged periodic self-reflection writing assignments which qualitatively seem beneficial to students as their progress through the curriculum is made apparent both to the students themselves and the instructor. These self-reflection activities thus serve a formative function as well.

Another outcome of the extra-credit team assignment and self-reflection papers is in terms of the quality of participation and work submitted for group projects, which are demanding. Students are given an opportunity to work with others in the class before committing to the team project, and the periodic self-reflection assignments allow students to pause and think more deeply about how they are approaching their project solutions. In addition, the instructor is given feedback on areas that require more or less focus in the classroom during the semester.

This paper presents a narrative of the evolution of an instructional intervention initially intended to focus purely on developing foundational spatial visualization skills through peer collaboration on additional exercises. As the pilot continued and then efforts were repeated in the subsequent semester, it became evident that while the initial visualization activity remained available, the practice truly beneficial to the dynamics of the classroom became regular in-class written and oral reflective writing communications between students and the instructor.

105 - Engineering Summer Camp for High School Students from Underserved Communities

T. Kunberger, K. Csavina, and L. Zidek

Florida Gulf Coast University

EXTENDED ABSTRACT

In the summer of 2012, the U. A. Whitaker College of Engineering at Florida Gulf Coast University hosted a week-long engineering summer camp for students from the rural underserved central Florida region. Forty high school students, mostly rising sophomores and juniors, from 10 high schools and 6 counties spent five days on the FGCU campus. The camp was designed to be highly interactive and contained four main types of activities: speed designs, discipline specific activities, broader impact activities, and a colossal challenge. Speed designs were structured to challenge students to work as a team and think outside the box, as well as introduce students to the engineering design process. Discipline specific activities included an introduction (via PowerPoint) to the specific engineering field and a number of activities focused on that discipline. A seminar on global engineering projects and two college student driven discussion panels on why engineering and why Florida Gulf Coast University were held as part of the broader impact activities. The overarching activity was a team colossal design challenge based on the Discovery Channel show "Unchained Reactions" and involved larger than life Rube Goldberg machines that encompassed large portions of a classroom. This paper will present the general layout of the week-long program, as well as specifics for each type of activity. Results from pre and post Likert surveys from the students will be summarized as well as written feedback from the participants. Also included will be reflections from the organizers with respect to things to consider when planning and hosting such a program.

*104 - Engineering Education – Past, Present and Future

Marcos Chu
Capella University

EXTENDED ABSTRACT

Engineering education is not a new topic. Studies and developments date from the mid-1800's. However, from a scholar/practitioner perspective, this area is relatively new, with only a few major universities offering PhD programs at the turn of the 20th century. This abstract examines a grass-roots movement in urban communities to develop a full-pipeline engineering education, from elementary to high school level and on to college study. The integrated curriculum involves not only the students and the school but also the community at large. Many urban schools involved in the robotics program have experienced multi-generational academic failure and it is necessary to develop a framework in which is sustainable where the funding for the program is raised locally and the materials provided are non-partisan from a technological point.

The focus in the past have been on Science, Technology, Engineering and Mathematics (STEM) where the goals is to motivate students to pursue careers in STEM or help them develop their knowledge and skills thru formal pre-engineering formal program. The challenges of this framework has been primarily in funding and in been able to attract and develop teachers to implement the program in an effective way. The main focus on STEM rather than on the problem solving aspect of engineering education has made STEM education the focus and engineering as a tool to accomplish the goals for STEM education. Another challenge is that those programs provide great benefits to their core constituents but they are not portable and replicable from a learning community perspective where you might have other stakeholders from a non engineering background.

It is necessary for engineering education to focus on the process of solving problems where in the most minimal process includes brainstorming, trade-study, prototyping and testing an idea. The curriculum needs to be project based with increasingly systematic learning techniques and expanded measurements for children's understanding of the process for solving program and use all the tools available be it in the Science, Technology, Engineering, Arts or Mathematics (STEAM) domain where it will allow them in the future to tackle real-life problem within realistic business constraints such as schedule and cost. The future of engineering education includes the measurement of student performance of meeting the challenges within the constraints as a team representing the whole school and be able to showcase their talents at a high visibility venue such as the Engineering and Science Festival in Washington D.C.

The future of engineering education involves including the topic of engineering affordability as part of the curriculum where students are given a real life challenge where they need to develop a solution to be implemented in the future when they are just entering the workforce.

187 - Real-World Design Challenges - A Crucial Component of STEM Teaching and Learning

Rebecca Jaramillo and Colin Britcher

National Institute of Aerospace (NIA) / Old Dominion University

EXTENDED ABSTRACT

Educators at the National Institute of Aerospace's Center for Integrative STEM Education (CISE) develop engineering design challenges for the K-12 classroom. As experienced teachers, NIA educators bring an understanding of student learning and real-world experiences with practicing scientists and engineers to the classroom. Current research drives the development of each design challenge and the accompanying professional development opportunities for educators.

Each challenge developed by the CISE educators is a real-world engineering problem identified by NASA with unique components. All design challenges incorporate a balance of hands-on activities, modeling and simulation, and testing. Reflective practices are encouraged through open-ended design packets. Access to scientists and engineers is provided to teachers and students through free online video clips, online tutorials, or synchronous webinars.

Importance of Engineering Design Challenges

For the first time, the word engineering takes a prominent place in science classrooms across the United States. Students are challenged to think like scientists and engineers; to understand how engineering and science are similar and how they differ; and to design solutions for real problems. But what connection does engineering have to science and how does the introduction of engineering design impact student learning?

The educators at CISE have created a series of engineering design challenges for teachers unfamiliar with the process of design solutions. Three initial engineering design challenges were created as part of the NASA eClips™ suite and are available online at no charge. The challenges use the 5-E model of learning and guided inquiry to increase teacher understanding of engineering design and build confidence in the implementation of design challenges. A virtual world challenge provides students a unique opportunity to develop modeling and simulation skills. Reflective practices in each challenge, allow teachers to assess student understanding and correct misconceptions. The challenges allow students to design and refine their solutions, demonstrating the iterative nature of problem solving, while changing student perceptions of failure and enhancing their understanding of science and mathematics content. Professional development opportunities for teachers provide support for implementation of the challenges while virtual and video support from NASA subject matter experts provide content expertise, building teacher confidence and increasing the likelihood that teachers may implement design challenges in the classroom.

129 - Using Future Engineers Camps to Advance STEM in Western North Carolina

William L. McDaniel and Sidney G. Connor

Western Carolina University /Appalachian State University

EXTENDED ABSTRACT

Ask – Imagine – Plan – Create – Improve. These five words were at the center of all activities introduced during Future Engineers summer camps held at the North Carolina Center for Engineering Technologies. Using the Engineering Design Process, the students learn about engineering through hands-on activities led by licensed public school and college teachers. Beginning in 2010, these camps were developed as a collaboration between the North Carolina Center for Engineering Technologies, Catawba Valley Community College's Champions of Education, and NC State University's College of Engineering. The 4 camps offered in the summer of 2012 added to the previous 4 camps make a total of 8 camps offered over the past three years. These camps were attended by 339 students ranging from rising 3rd to rising 8th graders. Special care was taken to ensure participation by females and minorities. Students participated in a week-long intensive immersion into engineering design and fabrication techniques. The application process was competitive and students from 12 counties were invited to apply. Applications have exceeded the available slots each year, as the program continues to grow. The primary goal of the camps is to introduce elementary children to the engineering design concept through hands-on activities using math and science skills.

This paper highlights the history, development, and implementation of the summer camps, and their impact on the community. In addition, results from parent surveys will be presented as an impetus for further development in STEM in the public schools. Other institutions should be able to utilize lessons learned in their respective communities.

182 - An Engineering Elective on Energy Resources

Shih-Liang (Sid) Wang

Department of Mechanical Engineering–North *Carolina A&T State University*

EXTENDED ABSTRACT

The energy sector in the past several years has gone through transformative changes and the implications are huge. According to a recent IEA (International Energy Agency) report, America could become the world's largest oil producer by 2020, outstripping Saudi Arabia and Russia. It could also be more or less self-sufficient in energy by 2035. To prepare our students for jobs in the energy sector during these transformative changes and equip them with energy literacy and numeracy, the author is offering an engineering elective covering renewable energy, nuclear power, and fossil fuels.

The objective of this course is to introduce fundamental principles of various energy options as we face climate change and other environmental impact, and to develop an appreciation of the energy challenges that confront our present and future generations. Although several textbooks are useful as references to this course, additional resources are needed to make the course contents contemporary and relevant. This paper reports the author's effort in preparing course materials for this course. The course was offered in Spring 2012 as a special topics course with an enrollment of 17 students. Student surveys are very positive and the course will be offered in the future.

128 - Novel Design for the Total Replacement of Finger and Toe Joints

Andrew Weems

Department of Biomedical Engineering–Mercer University

EXTENDED ABSTRACT

Current total metacarpophalangeal joint replacements (TJR), the most popular a one-piece silicone implant, do not provide the normal biomechanical range of motion and functionality. The proposed design attempts to correct this through the use of design geometry and functional anatomy. A tongue and groove joint is used to prevent medial/lateral dislocation with a ridge located superiorly to prevent hyperextension as well as to allow for the extensor tendons to move without catching on the mechanism.

The natural joint and one-piece implant were compared using two dimensional static and dynamic analysis. The forces taken into consideration were the flexor and extensor tendons that cross a metacarpal-phalangeal joint, as well as the joint capsule and joint reaction forces. The analysis was done over a length of bone equivalent to the length of the arms of the total joint replacement, with the length and radii of the bones of metacarpal and phalangeal bones assumed to be equal, respectively. To do this, an internal shear, moment and normal force were included in the models. For the one piece implant, additional forces are the moments associated with the geometry of the joint and the frictional forces holding the joint arms in place. Computational analysis was performed using Solidworks and ANSYS Multiphysics softwares to determine the force distributions across the joint replacement.

The proposed joint was designed by using the static and dynamic model of the natural joint. The static analysis showed the same behaviors, and the dynamic models were the same save for mass and moments of inertia. Computation analysis showed maximum force values between 3 and 4 MPa were found for loads of 10 N, with displacement values of less than 1.0 mm.

Theoretical testing of the joint demonstrated a high tolerance for applied stresses from daily activity involving the joint. The assigned forces were applied from assumptions made about basic tasks involving the joint, such as force applied parallel to the digit with the TJR. The second major force application was perpendicular to the fully extended digit. It is very plausible that this design can be used in total finger and toe joint replacement surgeries. Future work will include cadaver implantation of varying joint sizes, to determine the range of difficulty for surgeons and patients in terms of time of implantation, biomechanical functionality, and tissue destruction.

165 - Shaft Deflection—A Very, Very Long Example

Christopher D. Wilson and Michael W. Renfro

Dept. of Mechanical Engineering/Center for Manufacturing Research, Tennessee Tech University

EXTENDED ABSTRACT

Most textbooks in mechanics of materials and components of machine design describe numerous methods for determining shaft (beam) deflections. The examples in these textbooks are quite varied, but most are not interrelated or follow-up examples in which the same problem is attacked using different methods. Further, most examples are worked out by hand and do not emphasize numerical methods used in common practice, such as the finite element method. Finally, some of the examples omit enough steps that average students may miss subtle points and below-average students may simply fail to grasp the solution.

This paper presents several solutions for a single problem: a stepped-shaft in bending. The problem is statically determinate. First, superposition of beam table solutions is used to estimate the shaft deflection in a bounding fashion. Then, the deformed shape is exactly (exactly meaning that the assumptions of Euler-Bernoulli beam theory are exactly satisfied) determined using piecewise double integration and the determination of many constants of integration. The equations are set up by hand and then MATLAB is employed to solve the resulting system of equations. The complete elastica is determined. Then, the same problem is solved using Castigliano's Second Theorem at a small number of points of interest along the shaft. Here, Maple is used in a nature manner to develop the solution. Simple numerical integration (actually, successive integration) is used to determine the complete elastica. A discussion of the convergence of numerical solutions is made. Then, a simplified finite element model is constructed. The finite element coding is given in MATLAB. Solution convergence for both the numerical integration and the finite element solution is discussed.

The first author's experience with the example problem in a machine design course has been very successful. Students appreciate having a second (or third or even fourth) chance to successfully solve a problem. The example has been given to the class in three ways. First, the example has been used as an in-class case study spanning parts of lectures over a three-week period of studying design for stiffness principles. The total time expended for the example given here is approximately three hours (approximately one-third of the total time allocated for design for stiffness in the course syllabus). Second, the example (and other similar ones) has been used in successive homework assignments and quizzes. With this approach, students worked through three homework assignments in a series, having feedback (grades) before tackling the next assignment. The third way was a review problem set/example given at the end of the term in preparation for the final exam---no class time was expended. The anecdotal responses from students was good for all three approaches. However, no quantitative measurements of student improvement have been made.

*205 - Integrating a Design Project Into an Undergraduate Mechanics of Materials Course

Joseph J. Rencis and Hartley T. Grandin, Jr.

Tennessee Tech University / Worcester Polytechnic Institute

EXTENDED ABSTRACT

This paper presents a just-in-time approach developed and used by the authors to integrate a design project into an introductory undergraduate mechanics of materials course. The design project discussed in-depth is a statically determinate hoist frame structure. The hoist is used to lift an object of weight. It is assembled with smooth pins and is symmetric about the two-dimensional plane. Three other design projects discussed briefly include a brace structure, beam hanger, and simple hoist structure. Lecture examples, homework problems, and design project problems are solved with all equations formulated symbolically. One major advantage is that symbolic equations can be solved for any variable value. Furthermore, the design process generally requires solving problems over a range of variable values to obtain a satisfactory design. The design project involves all or almost all topics, covered in an introductory undergraduate mechanics of materials course. The project is divided into seven phases. The background required to complete each phase is based on the material covered up to that point in the course. After a topic is covered in lecture, reinforced through homework and classroom quizzes, the project phase related to the topic area is assigned.

153 - Compressive Strength Analysis of Mortar Mixes Consisting of Recycled Plastics

John W. McDonald and Charles D. Newhouse

Virginia Military Institute

EXTENDED ABSTRACT

In an effort to find new ways to minimize the amount of plastic waste the Virginia Military Institute (VMI) sends to local landfills, and part of a collaborative effort between the Civil and Environmental Engineering Department and the VMI Physical Plant, a research project was performed as part of the VMI Summer Undergraduate Research Institute (SURI). Researchers wanted to determine the viability of using recycled plastics as a fine aggregate in standard mortar mixes. The recycled plastics were collected, sorted by type, melted, shredded, batched into a standard mortar mix, and tested to determine the compressive strengths of the resulting mixes. Several testing procedures were developed in order to replace 25% of the fine aggregate by volume. One procedure developed allowed researchers to determine the specific gravity of the plastics, which was difficult to determine through traditional testing procedures because plastic is less dense than water, causing it to float. On average, the mixes produced from the varying plastic types maintained roughly 55% of the compressive strength of a standard control mix. These compressive strengths are in line with previous research and show that it may be possible to use mixes produced from recycled plastics for systems that require lower strength concrete such as: concrete formed homes, pedestrian sidewalks, decorative concrete, and more. It was also discovered that the water demand was more than anticipated and deserves additional consideration. The Environmental Protection Agency's (EPA) "Reduce, Reuse, Recycle," campaign urges citizens of the United States to address the amount of waste they generate and how it is ultimately disposed. Keeping with the EPA's charge, this research showed that it is viable to keep plastics out of landfills by incorporating them in lower strength concretes.

145 - Modeling Groundwater Flow Experiment

Daniel Bunei and Beth Todd

The University of Alabama– Department of Civil Engineering
The University of Alabama –Department of Mechanical Engineering

EXTENDED ABSTRACT

There are commercial groundwater flow models that can be used to teach students about groundwater flow. However, involving students in building their own groundwater flow models experiment increases their enthusiasm and learning. The purpose of this experiment was to enable students to conceptualize and understand the working of an aquifer, contamination of groundwater sources and mathematical concepts of measurement and unit conversions.

Groundwater flow modeling experiment is done in a science classes. However, this experiment was done by six graders taking math therefore mathematical concepts of measurement and unit conversions had to be incorporated in the experiment. The students were fully involved in building a group groundwater flow models using locally available materials. They brought different types of soils and two liter plastic soda containers for their models to be built in school. GK 12 program provided syringes and food dyes used as contaminants in the experiment. Students were divided into groups of four before the experiment. The experiment was started by first building the groundwater flow models. Thereafter, the models were used to demonstrate the workings of an aquifer and contamination of groundwater.

This paper gives a brief description of aquifers, saturated and unsaturated ground zones, contamination of groundwater, soil horizons and learning about groundwater flow. The procedure for the experiment, the materials required and learning outcomes are outlined.

Modeling groundwater flow experiment simplified the explanation of aquifer recharge and depletion, and contamination of groundwater sources for six grade students.

This experiment was part of GK 12 program funded by NSF GK-12 Grant No. 0742504.

185 - A Case Study Comparing the Container Shipping Industry in the US and Panama

Tulio Sulbaran, Ph.D., and Matt Gathof

The University of Southern Mississippi

EXTENDED ABSTRACT

Container shipping is the service of transporting goods by means of high-capacity, ocean-going ships that transit regular routes on fixed schedules (World Shipping Council). The universal sizes of shipping containers allow them to be transferred seamlessly between trains, trucks, and ships. Over the last several decades, container shipping has become an even more important aspect of trade, with an increase of outsourcing due to globalization. Today, approximately 90% of non-bulk cargo worldwide moves by containers stacked on transport ships (Ebeling). The container shipping industry has been an integral part of the success of globalization. Shipping companies are forced to maximize value to remain competitive in global markets. Reduced import and export duties go a long way in minimizing the cost of container shipping. An excellent geographical location, the Panama Canal, tax-free processing zones, and a zero percent tax rate on profits made outside of the country make Panama a world leader in container shipping. Thus, this paper presents a case study comparing the container shipping industry in the US and Panama. In Panama, information gathered from experts at the Panama Ports Company and the Manzanillo International Terminal was used to formulate a thoroughly developed case study on the container shipping industry in Panama compared to that of the US.

CHAPTER 3
TECHNICAL SESSION 5
ABSTRACTS

Tuesday, March 12, 2013

Technical Session 5 10:25 am – 11:45 am

10:25 am – 11:45am	T5-A Prescott 208	T5-B Prescott 222	T5-C Prescott 225
Technical Session 5	Instructional Division III	Professional Skills Division II	Research Division II
Moderator:	*Richard Mines*	*Richard Kunz*	*Gillian Nicholls*

T5–A: Instructional Division III **PRESCOTT HALL 208**

125 - A Preliminary Investigation of the Effectiveness of Peer Ratings in Engineering Design Teams 3-83
Richard O. Mines, Jr. and Joan M. Burtner

189 - Student and Faculty Impressions of an Online Computer Based Signal Processing Lab 3-84
Thomas Murphy and Christopher Williams

194 - Using Technology to Enhance Undergraduate Learning In Large Engineering Classes 3-85
John Abbitt and Bruce Carroll

T5–B: Professional Skills Division II **PRESCOTT HALL 222**

157 - Modern Drone Warfare: An Ethical Analysis 3-86
Joshua Olson and Dr. Muhammad Rashid

140 - Project Haiti 2012: Providing an Experiential Learning Experience Through the Design and Delivery of a Water Purifier in Haiti 3-87

T5–C: Research Division II **PRESCOTT HALL 225**

196 - Humorous Improvisation Tailored for Technical Innovation 3-88
Peter Ludovice, Lew Lefton, Richard Catrambone

124 - Measuring engineering students' conceptual and empirical understanding of sustainability 3-89
Adebayo Ogundipe and Olga Pierrakos

113 - Integrating Research Experience into Entry Level Electrical Engineering Graduate Courses 3-90
Thomas Yang and Ilteris Demirkiran

* Abstract titles marked with an asterisk are presentation only and have no manuscript in the proceedings. 3-82

125 - A Preliminary Investigation of the Effectiveness of Peer Ratings in Engineering Design Teams

Richard O. Mines, Jr. and Joan M. Burtner

Mercer University

EXTENDED ABSTRACT

At the Mercer University School of Engineering (MUSE), participation in engineering design teams is an essential component of our engineering curriculum. Students who earn a Bachelor of Science in Engineering from MUSE must successfully complete three semester-long courses in engineering design. One course, Introduction to Engineering Design (EGR 107), is included in the freshman year curriculum; two courses, Senior Design Exhibit I (EGR 487/ ECE 485) and Senior Design Exhibit II (EGR 488/ECE 486), are included in the senior year curriculum. Faculty members at MUSE are using a peer rating system developed by Professor Rob Brown and refined by Professor Rich Felder to assist them in evaluating individual and team performance in these engineering design courses. For a specific assignment, students confidentially assess themselves and their team members using a nine-item rating scale that ranges from "excellent" to "no show". After assigning a numerical value to each rating, the instructor calculates a grade adjustment factor by dividing the team average rating (TAR) by the individual average rating (IAR). The grade adjustment factor is then applied to the final grade for the assignment or to the final course grade.

The objectives of this study were to investigate potential correlations between final course grades and average peer ratings as well as correlations between final course grades and individual self-assessment ratings. We also investigated the possibility that peer ratings would be influenced by minority status. Based on non-parametric statistical analysis, we drew the following conclusions:

- There were significant correlations between final grades and peer evaluations for the preliminary design report (PDR) at both the freshman and senior design level.
- Statistically, there was no significant correlation between peer and self reviews in the freshman design course. However, strong correlations existed between peer and self reviews for both the PDR and critical design report (CDR) in the senior design courses at a 0.05 level of significance.
- In the freshman design course, there was a significant difference in the ratings given *by* non-minority when compared to those given *by* minority students for the PDR; whereas, for the CDR, there was a significant difference in ratings given *to* non-minority students when compared to those given *to* minority students.
- In the senior design courses, there were no significant differences in the ratings given *by* or given *to* non-minorities and minorities.

189 - Student and Faculty Impressions of an Online Computer Based Signal Processing Lab

Thomas Murphy and Christopher Williams

Armstrong Atlantic State University

EXTENDED ABSTRACT

Introduction to Signal Processing at Armstrong Atlantic State University is a four credit hour course consisting of three lecture hours and three lab hours (3-3-4). Prior to fall 2012, this course has been offered using traditional face-to-face lectures and face-to-face laboratory time. In fall 2012, the course was offered as a hybrid course with the traditional face-to-face lecture component but with the lab component online. This was necessary due to the larger than usual number of students enrolling in the course and a shortage of computer lab space due to some campus renovations.

The introduction to signal processing lab is easier to convert to an online format than most engineering labs since it is computer based. The necessary lab equipment is MATLAB software and a computer capable of running the MATLAB software. Students taking online courses should already have a computer and a student edition of MATLAB can be purchased for $99 from MathWorks. The lab content is a combination of analysis and design work, advanced programming, and interpretation of results.

This paper presents student impressions of the online lab format, lab material dissemination, availability and convenience of help, lab assignment submission, return of graded lab assignments, as well as some initial comparison of student performance in the online lab versus past student performance in the face-to-face offerings of the lab. The paper also presents faculty impressions on lab preparation, mechanics of receiving and returning assignments, and grading lab assignments.

194 - Using Technology to Enhance Undergraduate Learning in Large Engineering Classes

John Abbitt and Bruce Carroll

Senior Lecturer, Department of Mechanical & Aerospace Engineering, University of Florida, Gainesville, FL

Associate Professor, Department of Mechanical & Aerospace Engineering, University of Florida, Gainesville, FL

EXTENDED ABSTRACT

Lecture classes with enrollments in excess of 250 students and lab classes with enrollments of over 100 have become the status quo at many universities, and it is expected this trend will continue with class sizes becoming even larger. Traditionally, it has been thought that the quality of the learning experience is diminished in such large classes. However, as we adjust to the new norm, we are finding that it is possible to actually improve the learning experience by employing new classroom technologies and better management of existing resources. Improved internet based content delivery technology provides opportunities for blended learning strategies. In this paper, we describe how two classes are conducted at the University of Florida that employ blended learning. The first class is an introductory fluid mechanics class with an enrollment of 265. In this class, three traditional lectures a week are video-recorded with students watching these on-line at their convenience. Students then attend one mandatory recitation section per week which is devoted to problem solving. The recitation sections are relatively small with enrollment limited to 30 students. During the recitation sessions, instructors serve in the role of facilitator or mentor as students work in teams of two to apply the content covered in the internet based lectures. Conceptual errors are identified and resolved efficiently as compared to traditional instructional approaches. The other class described in this paper is a fluid mechanics/thermodynamics laboratory class with an enrollment of about 100 each semester. In this class, laboratory demonstrations are recorded for student viewing and on-line quizzes are administered. Thus, pre-lab preparation is automated and standardized across instructors and teaching assistants. During the lab sessions, student preparation for the lab is improved by allowing more time for instructors to spend interacting with students on conceptual aspects of the experiments. Specific multimedia technologies utilized in these courses include Sakai e-learning system and Camtasia Studio screen/audio capture software. The University of Florida EDGE (Electronic Delivery of Gator Engineering) facilities are also utilized for recording lectures and delivering video content via internet streaming video.

157 - Modern Drone Warfare: An Ethical Analysis

Joshua Olson and Dr. Muhammad Rashid

University of West Florida

EXTENDED ABSTRACT

The revelation of drone warfare presents an onslaught of new and never-before considered ethical issues. These aircraft are the equivalent of the robotic armies discussed in so many science fiction novels. While indeed drones do a great justice by protecting the lives of our countrymen and preventing the unnecessary loss of thousands of soldiers' lives, the long-term impact of this approach is not yet well understood. Popular culture uses terms like "Convenient Killing", "Death by Remote Control", "PlayStation Mentality" and "Death Machine" to describe these drones. This very much describes some of the issues surrounding this technology. Drones simplify the time and effort required for effective military operations, and remove the soldier from the reality of the situation. It is very difficult to distinguish true drone operations from a video game, and in fact, the military markets such positions within the gaming industry. The thought being, if you can fire a missile in a video game with accuracy, you will be similarly effective behind a drone control console. With the ever-changing defense technology industry, our policies and strategies need to progress correspondingly, and so far, they have not.

Student Learning Activities

This work is intended to develop the following student learning outcomes (a) ability to identify a contemporary ethical issue, (b) the ability for life-long learning, (c) ability to disseminate the information in the form of research paper within ethical dimensions.

140 - Project Haiti 2012: Providing an Experiential Learning Experience Through the Design and Delivery of a Water Purifier in Haiti

Yung Wong, Johnathon Camp, Shavin Pinto,Kyle Fennesy, Marc Compere, Yan Tang

Embry-Riddle Aeronautical University, Daytona Beach, FL

EXTENDED ABSTRACT

The earthquake that destroyed much of Port-au-Prince, Haiti in January 2010 was a rallying point for Embry-Riddle engineering students to help in a hands-on, tangible way. The desperate need for basic necessities like food, water, and shelter motivated the students to respond with a strong desire to help. The student chapter of the American Society of Mechanical Engineers (ASME) promoted the effort and raised funds to build the Project Haiti 2010 water purifier. This unit was based on an earlier Civil Engineering department's senior design project and provided 1 gallon per minute (gpm) of clean water. One student and one faculty from Embry-Riddle joined a larger group's travel for the installation. The following year, Project Haiti 2011, eight students from the Clean Energy Club and faculty designed and installed a purifier system to deliver 4 gpm powered entirely from the sun [Tang, 9]. During the summer of 2012, a team of thirteen installed the Project Haiti purifier delivering 20 gpm in Onaville, one of Haiti's largest tent cities, which has a population of roughly 100,000 Haitians.

196 - Humorous Improvisation Tailored for Technical Innovation

Peter Ludovice, Lew Lefton, Richard Catrambone

Georgia Institute of Technology

EXTENDED ABSTRACT

The Enhancing creativity among U.S. engineers has been labeled a high priority by government, industry and educational institutions. We applied humorous improvisation to various engineering design classes by using the creative energy derived from humor as the stochastic fluctuations in a Monte Carlo search of idea space. Analysis of the initial results of various innovation workshops using improvisation allowed the development of a three step process ideally suited for technical innovation. While humorous improvisation has been used successfully for decades in generating business and marketing ideas, it has not been successfully applied to engineering innovation. This lack of success is due to a significant difference in the shape of idea space between technical and non-technical fields. Technical idea space is more constrained than its non-technical counterpart, and therefore requires a systematic procedure that reflects this fact. Our three step approach to engineering innovation uses humorous improvisation in an initial divergent step to traverse idea space. This is followed by a convergent and emergent step that is required to address the constrained nature of this idea space. This three step procedure was applied to engineering design in various academic and professional groups. We present an analysis of this method and how it effectively addresses technical innovation. How it can be applied to engineering design classes is also discussed. Analysis of these applications indicates that this three step approach is superior to humorous improvisation alone. Other tests indicate that this method can also be applied in a video conference format.

124 - Measuring engineering students' conceptual and empirical understanding of sustainability

Adebayo Ogundipe and Olga Pierrakos

Department of Engineering –James Madison University

EXTENDED ABSTRACT

Engineering professionals are in a pivotal position to influence the way societies function and as problem solvers, their primary responsibility is to produce solutions that work in the real world, with all the attendant constraints. Traditionally, engineers have tackled most problems pertaining to individual dimensions of sustainability retroactively, but current challenges facing society require a more proactive orientation to the teaching and practice of the profession. This indicates that engineers, engineering managers, and technologists are now being tasked with understanding the broader social, economic, and environmental implications of their work. There are currently many efforts to introduce sustainability concepts in various classes across engineering departments. However, these efforts tend to simply promote the appreciation of sustainability as an ideal rather than introduce specialized technical content necessary for providing engineering based solutions. If engineers are to be effective participants in sustainable development, sustainability must become part of the engineering practice paradigm. This, on the other hand, can only be achieved if it becomes an integral part of engineering education programs, not a mere 'add-on' to the 'core' parts of the curriculum. Embedding sustainability within the curriculum does not simply mean including new content. There is currently no available assessment instrument to gauge the competencies acquired by students in the variety of sustainable engineering education efforts. More so, there is no data that tells us if any of the learning objectives developed by various programs are truly in line with what will be expected of the next generation of engineers. This work proposes a framework for assessing the changes in the conceptual and empirical understanding of sustainability by engineering students as wells as determining the degree to which engineering graduates are being imparted with the requisite skills to solve engineering problems in the context of sustainable development by first, determining and articulating what these skills should be. A model for the development of a research track on measuring the degree of attainment of sustainability learning objectives is proposed. The ultimate goal is to develop a basis for curricula and pedagogical changes to engineering education in preparation for sustainability challenges. As the competency requirements for the next generation of engineers change in line with changing global challenges and foci, we need to ensure that we are indeed preparing engineering students to competently address the problems of today and tomorrow. The fact that many professional bodies acknowledge this necessity attests to the broad impact this area of research can transfer to society through engineering education.

113 - Integrating Research Experience into Entry Level Electrical Engineering Graduate Courses

Thomas Yang and Ilteris Demirkiran

Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

For engineering graduate students, it is highly beneficial to introduce research activities as early as possible in their graduate study. Through research activities, students develop domain expertise, gain an understanding of engineering research process, and improve their communication, problem solving, and critical thinking skills. Moreover, research experiences enhance student motivations in studying highly theoretical course materials, because they develop first-hand understanding of practical applications of such knowledge.

A common problem with Master's level engineering curriculum is the lack of research component in the beginning part of the curriculum, especially at primarily teaching institutions that do not offer Ph.D. degrees. Master's students are often not exposed to research experience until the time for thesis or graduate research project, which typically occurs during the last one or two semesters of graduate study. In this paper, we describe our recent effort in incorporating small-scale research project experience in two entry-level graduate courses in the Master of Science in Electrical and Computer Engineering program at Embry-Riddle Aeronautical University (ERAU). Supported by ERAU's Center of Teaching and Learning Excellence, we conducted initial experiments and assessment of the teaching practice in two courses: "Random Signals" and "Linear Systems". We concluded that many benefits were achieved, including: enhanced motivation in learning theoretical knowledge; cultivation of critical thinking and problem solving skills; ability of using popular software programs for research purposes; ability to interpret data obtained from computer simulations; ability to communicate effectively, especially technical writing skills. It is particularly noteworthy that, several students even asked for an additional research project to explore on their own at the end of the semester, which indicated the success of our teaching practice in inspiring students' enthusiasm in engineering research.

CHAPTER 4
Student Poster Session Abstracts

Student Poster Session Abstracts

Data and Image Compression with Discrete Wavelet and Cosine Transforms 4-4
Athanasios Athanason

EPRI Boiling Water Reactor Instrumentation Nozzle Scanner…… 4-5
Martin Ayers, Brett Fluery, Will Lawson, Gerald Stott, Jeremy Hines, Aaron McClure, Jordan Currington

Education for the Future: Learning IE Skills Through Interactive Port Security Simulation Models ……..…..4-6
Alex Beauboeuf

Education Virtual Site Visit……...4-7
Felicia Blake

Duct/Duct Taped Specimen Fatigue Tester ……..4-8
Michael Bradshaw, Jonathan Field, Justin Hayes

Systematic Assembly of PSI on Chemically Patterned Substrates…….……...4-9
Michael Neil Brown, Hannah Haines

Examination of the Influence of Internal Structure of Coronal Mass Ejections (CMEs)…….4-10
Alex Garcia Burgos, Antti Pulkkinen, Aleksandre Takakishvili, Dusan Odstrcil

Closing the Reverse Engineering Loop: Laser Scanning as the Bridge from Legacy Part to CAD to CNC Machining ……..4-11
Samuel Burns

Marine Compounds Against Drug Resistant *Plasmodium*.……...4-12
Justin Deithorn

Air Flow Visualization System Using IR Thermography……..……...4-13
Matthew Eubanks, Reed Gonzales, Aaron Huffman, Sean Miles

Instantaneous Frequency Division Multiplexing (IFDM): An Approach for *In Vivo* High Definition Video……..…..……...4-14
Samuel Ford, Benjamin Martin, James McCoy, Dennis Ogbe, Andrew Piras, Jesse Roberts, Charles Witherspoon

Take a Ride on the Mocs Express……..……4-15
Saama Davies, Jessie West, Thomas Anderson, Patrick Godfrey Wesley Ford

Cooperative Analog Wireless Analog Sensor (AWAS) Networks: A Low-Cost, Low Frequency Approach to High-Density Applications……..……..…..……4-16
Gus Gillen, Morgan Barcio, Alexander Bear, Jeffrey Burgess, Zachary Eason, Samuel Ford

Haptic Nature of Wood Finishes……..……..……4-17
Ryan Gott

Grant's Variable Height Chair……..…….……4-18
Matthew Faircloth, Marshall Guillot, David Harris, Tom Mammen, Jeremy Miller

Converting Locally Generated Waste Cooking Oil into Biodiesel……4-19
Parker Helble, Valerie Wade, David Vargas, Nathaniel Colins, Rekan Mirawdly

Blast and Impact Effect Analysis of Cementitious Armour Panels…….…….....4-20
Mason Hickman

Effective UI Design to Enhance User Interaction……..…4-21
Duong Thai Ho

Attitude Control of Satellites Considering Communication Delays……..…4-22
Gabrielle Jordan

In-Situ Condition Monitoring of Components in Small Modular Reactors…….…..…4-23
Victor Lollar

Dual Media BioSand Filter……...……..…4-24
Laura Lopez Sosa, Katie Safford, Paige Sforzo

Synthesis of Colloidal Quantum Dots and Selection of Ligand Chemistry ……..…4-25
Michael McCreary

CNC Machining Capability Study Using Full Carbide Tooling…...……4-26
Timothy Moye

Analytics for Theme Park Management…….4-27
Andrea Otero

Therapy Roller ……..……..…4-28
Ulyana Pugina, Dakota Huddleston, Orlando Lourenco, Matthew Robinson, Michael Winn

Independent 3D Rendering Software for Engineers…….……..…4-29
John Runyon

The Effect of Stitch Bolts on Bolted Timber Connections……...……..…4-30
Joseph Scobey

Increasing 3D Printing Accessibility Through a Low-Cost, Automated Workstation ……...…….4-31
Matthew Sheen, Devin Tiernan, Patrick Jansen, Maggie Murphy, Hunter Brunner, Curtis Beck, Taylor Giel, Darren Gottschall, Ryan Lemert-Smith

Serinity's Toliet Stool……..……..…4-32
Nicholas True, Conner Johnson, Shannon Sharpe, Ryan Seyer, Wes Hutchins

A Scalable and Decentralized Publish/Subscribe-Based Weather Alert System……..……..….4-33
Violetta Vylegzhanina

Production of Biodiesel from WYO Using Small Scale Continuous Ultrasonic Processor…….4-34
Jared Slayor, Seth Parrott

Analysis of Transportation on Lifestyle Choices in Lesotho, Africa…….....4-35
Bailee Young

Data and Image Compression with Discrete Wavelet and Cosine Transforms

Athanasios Athanason

The Citadel

EXTENDED ABSTRACT

Background

A Citadel Foundation grant was obtained to support a one year student research project to investigate signal compression techniques. This work also met the curriculum requirements for The Citadel's Honors Program. Data and image compression is of interest to a wide variety of entertainment, business and scientific endeavors. Signal compression of data reduces digital storage requirements and enhances speed of transmission. Although many data compression algorithms can be found in the literature, this research paper focusses on a comparison of the advantage of one linear transform over another. We have compared the ability of the discrete wavelet transform (DWT), and the discrete cosine transform (DCT) to condense the signal information.

Purpose

The purpose of this research is to investigate and compare the discrete wavelet and cosine transforms for signal compression. This is done in order to assess the compression advantages of using one transform over the other before the implementation of encoding and decoding algorithms.

Design/Method

This paper applied wavelet-based signal and image compression techniques to synthetic signals, and extended these methods to the discrete frequency domain using the DCT. MATLAB software was used to analyze short synthetic signals and images. Each signal or image was transformed using the discrete wavelet and cosine transforms, then recursive simulations compared compression efficiency of the transforms.

Results

The original and the compressed versions of the signals are shown for comparison. The peak signal to noise ratio (PSNR), and the signal entropy were calculated to measure the performance of the compression using each transform.

Conclusions

The transform that represented the signals with the fewest number of significant transform coefficient data points (i.e., with the least entropy), were found to performed the best. Future work will be conducted using more complex signals such as audio, communication signals, and medical images.

EPRI Boiling Water Reactor Instrumentation Nozzle Scanner

Martin Ayers

University of North Carolina at Charlotte

EXTENDED ABSTRACT

Background

The current standard to detect leaks or cracks in a nuclear plant boiling water reactor (BWR) instrumentation nozzle is insufficient early in a nuclear reactor's refueling process. Current scanning methods must wait until the second week of the outage, once the reactor is drained, before the scan for defects can take place. This delays the reactor coming back online, if a defect is discovered, and could end up costing the company millions of dollars for each day the power outage must be lengthened. By designing a device that can detect a defect of any size and its position early in the two week long refueling process, proper measures can be taken to fix the issue to prevent any kind of outage extension.

Purpose

This device was designed to scan the instrumentation nozzles of a BWR for any defects in the early stages of the refueling outage by allowing the scan to take place before the reactor is drained, and without the need for an operator to descend into the BWR. By detecting these defects early on, proper action can be taken to fix the issue without lengthening the two-week outage.

Design/Method

The device was broken down into several subsystems to carry out the appropriate scan of the BWR instrumentation nozzle. Several ideas and methods were researched and analyzed for each subsystem before a specific method was chosen and further developed. A full integration of the individual subsystems was put together to complete the initial design of the device.

Results

The device was designed to attach to a pole and descend to the appropriate depth of the specified instrumentation nozzle in the BWR. The device, using a suction cup method of attachment, can secure itself to the inside wall of the BWR. The device uses ultrasonic time-of-flight diffraction to scan the initial 4 inches of the nozzle and relay the results and their positions back to the operator outside of the reactor. The device has the ability to conduct the scan in the warm, radioactive water of the BWR at depths of up to 100 feet. The final design was modeled in SolidWorks and an animation was used to verify the dynamic operation and geometries of the final design.

Conclusions

This device will provide the user with a safe and reliable method of scanning instrumentation nozzles of a BWR at an early point in the refueling process, enabling the company to catch and fix defects while cutting back on the risk of extending a scheduled power outage. The team will continue with an implementation phase to manufacture and test the physical prototype during Spring 2013.

Education for the Future: Learning IE Skills through Interactive Port Security Simulation Models

Alex Beauboeuf

North Carolina A&T State University, Department of Industrial and Systems Engineering

EXTENDED ABSTRACT

Background

The maritime system is a vital part of the economy and our way of life. Disruptions to this system can be very costly. Hurricane Ike caused 14 refineries in Texas to be shutdown which caused a major disruption in energy supplies nationwide. The 2002 west coast (Los Angeles/Long Beach) port shutdown due to labor disputes caused the U. S. economy to lose approximately 6.3 to 19.4 billion dollars. Many students are unaware of the role of the maritime transportation system as well as the role of the Department of Homeland Security in protecting the nation's ports and waterways from natural and manmade threats that can disrupt operations. This project seeks to increase maritime domain awareness among Industrial & Systems Engineering students through the use of an interactive simulation model of the maritime system.

Purpose

The main objectives of this research project are to 1) develop a case study based on the operations data obtained from the Port of Wilmington, NC; and 2) evaluate the effectiveness of the case study along with an interactive simulation model as a tool for increasing awareness about port operations and port security. The case study seeks to reinforce skills related to simulation model development, data analysis, and analysis of queuing systems.

Design/Method

First, instructional guides were created explaining how to interpret and execute the simulation model. Then, a case study was developed using operations data on vessel arrivals, departures, and cargo type. The study also requires students to use Excel as a primary analysis tool. The design of the case study was modeled from similar quantitative case studies published in *INFORMS Transactions on Education*.

Results

The case study was applied in one undergraduate statistics course. Additional courses in queuing theory and operations research offered in subsequent semesters will also make use of the case study. Preliminary results show the simulation model can be effective in increasing maritime domain awareness; In particular when questions are developed that require students to modify the model and interpret the model results.

Conclusions

Case studies are a major tool used to teach data analysis and queuing models. They provide students a real life example of a problem that utilizes the skills learned in the classroom environment which are needed in order to solve various problems.

Educational Virtual Site Visit

Felicia Blake and Dr. Hussein Abaza
Southern Polytechnic State University

EXTENDED ABSTRACT

Background

Within the past few decades, the advancement of technology has become the driving force of increased innovative ideas and has opened doors to a world of endless knowledge and information. One way technology is used to inform people is virtually, specifically through virtual site visits. A virtual site visit allows a person to experience a location without out having to physically be at the location. Virtual site visits can either be live or pre-recorded and are usually conducted with the use of digital media such as photography or video. In this research, live virtual site visits were conducted in the main Engineering building of Southern Polytechnic State University with students of a local elementary school called Marietta Center for Advanced Academics (MCAA).

Purpose

The purpose of the research project was to test how informative a virtual site visit would be to students who did not have the opportunity to visit the campus of Southern Polytechnic State University, and to have them experience how life would be at college if they chose a career in the Engineering field.

Design/Method

The virtual site visit consisted of a videographer, who was stationed at the college, a professor, who was there at the elementary school to help explain, and students who attended the Marietta Center for Advanced Academics. The devices used during the virtual site visits were an IBM ThinkPad Laptop, Panasonic 26x optical zoom video camera, headphones with microphones, wireless networking and a video calling program called Skype. Two virtual site visits were conducted at different times with two different groups of students, one being third graders and the other being fourth graders. For each group, we had the students set up in a classroom that had a projector and screen connected to the school's networking server. The students were connected to Skype which allowed them to connect with the videographer at SPSU who gave them a tour of the Student Center, Architecture Building and Engineering Building. The videographer was equipped with the IBM ThinkPad, which was connected to the SPSU's wireless network, along with the Panasonic video camera and headphones with microphone that was connected to the laptop. In the Engineering Building, the students were able to see the labs that consisted of different types of machinery used to teach college students. The students were also able to have an interview with a professor, Dr. Adeel Khalid, who discussed aerospace engineering and answered the many questions that the students inquired toward him. Throughout the entire process, students were able to engage, ask questions and request to have the videographer zoom in on certain areas of interest.

Results

Students from both classes expressed a high level of interest toward the information that was shown to them. Discussion between the videographer and students was very engaging since the students asked several questions and even shared some of the knowledge they knew about machinery and engineering. The part of the tour that was of real interest to the students was the discussion of aerospace with the Dr. Khalid, especially dealing with the space shuttle. Specifically, the students were fascinated by the information of the launching a space shuttle how the jettison process of the fuel tanks from the craft.

Conclusions

The results proved that virtual site visits are beneficial in relaying information in an educational environment. Further virtual site visits will be conducted in an attempt to inform more students about the possibility of learning without actually having to be at a location.

Duct/Duct Taped Specimen Fatigue Tester

Michael Bradshaw, Jonathan Field and Justin Hayes

Western Kentucky University

EXTENDED ABSTRACT

Background:

Engineers at our client company, which specializes in plastic and adhesive products, need to continuously improve their high performance tape. This duct tape currently meets the very challenging requirements of Underwriters Laboratory (UL181A) certification for the HVAC Industry. They are one of the few companies that produce a duct tape that meets these requirements. In order for them to remain competitive, it is necessary to research alternate designs and production methods to reduce the cost. However with each new design or process change, the duct tape must be re-tested and meet the requirements of UL181A to maintain its certification. This testing is very costly and time consuming. Therefore, it would be very valuable for them to have an understanding of how their design and process changes have affected the performance of duct tape prior to submitting a sample for certification.

Purpose:

The client has requested that the Department of Engineering, Mechanical Engineering Program at Western Kentucky University, assist them in the designing, building and commissioning (DBC) of a duct/duct taped specimen tester to demonstrate duct tape performance against the requirements of UL181A, Part I, Section 13 - Temperature/Pressure Cycling Test. With this air pressure fatigue tester, they will be able to have a way of knowing whether or not the design or process changes, have improved or adversely affected the ability of the tape to meet UL181A. The thought process being if the tape passes their in-house test, then they will know that the modified tape is ready to be subjected the UL181A test battery, but if it fails the in-house test, they save time and money by not submitting for certification. This effectively allows them to prescreen their product, and thereby, greatly reduce their cost of developing UL certified products.

Design/Method

In order to meet UL181A, the final system must pressurize and then depressurize the duct/duct tape specimen to prescribed levels, while being conditioned in various temperature and humidity conditions, much like blowing up a balloon and then letting the air out. This pressurization and depressurization cycle is repeated for thousands of cycles. While doing so, it must also monitor leakage rate and establish pass/fail criteria based on said standard leakage rate thresholds within a number of cycles. This tester is destined to be used in the process development laboratory at the client's location so it must be a turnkey solution requiring little to no interaction by plant or laboratory personnel except in the initial test setup process.

Results

At the time of abstract submission, the fatigue tester system has not been completed. Therefore, further details on this DBC project will be presented at the student conference poster session.

Conclusions

The goal of this project is to design, build and commission a duct/duct taped specimen fatigue tester. The tester must meet the test protocol as outlined in UL181A, Part I, Section 13 - Temperature/Pressure Cycling Test. This tester will allow our client to assess the impact of design and process changes on their duct tape performance.

Systematic Assembly of PSI on Chemically Patterned Substrates

Michael Neil Brown and Hannah Haines
University of Tennessee

EXTENDED ABSTRACT

Background

In nature, plants and algae have evolved an advanced photosynthesis mechanism that harnesses solar energy with nearly 100% quantum efficiency. In doing so the mechanism uses Photosystem I (PS I), a supramolecular protein complex, that functions as a biological photodiode and undergoes photochemical charge separation resulting in unidirectional electron transfer between the reaction center (P700) electron donor on the lumenal side and Fe-S clusters (F_A, F_B, F_X) at the stromal side[1]. The structure and dimensions of PS I being well-characterized[2] (Fig.1), the excellent photo-electrochemical properties of PS I makes it an ideal candidate for incorporation into solid-state bioelectronics or hybrid photovoltaic devices[3-5]. Such devices will be the next generation of high efficiency solar panels, potentially having a huge impact on renewable energy sources.

Purpose

The purpose of this line of research is to characterize the bio-hybrid system of PSI and solid surfaces in order to create the next generation of high efficiency solar panel.

Design/Method

In order to study the system, we have carried out many experiments in both solution and solid phase. The solution phase experiments have been primarily carried out to characterize the interactions of PSI with solvating detergents. These experiments are necessary in order to construct a robust procedure for creating the bio-hybrid devices. Also, many different measurement techniques have been performed on the solid state samples, such as Atomic Force Microscopy and Scanning Electron Microscopy as well as Fourier Transform Infrared Spectroscopy. These techniques have been employed to determine if the protein is systematically attaching to the surface. Our most recent solid state endeavor utilized chemically patterned substrates in order to detect single PSI deposition on gold islands. In order to accomplish this, we had to design a chemical tailoring scheme involving a combination of PEG Silanization as well as Thiolation. Two different methods of Silanization, Majumdau and Gao, were tested. In addition to the techniques I use most often, another graduate student in the same lab works in solid and liquid state to determine the electronic activity of PSI.

Results

In our set of experiments involving chemically patterned substrates (gold nanodots), we obtained stronger protein signatures over the silicone background of our nanopatterned samples when we used the Gao method of Silanization.

Conclusions

From our experiments involving the tailoring of solid surfaces to promote specific attachment of PSI, we can conclude that the combination of Silanization and Thiloation are effective in controlling where PSI attach. Furthermore, we concluded that the Majumdau method of Silanization was more effective. Ultimately, these have been the first steps toward controlling specific attachment of PSI.

Examination of the Influence of Internal Structure of Coronal Mass Ejections (CMEs)

Axel García Burgos *(ERAU)*, **Antti Pulkkinen** *(CUA)*,
Aleksandre Taktakishvilli *(UMBC)*, **Dusan Odstrcil** *(GMU)*
NASA Goddard Space Flight Center

EXTENDED ABSTRACT

The main purpose of this research is to determine the influence of internal structure of Coronal Mass Ejections (CMEs) on their propagation in the Heliosphere using WSA-ENLIL Cone Modeling[1]. The Integrated Space Weather Analysis System (ISWA) and Stereo analysis tool were used to obtain several CME parameters. The ENLIL Cone Model was used to run 90 simulations for different cavity parameters of CME internal structures. The relationship between the cavity and CME propagation time and Kp index was studied for 15 CME events. As expected, when the velocity of CME is higher than the ambient solar wind speed, CME with smaller cavity (more heavy ones) propagates faster than the same size CME with larger cavity (lighter CMEs). Quite naturally the opposite behavior is observed when the velocity of CME is less than the solar ambient wind speed. For fast CME velocity the Kp index tends to decrease as the cavity increases while for slow CME velocity the Kp index remains constant. This research is very important for improving model capability to forecast space weather.

Closing the Reverse Engineering Loop: Laser Scanning as the Bridge from Legacy Part to CAD to CNC Machining

Samuel Burns

Western Kentucky University

EXTENDED ABSTRACT

Background

Reverse engineering is the process of creating a digital computer model from an existing physical object that might be too difficult to reproduce directly on the computer screen in a computer aided drawing (CAD) package. In the past, parts were measured by hand and computer models created that attempted to closely resemble the part. Current techniques in laser scanning parts have greatly improved this process; no longer must the engineer physically touch the part to capture its size and shape. If the intention is to create a part that can be machined, the challenge becomes to create a work flow that results in a model recognizable by the programming software (CAM) used to control the machine tools.

Purpose

The goal is to produce open source CNC model workflow documentation that can be shared within the scanning community of users. Scanner manufacturers have made these devices attractive to schools and colleges, but little information exists on how to use the systems effectively for CNC preparation.

Design/Method

A range of parts were created in Solidworks, 3D printed, and then scanned for reverse engineering practice. They were designed to define operational limits to see how well objects could be scanned for eventual machining .

Results

Laser scanning using the NextEngine scanner provided reliable scan and 3D mesh files on most parts. Sufficient data to describe the geometry can be obtained, although multiple scans might be required to reach undercuts and hidden areas.

Watertight models for 3D printing are easy to achieve, while models for CNC programming are a greater challenge. Automatic surfacing worked to create a “dumb solid” such as a STEP or IGES file. However, this often results in complex small surfaces requiring 3D toolpaths, even on surfaces that should have been a flat plane. The best results were obtained using Rapidworks for generation of parametric models derived from the scan data. This is an add-on to the NextEngine scanner. However, adequate results were obtained using the Scan-to-3D add-on included in the student version of Solidworks. This feature allowed Solidworks to import the scan data directly, which could then be used to create planes and surfaces for the creation of solid geometry for easy programming.

Conclusions

Laser scanning for reverse engineering to CAM proved to be an effective profess, with the final results dependent on the techniques selected to process the mesh. Two useful methods were found, with Solidworks Scan-to-3D being the widest choice available to students.

Marine Compounds Against Drug Resistant *Plasmodium*

Justin Deithorn

University of Central Florida

EXTENDED ABSTRACT

Background

The term malaria in Italian means 'bad air', coined through its association with marshy areas (Tuteja, 2007). Malaria has been a problem for more then 4,000 years and to this day we still struggle to fight it off, with 40% of the world's population living in endemic countries (Malaria, 2012; Sullivan, Kaludov, & Martinov, n.d.). The first medicinal remedy utilized against malaria was Quinine, found in the bark of the Cinchona tree (Wells, 2011). Later around 1971, it was synthesized as Mefloquine (Wells, 2011). There have been many other novel antimalarial drugs developed from natural compounds, such as Artemisinin derived from wormwood and developed in 1971 (Wells, 2011). Due to the repeated use of the available antimalarial drugs over an extended period of time, the *Plasmodium* strains have developed a resistance to various drugs (Ginsburg & Deharo, 2011). With malaria being one of the most deadly and dangerous diseases, there is a high need for new drug development (Guantai, & Chibalea, 2011).

Design/Method

This study will take 100 marine fractures and test them against drug resistant strain of *plasmodium falciparium* for viable antimalarial drugs. The marine fractures acquired from HBOI are aliquoted in various serial dilutions (.01, .1, 1, 10 micrograms/milliliter) containing drug resistant *plasmodium falciparium* infected red blood cells in phenol red free media (Plouffe, Brinker, McNamara, Henson, Kato, Kuhen, & ... Winzeler, 2008; R. Bracken, personal communication, February 7, 2013). Utilizing 1 millimolar of Cloriquine as the positive control and an uninfected culture for the negative control and the serial dilutions of the marine fractures to create an IC_{50} curve utilizing the program Prism from graph pad. If the serial dilution of 1 micrograms/milliliter or less passes the IC_{50} test the compound is then tested for cytotoxicity (how toxic the compound is the human body). Cytotoxicity is determined using fibroblast cells (they are the cells that make up the connective tissue throughout the body) to test serial dilutions of the marine compound fractures in fibroblast cell media. The fibroblast cells are treated with varying concentrations of compound and then read MTS assay (cell viability assay) using a cell titer glo by promega (Poluffe et al., 2008; R. Bracken, personal communication, February 7, 2013). If these tests are passed the fracture is a good candidate for animal trials. A marine fracture may pass the cytotoxicity test but fail at animal trials due to only fibroblast cells being tested. If successful in animal trials it can be presented for human trials and drug approval.

Results

On average natural product fractions have a higher hit rate then synthetic compounds about a 10% hit rate compared to 1% hit rate of synthetic compounds (R. Bracken, personal communication, February 7, 2013). Out of the 10% that have passing IC_{50} levels only about 1-2% will have expectable therapeutic windows (R. Bracken, personal communication, February 7, 2013). This is the point where it kills off the *Plasmodium falciparium* while still being safe for human use. This selectivity index is determined by dividing the cytotoxicity value by the IC_{50} value (R. Bracken, personal communication, February 7, 2013). A selectivity index level of 10 or higher will only be considered fore drug approval (R. Bracken, personal communication, February 7, 2013). The selectivity index is highly important with malaria due to malaria effecting 85% of children under five years of age (Wells, 2011). So only 1 to 2 fractions out of the 100 will be viable drugs and even those hits still need to have the active fraction isolated (find out what is directly effecting the virus for possible synthesizing of the fraction).

Air Flow Visualization System Using IR Thermography

Matthew Eubanks, Reed Gonzalez, Aaron Huffman and Sean Miles

Western Kentucky University

EXTENDED ABSTRACT

Background

Building science thermography requires the knowledge and understanding of where and how heat transfers and air flows throughout a building envelop. Infrared thermography is one of the most valuable diagnostic tools for building energy efficiency, and for air leakage, handler (i.e., fans, blowers) and distribution (i.e., duct/plenums, registers and diffusers) systems. Of particular interest is the ability to "visualize" convective energy loss due to air leakage from the building envelop or duct system. Of course, all thermographers recognize that air is transparent in the infrared spectrum. This statement is valid for traditional cameras, both long or medium wave regions, and from a rather short distance of observation. Transparency means no absorption, which translates into no emission. Thus, in the end, air cannot be imaged directly.

Purpose

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) provide annual support for senior projects through its Senior Undergraduate Project (SUP) Grant Program. The Mechanical Engineering Program in the Department of Engineering at Western Kentucky University received a SUP Grant for academic year 2012-2013. The purpose of this project grant is to design, build and test (DBT) a simple and easy-to-implement indirect visualization system. This will aid the energy auditor in visualizing air flows with IR thermography when a building surface is not readily available to image this convective heat transfer phenomena. Excessive air leakage in building envelops or from duct systems is known to be a major contributor to the energy consumed in conditioned buildings. With this tool, an estimate of energy losses and mitigation methods can be determined.

Design/Method

A calibrated Air Moving Device (AMD) such as a blower door/duct blaster is used to achieve the desired air flow rate for the system. The Air Flow Visualization System (AFVS) also conditions the air to a desired temperature sufficiently high enough above or below the room air temperature to produce a discernible thermal image. An infrared camera is used to capture these visual images of the conditioned air "spilling" perpendicular to an opaque, low conductive and high emissivity screen. Other quantifying data such as air flow rate, pressures and temperatures are recorded and correlated to this captured image.

Results

At the time of abstract submission, the AFVS system has not been completed. Therefore, further details on this DBT project will be presented at the student conference poster session.

Conclusions

The goal of this project grant is to design an air flow visualization system using infrared thermography. Discernible thermal images and patterns produced by the AFVS can give a field energy auditor insight into leakage or flow rates, which can then be used to estimate energy loss and implement mitigation methods.

Instantaneous Frequency Division Multiplexing (IFDM): An Approach for Wireless *In Vivo* High Definition Video

Samuel A. Ford

Tennessee Tech University

EXTENDED ABSTRACT

Background

In modern minimally invasive surgery, doctors are able to perform an entire surgical procedure through a single incision. This procedure is much less traumatic on the body and can leave the patient with no scarring. To perform this surgery a single endoscopic cameras is inserted through the abdominal wall to give the surgeon an *in vivo* view. This technique makes it difficult for surgeons as multiple surgical tools all occupy the same incision.

Purpose

Since the surgeon has only one small incision to work with, there is a need to provide more space in the opening. A few ways to make this procedure more efficient are to make the endoscopes wireless and to make the video high-definition as surgeons are accustomed to with current procedures. This project will present a new analog modulation and multiplexing technique for wirelessly transmitting high-definition video using hardware which is smaller in size and less expensive than a comparable digital system. In addition to the RF front end, a digital system for transmitting high definition video requires numerous digital components including processors, encoders, and analog-to-digital converters. For applications such as surgical endoscopy, the cost and size of these digital components is prohibitive. Large and expensive digital components can be avoided entirely by keeping the signals analog.

Design/Method

High-definition video components can be transmitted wirelessly using a new analog modulation scheme which will be referred to as instantaneous frequency division multiplexing (IFDM). Each video component is frequency modulated and then transmitted. The receiver will utilize a hybrid phase-locked loop to track the orthogonal instantaneous frequencies. Unlike frequency division multiplexing (FDM) which requires each signal to occupy separate frequency bands, the use of orthogonal instantaneous frequencies allows the video components to occupy the same bandwidth and benefit from the modulation gain of FM.

Results

The IFDM technique will be demonstrated through simulation and a prototype hardware implementation. It is expected that the performance of this system will be comparable to digital modulation schemes, but with fewer cost and size requirements. The signal to noise ratio, bandwidth, range and fidelity of the system will be determined and compared to a similar, wired, digital system.

Conclusions

Our solution to this problem is a novel approach to modulate the individual video signals. They will stay analog, which eliminates the need for an overwhelming amount of electronics. To the best of our knowledge this will be the first time such a system has been developed for wireless high-definition video transmission. Finally, possible applications and topics for future research will be proposed.

Take A Ride On The Mocs Express

Saama Davies

University of Tennessee at Chattanooga

EXTENDED ABSTRACT

Background

For approximately 10 years, UTC has used the Mocs Express, a train body on a jeep frame, for football games and other events. In recent years, the train has fallen into a state of disrepair. For example, the smokestack was held in place with bungee cords and the fog lights were attached to the front of the train with duct tape. The hood of the train was unstable and had a problem of opening on inclines. Also, the operators needed to make announcements through a public address (PA) system.

Purpose

The design team's goal was to repair the Mocs Express to increase its capability to promote school spirit.

Design/Method

The major systems focused on during the Mocs Express train's renovations were the smokestack, the PA system, and the hood. To aid in creating designs for the train's problems, the team used decision matrices, objective trees, function node trees, sketches and computer modeling.

Results

The smokestack was designed to be stabilized by replacing the current mounting bracket with two cross-beams connected in the center. The solution for the PA system consisted of a control box mounted inside the cabin. Additionally, a microphone was attached to the PA system to project announcements. To secure the hood, a latch was installed on each side of the train. These were attached to the underside of the hood, while the tension brackets were attached to the cabin. This design removed the possibility of the hood opening unexpectedly.

Conclusions

All the implemented solutions met the expectations set at the beginning of the project of the customer. This was expressed by the customer's approval.

Cooperative Analog Wireless Analog Sensor (AWAS) Networks: A Low-Cost, Low-Frequency Approach to High-Density Applications

Gus Gillen

Tennessee Tech University

EXTENDED ABSTRACT

Background

There is a great need for inexpensive, wireless sensor networks. Being able to control and monitor everything around us drives and facilitates our research. Such control is ubiquitous in the modern world with sensors included in many common products that contain electronics. In a world constantly growing more dependent on technology, we are always searching for more cost effective ways of communicating between people, machinery, and the real world.

Purpose

We are developing an analog wireless analog sensor (AWAS) capable of being mass produced with the ability to operate cooperatively in a low-cost radio frequency channel. This device should be small enough to be placed *en masse* and be able to transmit the signal produced by the sensor in the analog domain. Avoiding conversion from analog to digital - which can be much more expensive than using analog parts – is the focus of this work. By avoiding digital conversion we are also avoiding losses in signal fidelity suffered due to quantization errors.

Design/Method

The actual signal we will be sending should be assumed to be steady or slowly varying which is valid for various types of sensors: temperature, power, radiation, acoustic, etc. The data pulse will contain a training voltage to probe the communication channel, the actual sensor information, and an individual ID voltage for each unique sensor. The bandwidth of the signals will be small due to the constant nature of the proposed communication protocol and obviate the need for a medium access controller.

Results

As mentioned earlier the measured values will change very slowly with respect to time and therefore the transmitted messages should contain only a single tone and use minuscule bandwidth. We will be looking at factors such as signal to noise ratio (SNR), spectrum efficiency, range, cost, and size compared to a similar digital WSN in hope of constructing a more accurate analog transmitter than an equivalent digital signal while at a lower cost.

Conclusions

Although we are currently only working on research and proof-of-concept results, we could potentially go well beyond that by introducing a practical and useful product to industry and research communities. By creating a low cost alternative to typical wireless sensors, including a potential for equivalent accuracy at a lower cost and greater spatial range, we have a chance to make something important for future applications in wireless sensing.

The Haptic Nature of Wood Finishes

Ryan Gott

Western Kentucky University

EXTENDED ABSTRACT

With the growth of touch-screen technology there has been an increased interest in the friction characteristics of skin, especially the fingertip on flat surfaces. This haptic nature of many different materials had been studied, but wood finishes have not been explored. This is an important area to study because friction affects interactions with objects. Wood finishes are used for many purposes and serve to protect the wood from deterioration. In some applications, the tactile quality of the finish is important. Wood-based products like furniture, sports equipment, tools, and instruments can be judged more functional as a result of their tactile quality. Surfaces with a slippery response will function differently than those with a sticky response. Moreover, it has often been noted that a wood masterpiece invites the viewer to touch it, and that action has a significant impact on perceived quality. The goal of this project was to quantitatively define the frictional effects of different wood finishes for the use of fine woodworking.

Using a state-of-the-art test device, the frictional properties of skin on different wood species and wood finishes were tested. Chosen for their closed-grain structures, the woods used were Eastern White Pine (*Pinus Strobus*), North American Cherry (*Prunus Serotina*), and Birdseye Maple (*Acer Suchrum*). Chosen for their ability to be applied by spraying so that surface textures could be consistent, the finishes used were Zinsser® shellac (product number 00408), Deft® lacquer (both clear gloss and clear satin), and Minwax® polyurethane (both clear gloss and clear satin).

The friction coefficients of a finger on those surfaces ranged from kinetic values of 0.22 to 5.42 and static values of 0.46 to 4.80. Unfinished wood had the lowest friction coefficients of the samples evaluated. The results showed that the satin finishes had lower friction than the gloss finishes on each type of wood. On average, a satin finish has 1/3 the friction of a gloss finish. The increased and very high friction from skin on gloss finish suggests an adhesion mechanism is a strong factor in the friction system. The data also demonstrated that moisture in a hydrated finger increases friction in both satin and gloss finishes. The research presented is the first to quantitatively define the tactile feel of wood surfaces. These results show that there is a tremendous difference in friction between wood finishes. This addresses the gap in literature by quantitatively describing the tactile feel of a wood surface and finish. These consumer-friendly results will be of use not only in the fine woodworking world, but also to anyone purchasing furniture or finishing wood. Also, finishes with a higher static friction, such as lacquer gloss and shellac, will now be known for having a better grip.

Grant's Variable Height Chair

Matthew Faircloth and Marshall Guillot

University of Tennessee at Chattanooga

EXTENDED ABSTRACT

Background

Every year, the University of Tennessee at Chattanooga partners with special needs organizations in the Chattanooga area. Signal Centers Inc. provides several projects and opportunities for the UTC Engineering Design students each semester. The Variable Height Chair was designed for an individual by the name of Grant Nunley. Grant is a special needs student at Signal Centers Inc.

Purpose

The Variable Height Chair was designed to provide Grant mobility around the homestead at different locations and in reference to height and position. The chair's sole purpose was to safely contain Grant while still allowing him to interact during play time, dinner, and social events.

Design/Method

The team talked to Grant's parents to have a better understanding of the individual needs of Grant as well as the parents' preferences. The specific need of the chair was to change heights between household surfaces such as countertops, dinner tables, and coffee tables. The chair needed to be easily transportable, in case the parents wanted to commute with the chair outside of the home. The chair was designed to safely contain Grant in and around the homestead daily. The chair needed to fit into ADA compliant doorways to allow ease of accessibility. The team created several design options by brainstorming and rough sketches to determine different ways to lift the chair. The team then evaluated the design's compliancy to the client's needs through the use of morphological charts. This process provided the methodology in selecting the chair's final design.

Results

The final design of the Variable Height Chair met all the needs and wants specified by the client. Grant's chair easily changes heights with an adult's assistance. Gas shocks were implemented into the design to assist in raising the height of the chair. The chairs surface height accessibility ranges from 22 to 42 inches. Rollers were used on the chairs base to allow mobility in the home. The chair's dimensions allow full accessibility to ADA compliant doorways. The chair can easily fit into a trunk of a standard size car after breakdown.

Conclusions

Overall, the chair met all the needs of the client. The client was contacted approximately nine months after the completed chair delivery to follow-up concerning any design flaws, safety concerns, or suggestions. The client was highly satisfied with the overall design and product and suggested that there were no issues concerning the variable height chair.

Converting Locally Generated Waste Cooking Oil into Biodiesel

Parker Helble

James Madison University

EXTENDED ABSTRACT

Background

This research was prompted by an engineering capstone project that has been in progress for over a year. This research is unique in that it utilizes a highly mobile continuous flow reactor to produce biodiesel wherever it is required. The results will be used virtually anywhere there is a supply of waste cooking oil and a need for diesel fuel – reactor designs can be replicated if proper plans are provided.

Purpose

The main problem with the current method of quality biodiesel production is cost. The goal of this project is to minimize the cost of biodiesel production by generating biodiesel from locally collected waste cooking oil. By doing this, the transportation costs associated with current biodiesel production systems will be significantly reduced. The end deliverables of this project will be a mobile continuous flow reactor to fit the team's customer needs and a general reactor design equation that allows the optimal reactor design to be determined for a given set of customer needs.

Design/Method

Two issues with current biodiesel production processes that the team focused on improving through this project were transportation costs and mixing of reactants. The team chose to utilize a packed bed style reactor because, theoretically, it allowed for significantly better mixing of reactants than a traditional batch reactor. In addition, the packed bed reactor allows for continuous conversion of varying volumes of waste oil which resulted in a more compact and mobile final reactor design. Once the optimal type of reactor was determined, the team worked to create a general reactor design equation that could be tailored to calculate the ideal reactor volume required to meet a specific set of customer needs.

Results

The following equation calculates the minimal reactor volume for a given combination of customer needs and reaction conditions.

$$V_R = \frac{5Q_{WO}t_r}{4\varepsilon} = \frac{\pi(D_R)^2}{4} * L_R$$

Q_{WO} is waste oil input flow rate, t_r is the reaction time at STP (90 minutes), ε is the void ratio for a given packing material, D_R is the diameter of the reactor (limited by manufacturer), and L_R is the length of the reactor (limited by need for mobility).

Conclusions

A general reactor design equation that can be utilized to meet an infinite combination of customer needs was generated by the team. This equation was used in conjunction with defined physical constraints, experimentally determined packing material data, theoretical input ratios, and theoretical transesterification reaction time values to design and build a packed bed reactor of optimal size and to acquire pumps that provide variable flow rates that satisfy our needs.

Blast and Impact Effect Analysis of Cementitious Armor Panels

Mason Hickman
Vanderbilt University

EXTENDED ABSTRACT

Background

The U.S. Army Corps of Engineers has been undertaking extensive research regarding the usability of cementitious materials for defense applications. The Advanced Fundamental Concrete (AFC) Model was developed in order to more accurately model high-velocity projectile impact of Ultra-High Performance Concrete (UHPC) armors by defining a reduced tensile failure surface which included the effects of shockwave propagation caused by ballistic projectile impact.

Purpose

This research focused on developing an improved material model to simulate the performance of Ashcrete, a UHPC developed for the purpose, subject to high-velocity projectile impact and accurately characterize the parameters of the model based on a series of standardized test undertaken for the purpose. The resulting model was then used to simulate scenarios likely to be encountered during asymmetric warfare, such as IDE blast action and small arms fire. Projectile penetration resistance of a single and stacked armor panels were undertaken to assess the relative effectiveness.

Design/Method

Experimental results detailing the behavior of Ashcrete in compression, tension, flexure, as well as strain-rate dependence were generated by the research team working on the U.S. Army project. An algorithm was developed in MATLAB to characterize the material constants for implementation in several previous material models for concrete. The constitutive equations of the AFC model provided the most reasonable fit of the experimental data. Improvements were made to the AFC Model to more accurately describe the high-strain rate as well as confining behavior of UHPC. ABAQUS Commercial Finite Element Software was used to perform several projectile impact simulations by implementing VUMAT code to represent the improved material model. Blast wave data were generated by DOD's software ConWep for 25 lbs of TNT detonated at a distance of 25' from the panel to determine if the added effect of the pressure shock wave during projectile impact caused significantly more damage to the armor panel.

Results

A fragment simulating projectile test was undertaken using the improved AFC Model. An element model yielded only a 5.22% difference in projectile exit velocity as compared to experimental findings. However, using a hydrocode model, a 2.12% difference was achieved. Both models exhibited localized cratering and tensile spalling effects as seen in actual ballistics experiments. It was determined that a 1" panel of Ashcrete is more effective in resisting projectile penetration than a stacked ½" panel arrangement. The effects of added TNT detonation showed no significant increase in panel damage during projectile penetration, because the damaging effect of the blast wave was found to be negligible as compared to that from the projectile by itself.

Conclusions

A thorough analysis of potential material models was found to be necessary prior to modeling UHPC armor, because alternate constitutive equations may, sometimes, provide an improved fit of material strength properties. The improvements made to the AFC Model were effective in modeling the high-velocity impact performance of Ashcrete. The material parameters determined for Ashcrete have potential for use in different asymmetric warfare situation in assessing the effectiveness of Ashcrete armors in withstanding enemy aggression.

Effective UI Design to Enhance User Interaction

Duong Thai Ho

Southern Polytechnic State University

EXTENDED ABSTRACT

Background

The objective of this project submitted to the American Society for Engineering Education (ASEE) is an exploration into Human-Computer Interaction (HCI) with a specific analysis of a software system. As an honor senior at Southern Polytechnic State University (SPSU), I am conducting an in-depth research related to my major, Software Engineering, and a specific study of effective user interface (UI) design.

Purpose

Technology has undeniably become a necessity in our everyday life. It is more of a challenge when ineffective interaction problems arise in the daily usage of the computational devices such as cell-phone, tablets, laptops, etc. The steps between the user and their technological devices demands UI designers to be able to develop better UI in order to enhance, and maximize the interaction. Therefore, the purpose of this thesis is to research and study how to effectively design UI for software systems.

Design/Method

This project focuses on Human-Computer Interaction (HCI), as well as introduces and analyzes good UI practices that can provide the UI designers the necessary knowledge for them to conquer their challenge, and to accomplish their task. Particularly, this project will be analyzing the following four questions:

1) Who is the user of the system?
2) What is the task the system is used for?
3) What is the work context and the environment in which the system will be used?
4) What is technically and logistically feasible?

Results

The results of this project include the following:

1) A pre-questionnaire survey template that can be used to determine the true-user of the system
2) A user-profile template that can be used to determine the distinguished characteristics of the users.

Above all, the project findings are the main objective of my research and study.

Conclusions

The data, results, and conclusions of this in-depth study will be given in the poster session in the ASEE Conference in March 2013. The complete project will report the effectiveness in the specific user interface evaluated.

Attitude Control of Satellites Considering Communication Delays

Gabrielle Jordan

Mechanical Engineering, North Carolina A&T State University

EXTENDED ABSTRACT

Background

Satellite formation flying has become one of the most active research topics of space science due to the ever-increasing interest in 'small' satellites, such as micro- and nano-satellites. However, the successful deployment of a satellite formation requires the design of control systems to overcome the many challenges. One of such critical challenges is existence of time-delays. Due to distance between the satellites and the finite speed of light, signal propagation time from one satellite to another cannot be neglected. It is common knowledge that time-delays can cause undesired responses. Then, it can take a long time and more than desired energy for satellites to settle at desired positions. Thus, time-delays in satellite control cannot be ignored and they form the fundamental barrier to success.

Purpose

Effects of time-delay are studied using analytical tools for delay equations. And the results are confirmed via simulations using MATLAB/Simulink. Then, this project develops a new control method for time-delay problems in satellite formation flying by using an analytical tool, and the method is validated using simulation and experiments. Among many issues for satellite control, attitude control of a satellite is focused in this project.

Design/Method

The new analysis and control strategy accommodates time-delays, which is one of the critical obstacles for satellite control. When the chief satellite is in circular orbit, the motion of deputy satellites relative to the chief and spacecraft attitude dynamics can be represented as delay differential equations. Based on the solution to the delay differential equations, a systematic approach is used to control satellite formation flying. The proposed method is verified and compared via simulations in MATLAB. Then, responses of models without delays are compared to ones of delayed models to show effects of time-delays on the satellite control. Momentum Exchange devices (MEX) are devices that are used in attitude control of satellites. They consist of stepper motor and Brushless DC motor, which is set up, modeled and simulated for control of satellites. A control algorithm for the complete system and its real time digital simulation is developed.

Results

Using the analytical tool for delay differential equations, stability analysis and design of control for satellite attitude have been studied. Stability is predicted from positions of eigenvalues, and applying the feedback control, linear feedback systems have been developed via assignment of eigenvalues. The eigenvalues of the closed-loop are assigned to the desired locations in the complex plane. The analytical results are validated vial simulation using MATLAB/Simulink. Also, experimental results show agreement with analytical analysis and simulations.

Conclusions

The solution methods for delay differential equations give one to analyze time-delay effects and enable one to find feedback gains. The stability analysis results show clearly how the system is. And the control method is used to improve system performance as well as stabilization. In future, safe implementation of the method should be considered.

In-Situ Condition Monitoring of Components in Small Modular Reactors

Victor Lollar

University of Tennessee, Knoxville Nuclear Engineering Department

EXTENDED ABSTRACT

Background

Small modular reactors have emerged as the future of nuclear power generation. SMR designs feature lower startup costs, greatly enhance safety, have longer fuel cycles, and can be deployed remotely. Before SMRs can be added to the nation's power grid, several key issues must be addressed. One of these important issues is the monitoring of components inside the reactor vessel.

Purpose

The current designs incorporate most of the critical equipment used for power generation inside the reactor vessel. Therefore, reactor coolant pumps, motors, and control rod drives among others, are in a hazardous environment and must be monitored remotely for long periods of time in order to keep the reactor operational. Conventional component instrumentation used in current reactors cannot withstand this harsh environment making electrical signature analysis (ESA) a viable option for ascertaining component condition. ESA was pioneered by Oak Ridge National Laboratory and takes advantage of a motor's inherent ability to act as a transducer through its varying loads. The changes in the pump motor's electrical signature (current drawn) can be then be related to other process variables such as flow or pressure to monitor the health of the pump.

Design Method

An existing experimental flow loop was modified with the addition of a submersible pump, new sensors, and data acquisition equipment. The loop consists of two coupled water tanks, computer controlled valves, a submersible pump, various flow meters, pressure transmitters, and accelerometers, all of which are hooked up to a data acquisition system. LabView is used to record the sensor data at both steady state and transient operating conditions and then imported into MATLAB for post processing in the time and frequency domain.

Results

Several test runs were made to establish the relationship between process variables and electrical signatures. It was observed that the pump outlet pressure and the motor current signals show similar behavior, in the transient region (start-up and shut-down) and during steady-state operation. It was also shown that when the supply frequency of the pump was altered, changes in the current were reflected in the process variables and were highly correlated with each other.

Conclusion

A fully instrumented flow control loop with a submersible pump and a variety of sensors has been developed to establish the feasibility of using electrical signatures for remote monitoring of reactor internals in a SMR. Preliminary results show a strong correspondence between current changes and process variables. Future work includes the development of models of an SMR and pump-motor dynamics to determine the sensitivity of electrical signatures as a function of process and pump conditions.

Dual Media BioSand Filter

Laura Lopez Sosa, Katie Safford, and Paige Sforzo

Mercer University School of Engineering

EXTENDED ABSTRACT

Background

Vietnam has a dense river network consisting of 2,372 rivers and over 600,000 square miles of watershed basins with most of these basins densely populated with floating houses (Whitney). Due to the recent socio-economic development, the rise in population, and the lack of government environmental regulations the quality of river water has drastically declined. The water is down river from urban and industrial areas and contains high concentrations of organic matter, viruses, bacteria, fertilizers, and pesticides. When considering pesticides and other uncommon substances it becomes apparent that typical water purification methods will not be an effective solution to treat the polluted water. The polluted water leads to diseases and if left untreated can lead to Gastro Intestinal infection, birth defects, and ultimately mortality. According to the World Health Organization, "1.4 million children in the world die every year from diarrhea caused by unclean water and poor sanitation – this equates to 4,000 child deaths a day or one child every 20 seconds" (WHO). It is evident that an affordable method to provide clean water is necessary.

Design/Method

To simulate the water of the Vietnam Rivers, waste water from the aeration basin at Lower Poplar Waste Water Treatment Plant was used. The influent from the aeration basin has similar characteristics, such as BOD_5 and COD levels, to the major Vietnamese rivers. In order to imitate the pesticide concentration found in these rivers, p-nitrophenol, a component commonly found in pesticides, was diluted into the wastewater sample at a high concentration. A total of seven test analyses were performed on the influent and effluent side of each filter. COD, Coliform, Absorbance, Turbidity, Flow rate, pH, and Solids Test were conducted in order to test the performance of each filter.

Results

Both biosand filters, met the criteria set forth by EPA regulations. The criteria used are as followed:

- 95% Coliform removal
- 75% pesticide removal
- Turbidity less than 5 NTU
- Total solids concentration less than 500 mg/L

Based on results and analysis, both filters performed similarly, however due to a higher percentage of coliform removal the GAC before the biosand filter was chosen as the better alternative.

Synthesis of Colloidal Quantum Dots and Selection of Ligand Chemistry

Michael Z. McCreary

University of Louisville, Speed School of Engineering

EXTENDED ABSTRACT

Background

Efficient lighting is needed to lower our energy consumption to fuel growth of developed and undeveloped countries. In addition, the development of lightweight, flexible, efficient lighting is crucial for space exploration and colonization, as well as in residential and commercial lighting. This project is only a small part of creating such lighting by optimizing the interface in Inorganic-Organic light emitting devices using Quantum Dots. Quantum Dots also have applications in solar cells as well as other renewable devices.

Purpose

The purpose of the research is to synthesis quantum dots and to modify its surface chemistry to better suit our application. Although quantum dots can be purchased, this can prove expensive and increase the amount of steps to change the surface chemistry. Also, development of novel quantum dots is necessary to reach goals of efficiency and cost reduction. It is believed that manipulating the surface chemistry of the quantum dots and the polymer used in the device can increase the efficiency of the device. Therefore, by changing the ligands on the quantum dots, the efficiency of the device can be tested systematically to document any change of performance based on the surface properties of the ligands.

Design/Method

A cadmium aqueous solution and a selenium aqueous solution are created and combined under an inert atmosphere to synthesis the quantum dots. The quantum dots are then isolated and dispersed in a tri-n-octylphosphine to be injected into hot hexadecylamine for capping of the quantum dots. The quantum dots are isolated and dispersed in toluene.

To alter the surface chemistry of the quantum dots to better suit the polymer of the device, 1 mL of quantum dot solution produced is diluted with 50 mL of distilled water and ultrasonicated for 1 hour to breakup any conglomeration. 4-Mercapto-benzoic Acid is added to the solution and after 2 hours, the acid has attached to the quantum dot. 1,4-benzenedithiol (BDT) will also be used as a ligand on the quantum dots to test organically soluble quantum dots. Each type of ligand will be tested on the polymer PEDOT and the 4-mercapto-benzoic acid will be tested on polypyrrole as well.

Results

This process creates roughly 10 mg of CdSe organically soluble Quantum Dots.

Conclusions

This research is in the early stages of development, we are still in the process of refining our synthetic process. It has been found that the cadmium solution must be added to a nearly boiling selenium solution for creation of the quantum dots. Otherwise, large CdSe particles are fo rmed on the scale of microns. We anticipate having the synthetic process worked out and some early results by March.

CNC Machining Capability Study Using Full Carbide Tooling

Timothy Moye

Western Kentucky University

EXTENDED ABSTRACT

Background

Computer Numerical Control (CNC) machining is the long established norm in advanced manufacturing. Many of the cutting tools available for these machines use replaceable carbide insert cutting tips. The cutting speeds and feeds for these tools are well known. However, many smaller shops which do not run the same parts over and over often use full carbide tools ground from a solid piece of ceramic. They are more expensive than replaceable inserts, but are cheaper since they can be purchased for a specialized single task that the replaceable inserts might not be optimized to handle. In addition, they do not have to buy the holder for the inserts.

Purpose

The focus of this work is to generate a protocol for the selection of appropriate speeds and feeds for solid carbide tools in a vertical CNC milling machine. The desire is to replace generic tables of cutting speeds and chip loads with a procedure that accommodates the entire system: material, machine, tool, cutter, and workholding.

Design/Method

A standardized cutting profile was established for each test. The machine was run at the maximum material removal rate that resulted in a chatter-free cut, with tool chip load and cutting depth held constant. Once the maximum spindle speed was found, the depth of cut and radial width of cut were varied to find stable points of operation.

Results

Cutting speeds, feeds, and chip loads were found that generally exceeded the stated table values. The procedure was found to be simple to use, but the work required to include the different motions (roughing, finishing, slotting, etc.) proved to be extensive if a wide range of tools were included in the tool library.

Conclusions

The methodology of setting the feeds and speeds to maximum material removal rate without chatter was proven to be effective. In general, solid carbide endmills were limited by chatter conditions rather than erosion, wear, or breakage. Limiting the machine to stable chatter-free operation proved to be the best operating point. However, changes to toolpath during the CAM development could result in chatter conditions at conditions which should have been stable. Many of these were found to be actually above the material removal rate predicted, implying the tool is overloaded. In addition, poor workholding and thin material sections can rapidly change the tool to a chatter condition when least expected. As long as the tool selection was repeatable over time, the results were found to be consistent. If different tools with different coatings were used, the tests would periodically need repeating.

Analytics for Theme Park Management

Andrea Otero

University of Central Florida

EXTENDED ABSTRACT

Background

The economy of a country operates in an environment that is subject to factors such as tourism. With the industry of tourism quickly expanding, it is crucial to detect ways to build enhanced management systems to deliver more fast-paced services with higher quality and fewer employees. Simulation as Analytics tools would provide frameworks that will help predict future behavior patterns in tourism places of high frequency, like hotels or theme parks. By utilizing behavioral and demographic data patterns in a theme park setting we will try to detect these frameworks and help predict the patterns of movement within the theme park thus achieving an improvement on park flow, expediting service to customers, keeping customers happy, and reducing the risk of over/under supply keeping balance over loss versus profit. Simulation can help to plan effectively for the optimum capacity to serve visitors needs efficiently.

Purpose

The primary objective of this research is to use simulation to evaluate options for reducing wait-time experienced at theme parks, increasing the performance and customer service in theme parks. Accurately estimating the performance of each part of the park will be a critical component of the analytics work. Developing a simulation model will help to understand about the behavior and demographics of customers. The simulation model will represent the key characteristics or behaviors of visitors in theme parks.

Design/Method

It is necessary to assess the expected length of queue and waiting time in each part of theme parks to avoid long queues and meet the customer satisfaction. In this research, we use simulation to estimate the expected time and number of customers in a queue in theme parks. This study uses Any Logic 6.8.1 to build a simulation model in order to identify alternatives that reduce the theme park's congestion.

Results

The quantitative and analytical results of simulation in theme parks will be alternatives to reduce waiting time in system in theme parks, estimate the performance of the system. The dynamic nature of simulation allows seeing results across the whole theme park. It's not just for a single period, It can be projected over an hour, a week, whenever. Whether it's a high waiting time or low revenue, simulation results enable us to accurately identify the area to improve.

Conclusions

The objective of this study is to evaluate options in order to reduce wait-time experience at theme parks using simulation. The output of the simulation technique would be alternatives to enhance the performance and customer satisfaction in theme parks. Therefore, we could allocate resource effectively, manage costs efficiently, and initiate plans to increase capacity.

Therapy Roller

Ulyana Pugina

University of Tennessee at Chattanooga

EXTENDED ABSTRACT

Background

Persons with autism deal with sensory issues on a daily basis. For autistic people sensory stimuli can overwhelm the central nervous system. Sometimes children with autism can suffer from breakdowns due to sensory overload. A soothing pressure can help to reset the nervous system. The Therapy Roller applies this type of calming pressure. The main beneficiary of the Therapy Roller described here is a little boy. He is non-verbal and and requires a lot of attention. Other autistic students will benefit as well.

Purpose

The Comprehensive Development Classroom (CDC) at Waterville Elementary School in Tennessee needs a Therapy Roller to assist calming children with autism. Thus, the goal of this project was to design and build a Therapy Roller to apply a calming pressure to the students with sensory issues. The students must use the roller independently and must safely exit at any time. The roller should apply various levels of pressure. The students need to easily adjust the pressure at any time.

Design/Method

The process of picking the final and best Therapy Roller design involved multiple steps. The first step was to research current Therapy Roller designs and standards related to production of a Therapy Roller. The second step was brainstorming possible Therapy Roller designs which meet the customer's needs. The next step was to create virtual designs of the product using Solid Works and Pro-E software. The device was then partially built for testing with the customer. Final build followed once the fit was satisfied.

Results

The therapy roller is 33.5" long, 33" wide, and 19" tall. The arms, sides, support slats, and U-braces are cut from 3/4" blondewood plywood. The wooden parts are stained with a water-based stain and sealed with polyurethane. The bottom rollers are 30"-long standard 1.9" diameter steel conveyor rollers with 7/16" hex axles. The top rollers are 30"-long 3/8" diameter steel conveyor rollers with 1/4" round axles. Each roller is covered with a 30"-long 8" diameter super-cushioning polyurethane foam cylinder. The foam is upholstered with a dark green vinyl. 10" mini-bungees are attached from eye bolts on the arms to eye bolts on the side panels to create tension.

The user enters the Therapy Roller from either side. The user enters with arms first, then with the head. As the user's body moves through the roller, the top rollers move up and increase the tension in the bungees. The tension in the bungees causes the pressure from the top rollers. The weight of the user creates the pressure between the user's body and the bottom rollers.

Conclusions

The final therapy roller design produced by the team was a success. After constructing the Therapy Roller and testing them with the customer at Waterville Elementary School, it was confirmed that the Therapy Roller achieved all intended objectives and performed all intended functions.

Independent 3D Rendering Software for Engineers

John Runyon

Western Kentucky University

EXTENDED ABSTRACT

Background

In order to better ourselves and our university's engineering department's capabilities to perform high quality, photorealistic renderings of 3D CAD assemblies and models beyond current capabilities, in depth looks into KeyShot and Bunkspeed Rendering software were taken. With our past knowledge of 3D modeling and rendering from SolidWorks, and our extensive use of animated and rendered modeling of prototype designs in projects, we wished to determine how beneficial new and more comprehensive rendering software could be in further enhancing Western Kentucky University's student presentations.

Purpose

Visual representations are vital aspects of any engineering presentation to help provide a better understanding of how a project will both look and work in practical settings. As such, standalone rendering software can provide the tools needed to create photorealistic models, allowing students to present their project contacts with realistic images of the project fully scaled and in its actual environment prior to ever building the first prototype. For this purpose, studies into rendering software were undertaken to see how approachable these new tools could be and whether either would be worthwhile to adopt for future student use.

Design/Method

Versions of two different rendering softwares were purchased and installed for testing, one based on graphics card performance called Bunkspeed, and the other based on processor performance called Keyshot. Initial trials using only material mapping on more basic models were done to help familiarize us with the new software and determine the base performance of the software. Once we became adequate users of the tools, more complex renderings were done which take into account texture mapping, environments, lighting, and depth.

Results

Even with little manipulation of the model utilizing simple in-program material mapping, both BunkSpeed and Keyshot were able to provide renders of a quality far beyond the standards of SolidWorks or AutoCAD's built in software. Once the extensive texture, environment, and lighting tools in both programs were taken into account, along with ample experience and artistic talent, both Bunkspeed and Keyshot easily produced renders of near-realistic quality.

Conclusions

After extensive experimentation with a variety of renderings both simplistic and complex, taking into account models simply utilizing higher quality material mapping to projects rendered with complex texture mapping, lighting, and depth of field adjustments, both KeyShot and BunkSpeed provided visibly higher quality borderline-photorealistic images compared to the current software available for student use through SolidWorks. As such, the potential benefit of having one of these high-quality rendering softwares available for student use, even if only on one or two computers on campus, is certainly a worthwhile investment.

The Effect of Stitch Bolts on Bolted Timber Connections

Joseph Scobey and Dr. Ray Witmer, Jr.
University of Tennessee at Martin

EXTENDED ABSTRACT

Background

This is a two year University Scholars undergraduate project at the University of Tennessee, Martin.

Purpose

The goal of this project is to determine the effects of stitch bolts on bolted timber tensile connections. Figure 1 shows a timber connection acted upon by a tensile force. The connection consists of steel side plates bolted to timber main members. The stitch bolts are bolts used to keep splits from developing in the timber main members and are placed perpendicular to the connection bolts. Very little research exists pertaining to bolted timber connections reinforced with stitch bolts. If the addition of one additional stitch bolt can significantly increase the strength of the connection, smaller and less expensive connections can be used to transmit tensile loads.

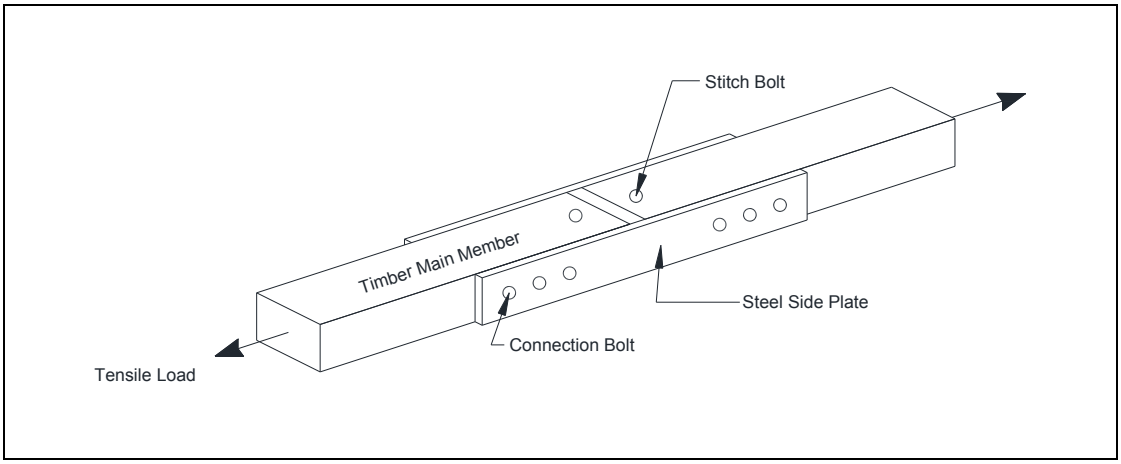


Figure 1 – Tensile timber main members connected by bolted steel side plates. Stitch bolts are placed perpendicular to the connection bolts.

Design/Method

The bolted timber connections were designed to fail in the main timber member. Connections were tested with and without stitch bolts to determine the effect of the stitch bolt on the connection strength. Basic material properties were also determined for use in the National Design Specification's (NDS) analytical connection strength model.

Results

Experimentally determined material values were slightly larger than the NDS published values. The coefficients of variation for timber and bolt material properties were approximately 9% and 2.5%, respectively.

Conclusions

The timber connection tests have not been completed at the time this abstract was submitted. Therefore, final conclusions cannot be determined.

Increasing 3D Printing Accessibility Through a Low-Cost, Automated Workstation

Students: **Matthew Sheen, Devin Tiernan, Patrick Jansen, Curtis Beck, Hunter Brunner, Taylor Giel, Darren Gottschall, Ryan Lemert-Smith, Maggie Murphy;** *Advisors:* **Todd Schweisinger, John Wagner, Timothy Burg, James Gibert**

Clemson University

EXTENDED ABSTRACT

Background

Rapid prototyping technology is currently staged to revolutionize manufacturing by allowing on-demand, one-off production of parts without the extensive setup required by traditional manufacturing methods. 3D printers, for instance, can automatically fuse or deposit a material (e.g. plastic, metal, paper) to form complete products based on computer assisted drawing (CAD) models. Over the past decade, 3D printers have become increasingly versatile, available, and cost effective. Start-up companies have begun to sell 3D printer kits that are affordable to enthusiasts. With minimal training, individuals can now assemble desktop-sized machines, download or create CAD models, and print plastic parts (anything from kitchenware to replacement cell phone parts) at home. To effectively reach the consumer market, however, 3D printers must become more accessible, user-friendly, and automated.

Purpose

The 3D Printing Creative Inquiry group at Clemson University is developing a low-cost rapid prototyping system easily accessible to students on campus for personal and academic projects. The goals have been twofold: the evaluation and construction of several 3D printer designs and the creation of a printing station which can operate with minimal outside intervention. The end objective is a rapid prototyping "vending machine" to automatically print and distribute uploaded designs from users.

Design/Method

A multidisciplinary team of engineering and science students evaluated existing 3D printing technology and identified a niche of budget devices which create parts by heating and extruding polymer filaments in layers. Two contrasting designs, available for purchase as unassembled kits, were selected to meet desktop size constraints and affordability targets. In both designs, stepper motors move an extrusion nozzle to create solid parts within a $200mm^3$ print window. The pyramidal RepRap Prusa Mendel printer has open-source plans and software, can reproduce most of its own components, and deposits layers on a heated platform. The cube-shaped Bits from Bytes RapMan is a proprietary design, optimized for easy assembly and capable of printing directly from a flash drive. Components were acquired and assembled throughout 2012.

Simultaneously, the "vending machine" concept was developed to pair and automate the two printers once assembled. 8-bit chips control the 3D printers, and a similar IO board (Arduino) was used to interface vending machine hardware to central server. C and Matlab programs were developed to combine user interface elements, printer microcontrollers, sensor hardware, vending machine actuators, and web server controls.

Results

Printer hardware assembly was completed in Fall 2012, revealing design tradeoffs between the open-source (Mendel Prusa) and proprietary (RapMan) 3D printers. The Mendel provided greater customization options and a large community of enthusiasts, yet components, manufactured using other 3D printers, presented compatibility, tolerance, and calibration challenges. The RapMan was a more complete package—straightforward to assemble, yet more difficult to modify or interface with the non-proprietary vending machine system.

Vending machine infrastructure was created to receive remote commands, provide online monitoring, verify user identities, and control hardware. Users can remotely email commands to the printer system, receive status notifications. At the central console, a radio frequency identification (RFID) reader allows students to scan their ID cards, uniquely associating them with their print job and activating linear actuators which grant access to the machinery.

Conclusions

Just as conventional paper printing has become universal in homes and offices, 3D printing is poised to become similarly universal and user-friendly with the development of systems like the rapid prototyping "vending machine." In this project, a team of undergraduates with no prior experience were able to construct two cost-effective 3D printers. Simultaneously, the team developed and demonstrated an automation system intended as a step to transform rapid prototyping from a laboratory phenomenon to a publically accessible convenience. In the future, the team will complete system development and testing in order to install a complete "vending machine" printer workstation on the university's campus.

Serinity's Toilet Stool

Nicholas True

University Of Tennessee At Chattanooga

EXTENDED ABSTRACT

Background

Serinity is a 41-inch tall micro-cephalic five-year-old who cannot use the restroom independently. She can use a toilet once she gets on to it, however she currently needs the teachers help and a stool to reach. The current stool, however, is too tall for Serinity to step on to alone, and it does not have enough surface area for Serinity to feel comfortable using. Because she cannot stand on the stool alone without support, it is impossible for her to spin around or pull down her pants. Serinity needs a stool that allows her to use the restroom independently and that is portable for her to move with her as she travels throughout the school.

Purpose

The purpose of this project was to design and build a portable stool that would give Serinity access to a toilet. Serinity's small stature makes it difficult for her to use a toilet without the aid of her teacher.

Design/Method

The methodology of the project took place in 4 steps - conducting research by talking to Serinity's teachers about her needs, brainstorming design ideas, deciding on a design, and prototyping/testing. The design process began by deciding on design objectives, functions, and constraints. The functions describe what the stool should do. The objectives describe what the stool should be, and constraints gave limitations for the design. One example is an objective for the stool to be safe for Serinity to use. The function that accomplishes this is that the stool maintain (its) position while in use. A constraint for safety is that the stool must not have any pinch points.

Results

The stool was designed in Solid Works and constructed from pinewood. The stool is 9 inches tall, 15 inches wide, and 11.25 inches deep. The sides of the stool are arched, and the underside of the stool is pocketed to make the stool light. The stool is purple, blue, and pink - Serinity's favorite colors. For ease of moving and using, the stool has two roller wheels and an adjustable handle on the side. The handle and wheels allow Serinity to roll the stool like a suitcase. The handle also gives Serenty support during use.

Conclusions

The stool built for Serinity meets the design objectives well and allows her to use the restroom alone. When the stool was delivered to Serinity she was very excited and loved playing with the handle. Transporting the stool was no problem for her, and she felt comfortable standing on the stool to access both the toilet and the sink.

A Scalable and Decentralized Publish/Subscribe-based Weather Alert System

Student: Violetta Vylegzhanina, Faculty Mentor: Aniruddha Gokhale

Vanderbilt University

EXTENDED ABSTRACT

Background

Our work was motivated by the limitations we observed with the existing severe weather warning system at Vanderbilt University, which is a centralized solution that sends out reports to all users who are registered with the system. There are two major problems with this solution. First, the centralized nature of the system adversely impacts scalability. Second, because alerts are sent to all registered users, a user who is currently not in the area of hazardous weather may still receive an alert thereby resulting in false alarms for that user.

Purpose

The purpose of the project was to overcome the limitations in the existing, centralized warning system by investigating a decentralized, scalable, and easy-to-use solution for the severe weather warning system where Android devices in the vicinity of the hazardous weather event can post data to a server including the approximate location of a severe weather. The server in turn can distribute messages scalably to Android devices that are in the proximity of the weather event and eliminate false alarms.

Design/Method

For a decentralized and scalable solution, we used the Google Cloud Messaging (GCM) service, which allows data from servers to be sent to Android devices using publish/subscribe messaging. We designed a RESTful web server, which distributes information to devices by communicating with GCM server. We implemented an Android application that registers an Android device with the GCM server and sends its registration ID to the server. The server stores the ID in a MySQL database. For ease-of-use, we extended the application to include an option allowing a user to send the device's location to the web server; the web server in turn would disseminate the data via notifications to all other Android devices whose registration IDs it stores. To eliminate false positives, we studied ways of blocking notifications when a device is located outside a certain severe weather radius.

Results

The insights we gained thus far are qualitative. We learned that the GCM technology makes it possible to eliminate the requirement for an application to query the server for the content, because the server itself initializes the distribution of data to relevant devices. We were also able to experiment the system with a server and a few Android devices.

Conclusions

This poster describes a decentralized, scalable, and easy-to-use design of a severe weather warning system based on publish/subscribe communications. This project incurred a steep learning curve and integration challenges. Our future work involves large-scale experimentation. It also involves populating the application with more advanced features and extending the application to Android devices that do not support GCM.

Production of Biodiesel from WVO Using Small Scale Continuous Ultrasonic Processor

Justin Wood[1], Jared Slayton[1], Seth Parrott[1], Chinyere Mbachu[2], and Ahmed ElSawy[3]

[1]Undergraduate Students, [2]Ph.D Candidate, and [3]Professor and Faculty Advisor

Department of Manufacturing and Engineering Technology, Tennessee Tech University

EXTENDED ABSTRACT

Background

There is a need in the USA to decrease dependency on fossil fuels. One alternative fuel that has gained much popularity in the past few years is biodiesel. Biodiesel can be produced using vegetable oil, waste vegetable oil (WVO), animal fat and yellow grease as raw materials. However, the process of converting a batch of WVO into usable biodiesel is time consuming, requires a human operator to run the system, and necessitates the performance of a chemical titration for each batch of biodiesel produced.

Purpose

The ultimate goal of this project is to significantly increase the production capacity and product quality while reducing cost and human interaction.

Design/Method

In the first phase of this project, the processor was designed and built by the senior design students utilizing a programmable logic controller (PLC) in conjunction with pumps, valves, temperature sensors, etc. to completely handle the production of biodiesel with minimum operator interaction. This was the first step toward continuous flow processor and the elimination of the titration process. In the second phase of this project, the students integrated a small Hielscher Ultrasound continuous processing unit to the automated system. This paper presents the newly developed system and demonstrates the design aspects of the automated biodiesel production processor using a PLC and ultrasonication (continuous processing) as well as how the chemical titration procedure for each batch is eliminated

Results

Our results are a greatly reduced reaction time of approximately 1 hour using ultrasonication compared with 4 hours by using traditional means. Also, the settling period has been reduced from 12 hours to less than 2. Small batches were titrated and reacted by traditional means for comparison and 27/3 tests were performed on both these and the ultrasonified fuel. The use of sonochemistry provided B100 of even greater quality with more yield quantities than all previous tests.

Conclusions

The conclusion of the senior project work is an automated processor that is capable of producing biodiesel with very limited operator interaction. For the system operators, a set of complete work instructions have been written to go along with the processor. The produced biodiesel was analyzed by the chemistry department and we believe it does meet the ASTM standards. It was used successfully in running an AMICO diesel engine AD 186FE.

Also the processor was created to be a more efficient and effective way of converting WVO to a burnable energy resource. Implementing automation and ultrasonic technology has proven to be one of the most efficient ways of processing biodiesel. This allows for cutting the processing time by 75% compared to conventional agitation and mixing.

Analysis of Transportation on Lifestyle Choices in Lesotho, Africa

Bailee Young

University of Tennessee - Knoxville

EXTENDED ABSTRACT

Background

The link between transportation and quality of life is particularly strong in the developing world. Transportation can provide opportunity, education, and income. However, if transportation consumes so much of one's day due to the sheer duration of critical life tasks, it can preclude a high quality of life. In this study, we choose to examine the link between transportation and quality of life and how the link differs across segments of the population (genders, vehicle owners, etc.). We use a survey conducted by Dr. Dayton Lambert's team in the Department of Agricultural and Resource Economics at the University of Tennessee- Knoxville of transportation and farming behaviors in Lesotho, Africa. Lesotho is rated as the third highest nation for the percentage of population testing positive for HIV and is characterized by extreme poverty, illiteracy, gender inequality, and poor health care; therefore, the basic needs of the people are not being met.

Purpose

The purpose of the transportation analysis was to determine what relationships exist between transportation and lifestyle choices of individuals in Lesotho, Africa, and how these relationships differ across segments of the population.

Design/Method

An existing survey, displaying household choices and behaviors in Lesotho, was used as the data source. Using statistical techniques, we investigate household characteristics and their correlation with vehicle ownership/transportation options. The data from these questions were summarized and analyzed in charts to determine what relationships exist between lifestyle choices and transportation availability and type.

Results

We find that the availability of transportation sources does not differ greatly between the genders, however, all the vehicles in Lesotho were owned by households with a male head of household. In addition, females with a transportation source are willing to travel longer distances to make a transaction or to get water, revealing a gender inequity. We also found that the majority of vehicles were owned by individuals in one village, which points to a spatial and gender-based income and access disparity.

Conclusions

Studying the differences between individuals with transportation and those without reveals the significant impact transportation has on quality of life, influencing distance to market, water, and other opportunities. Therefore, enhancing transportation in Lesotho could positively impact the lifestyles of individuals there, by meeting more of their needs.

CHAPTER 5
Index

Chapter 2 – Conference Workshops

Workshop 1: Screen Engineering 2-2
Lead Author: Chris ORiordan-Adjah
Workshop 2: Introduction to Arduino 2-3
Lead Author: Timothy Wilson
Workshop 3: A Framework to Predict Dissemination Success of STEM Education Innovations 2-4
Lead Author: Chetan Sankar
Workshop 4: Screen Engineering Showcase 2-5
Lead Author: Chris ORiordan-Adjah
Workshop 5: Engineering EFFECTs: Environments for Fostering Effective Critical Thinking 2-6
Lead Author: Charles E. Pierce
Workshop 6: A K-12 Engineering Outreach Workshop 2-7
Lead Author: Sally Pardue
Workshop 7: Creating Hands-on Programming Experiences for Engineering Students 2-8
Lead Author: Sheikh Ghafoor
Workshop 8: Developing the NAE 2020 Engineer 2-9
Lead Author: Pedro Arce

Chapter 3 – Technical Session Extended Abstracts

T1–A: Instructional Division I

175 - Engineering of Beer: Hard Work of Too Much Fun? 3-6
Monika Bubacz, Philip McCreanor, Hodge Jenkins

177 - The New Frontier of Education: The Impact of Smartphone Technology in the Classroom 3-7
Jessica L. Buck, Elizabeth McInnis, Casey Randolph

*178 - The Role of a Freshmen Programming Course for Engineers on Student Success 3-8
Priya T. Goeser, Wayne M. Johnson and Delana A. Nivens

131 - Sustainable development: Understanding How Things Break 3-9
Robert R. McCullough, Beth A. Todd, J. Brian Jordon

T1–B: K-12 Division I

*137 - Engineering Conceptual Design Approach for Pre-College Students 3-10
Otsebele Nare, Ziette Hayes, Michael Reynolds, and Shannon Davis

141 - Science Technology Engineering Program (STEP) Summer Camp for K-12 Students 3-11
Atin Sinha and Wanjun Hu

*169 – Structures and Natural Disasters 3-12
Andrew T. Brammer, Beth Todd, and J. Brian Jordon

170 – Solar Ovens 3-13
Joseph L. Waters an, Beth A.Todd

T1–C: Administrative Division I

159 - Ten Years Experience with a Multi-University Collaborative Graduate Education Program 3-14
Colin P. Britcher, Bernard M. Grossman

142 - The Use of a Fundamentals of Engineering Course to Enhance the Capstone 3-15
David W. Johnstone, Charles D. Newhouse

136 - The Future of Course Work: Customizing Community College Curricula to Meet Industrial Needs 3-16
Amber C. Thompson, William L. McDaniel, Jo James, Chester Peeler, Steve Hollifield

130 - Impact on Retention from a Change In Undergraduate Computing Curricula 3-17
Donna S. Reese, T.J. Jankun-Kelly, Lisa Henderson and Sarah Lee

T1–D: Civil Engineering Division I

183 - Logistical Impact of Intermodal Facilities 3-18
Tulio Sulbaran, MD Sarder

134 - Confessions of a novice Class Room Technology (CRT) user - Through the eyes of a new faculty member 3-19
Alfred Kalyanapu

106 - The Impact of Non-Traditional Laboratory Report Formats on Student Performance of Course Objectives 3-20
T. Kunberger

192 - Using the Toolbox Approach with Mathcad Prime 2.0 in a Computer Applications Course 3-21
Kenneth P. Brannan, Kaitlin H. Marley, John A. Murden

T1–E: Mechanical Engineering

*195 - Introducing Statistical Analysis in Experimental Data Collection in an Undergraduate Fluid Mechanics Laboratory 3-22
Bruce Carroll, John Abbitt

138 - Reynolds Transport Theorem Applied to Classical Thermodynamics 3-23
David Calamas, Alan Hewitt, John Baker and Beth Todd

*114 - Determination of Building Envelope and Duct System Integrity through the Quantification of Air Flow Leakage Rates 3-24
Justin Hayes and Robert Choate

151 - Simple Demonstrations in Basic Mechanics Courses 3-25
Richard Kunz

T2–A: Instructional Division II **LL 208**

115 - Improving Student Interest in Engineering Curricula – Exciting Students About Their Classes 3-29
Adeel Khalid

117 - Teaching Adult Engineering Learners – Ease and Challenges 3-30
Adeel Khalid and Beth Stutzmann

*200 - Transforming Undergraduate Laboratories for Sustainable Engineering – Expanding the use of case studies and project based learning in laboratory courses 3-31
Stephanie Luster-Teasley and Cindy Waters

152 - The Final Exam – To Have or Have Not 3-32
Hodge Jenkins and Scott Schultz

T2–B: K-12 II

*162 - Using Engineering, Science and Literacy to Improve Math Understanding 3-33
Cecelia M. Wigal, Kay Cowan, Louis Elliott, Betsy Darken

202 - Teaching Physical Properties of Water using Hydraulics 3-34
Tabatha Dye, Beth Todd, and Pauline Johnson

203 - Using College Student Competitions to Recruit Middle-School Students to Engineering: The Visual Display Competition at the ASCE 2011 Southeast Student Conference 3-35
Steven M. Click

*225 - Overview of Next Generation Science Standards for K-12: What impact on K-12 Engineering Outreach? 3-36
Sally Pardue

T2–C: Administrative Division II

160 - Novel First Year Engineering Summer Session 3-37
Gail D. Jefferson, Sally Steadman, Tom G. Thomas, Kuang-Ting Hsiao

161 - Transfer Student Retention 3-38
Gail D. Jefferson, F. Carroll Dougherty, Sally Steadman, Tom G. Thomas

116 - Advising Engineering Students – Demands and Challenges 3-39
Adeel Khalid, Jessica Williamson

*166 - Math Requirements and Expectations for Lower Division Engineering 3-40
Christopher D. Wilson

T2–D: Computer Engineering and Technology Division

174 - Newsvendor Problem Simulation of Operations 3-41
Hassan Alfadhli and Leticia H. Anaya

199 - Engaging Students in Electromagnetics Through Hands-On Skills and Computer Simulation 3-42
Zhaoxian Zhou

102 - Implementing the Design-Build-Instrument-Test Approach for Curriculum Integration in Engineering Technology 3-43
Paul M. Yanik and Aaron K. Ball

179 - Building a Community of Successful Technology Scholars 3-44
Laura E. LeMire

T2–E: Mechanical Engineering Division II

111 - Residential Emergency Solar Power in Western North Carolina 3-45
George Ford and Sung Joon Suk

120 - Using Animations to Enhance Understanding of Energy System Concepts 3-46
B. K. Hodge and Govinda Mahajan

103 - Biovolatilization, a Different Way to Gasify Biomass 3-47
David Domermuth

T3–A: Cancelled

T3–B: K-12 Division III

*119 - K-12 STEM Outreach Pilot: Autonomous Quadcopter Assembled and Tested By Middle School Students 3-52
Jamil Anaguano and Yosef Allam

127 - Understanding Barriers to Engineering as a Career Choice for Appalachian Youth: Investigating the "heart" of the Region 3-53
Matthew Boynton, Cheryl Carrico, Marie Paretti, and Holly Matusovich

147 - A Strategic Case of Infusing Sustainability and Integrative Education in a Korean High School Pre-Engineering Course 3-54
Yonghan Ahn and Hyuksoo Kwon

148 - Research Trends and Priorities in K-12 STEM Outreach 3-55
Twanelle Majors, Jennifer Meadow, Laura Luna, Hyuksoo Kwon

T3–C: Computer/Software Division

193 - Formulation and Development of the Wasson Systems Engineering Process Model 3-56
Brittany Luken, Susan Hotle, Laurie Garrow, Christopher Cappelli, Lauren Jones, Stefanie Brodie, Margaret-Avis Rabah Aoufi

112 - Use of Facebook Group Feature to Promote Student Collaboration 3-57
Anthony Choi

172 - A Multi-Level Curriculum in Digital Instrumentation and Control based on Field Programmable Gate Array Technology 3-58
Omar Elkeelany and Mohamed Abdelrahman

T3–D: Research Division I

143 - Positive and Negative Motivators and Their Effect on Engineering Student Success 3-59
S. Michael Wells, Sabrina D. Wells

150 - Encouraging Undergraduate Engineering Students to Generate Research and Design Publications 3-60
Philip T. McCreanor, Laura W. Lackey, Hodge Jenkins, Michael Leonard, Sinjae Hyun

186 - Analyzing Time to Student Course Withdrawal Patterns for Predictive Modeling 3-61
Gillian M. Nicholls

T3–E: Professional Skills Division I

135 - Introducing Technical Communication through Science Fiction: A Freshman Seminar 3-62
Amy Barton

*188 - Ethics and Biomedical Informatics: a Research Experiences for Undergraduates Program at the University of Tennessee at Chattanooga 3-63
Claire L. McCullough and Yu Cao

156 - An Ethical Approach to Hydraulic Fracturing 3-64
Andrew Potter and M. H. Rashid

T4–A: Engineering Graphics Division

144 - An Interactive Tool for Visually Presenting Conic Sections to STEM Students 3-68
Matthew K. Swenty, Gregory N. Hartman, David W. Johnstone, Daniel S. Joseph, Troy J. Siemers, and James C. Squire

181 - Pilot: Extra Credit-Incented Collaborative Learning & Reflection in an Engineering Graphics Course 3-69
Yosef Allam

T4–B: K-12 Division IV

105 - Engineering Summer Camp for High School Students from Underserved Communities 3-70
T. Kunberger, K. Csavina, and L. Zidek

*104 - Engineering Education – Past, Present and Future Outcomes 3-71
Marcos Chu

187 - Real-World Design Challenges - A Crucial Component of STEM Teaching and Learning 3-72
Rebecca Jaramillo and Colin Britcher

129 - Using Future Engineers Camps to Advance STEM in Western North Carolina 3-73
William L. McDaniel and Sidney G. Connor

T4–C: Mechanical Engineering Division III

182 - An Engineering Elective on Energy Resources 3-74
Shih-Liang (Sid) Wang

128 - Novel Design for the Total Replacement of Finger and Toe Joints 3-75
Andrew Weems

165 - Shaft Deflection—A Very, Very Long Example 3-76
Christopher D. Wilson and Michael W. Renfro

*205 - Integrating a Design Project into an Undergraduate Mechanics of Materials Course 3-77
Joseph J. Rencis and Hartley T. Grandin, Jr.

T4–D: Civil Engineering Division II PRESCOTT HALL 325

153 - Compressive Strength Analysis of Mortar Mixes Consisting of Recycled Plastics 3-78
John W. McDonald , Charles D. Newhouse

145 - Modeling Groundwater Flow Experiment 3-79
Daniel Bunei, Beth Todd

185 - A Case Study Comparing the Container Shipping Industry in the US and Panama 3-80
Tulio Sulbaran, Ph.D ; Matt Gathof

Chapter 4 – Student Poster Session Abstracts

Data and Image Compression with Discrete Wavelet and Cosine Transforms 4-4
Athanasios Athanason

EPRI Boiling Water Reactor Instrumentation Nozzle Scanner 4-5
Martin Ayers, Brett Fluery, Will Lawson, Gerald Stott, Jeremy Hines, Aaron McClure, Jordan Currington

Education for the Future: Learning IE Skills Through Interactive Port Security Simulation Models 4-6
Alex Beauboeuf

Education Virtual Site Visit 4-7
Felicia Blake

Duct/Duct Taped Specimen Fatigue Tester 4-8
Michael Bradshaw, Jonathan Field, Justin Hayes

Systematic Assembly of PSI on Chemically Patterned Substrates 4-9
Michael Neil Brown, Hannah Haines

Examination of the Influence of Internal Structure of Coronal Mass Ejections (CMEs) 4-10
Alex Garcia Burgos, Antti Pulkkinen, Aleksandre Takakishvili, Dusan Odstrcil

Closing the Reverse Engineering Loop: Laser Scanning as the Bridge from Legacy Part to CAD to CNC Machining 4-11
Samuel Burns

Marine Compounds Against Drug Resistant *Plasmodium* 4-12
Justin Deithorn

Air Flow Visualization System Using IR Thermography 4-13
Matthew Eubanks, Reed Gonzales, Aaron Huffman, Sean Miles

Instantaneous Frequency Division Multiplexing (IFDM): An Approach for In Vivo High Definition Video 4-14
Samuel Ford, Benjamin Martin, James McCoy, Dennis Ogbe, Andrew Piras, Jesse Roberts, Charles Witherspoon

Take a Ride on the Mocs Express 4-15
Saama Davies, Jessie West, Thomas Anderson, Patrick Godfrey Wesley Ford

Cooperative Analog Wireless Analog Sensor (AWAS) Networks: A Low-Cost, Low Frequency Approach to High-Density Applications 4-16
Gus Gillen, Morgan Barcio, Alexander Bear, Jeffrey Burgess, Zachary Eason, Samuel Ford

Haptic Nature of Wood Finishes 4-17
Ryan Gott

Grant's Variable Height Chair 4-18
Matthew Faircloth, Marshall Guillot, David Harris, Tom Mammen, Jeremy Miller

Converting Locally Generated Waste Cooking Oil into Biodiesel 4-19
Parker Helble, Valerie Wade, David Vargas, Nathaniel Colins, Rekan Mirawdly

Blast and Impact Effect Analysis of Cementitious Armour Panels 4-20
Mason Hickman

Effective UI Design to Enhance User Interaction 4-21
Duong Thai Ho

Attitude Control of Satellites Considering Communication Delays 4-22
Gabrielle Jordan

In-Situ Condition Monitoring of Components in Small Modular Reactors 4-23
Victor Lollar

Dual Media BioSand Filter 4-24
Laura Lopez Sosa, Katie Safford, Paige Sforzo

Synthesis of Colloidal Quantum Dots and Selection of Ligand Chemistry 4-25
Michael McCreary

CNC Machining Capability Study Using Full Carbide Tooling 4-26
Timothy Moye

Analytics for Theme Park Management 4-27
Andrea Otero

Therapy Roller 4-28
Ulyana Pugina, Dakota Huddleston, Orlando Lourenco, Matthew Robinson, Michael Winn

Independent 3D Rendering Software for Engineers 4-29
John Runyon

The Effect of Stitch Bolts on Bolted Timber Connections 4-30
Joseph Scobey

Increasing 3D Printing Accessibility Through a Low-Cost, Automated Workstation 4-31
Matthew Sheen, Devin Tiernan, Patrick Jansen, Maggie Murphy, Hunter Brunner, Curtis Beck, Taylor Giel, Darren Gottschall, Ryan Lemert-Smith

Serinity's Toliet Stool 4-32
Nicholas True, Conner Johnson, Shannon Sharpe, Ryan Seyer, Wes Hutchins

A Scalable and Decentralized Publish/Subscribe-Based Weather Alert System 4-33
Violetta Vylegzhanina

Production of Biodiesel from WYO Using Small Scale Continuous Ultrasonic Processor 4-34
Jared Slayor, Seth Parrott

Analysis of Transportation on Lifestyle Choices in Lesotho, Africa 4-35
Bailee Young

ASEE SOUTHEASTERN SECTION CONFERENCE

MARCH 30-April 1, 2014

Mercer UNIVERSITY
MACON, GEORGIA

PREPARING ENGINEERS FOR THE GRAND CHALLENGES OF THE FUTURE

Engineers educated now will be the catalyst of change and will propel society forward through new technologies for decades to come. Thus, it is the responsibility of engineering educators to prepare these engineers to meet the grand challenges facing them currently and in the future. Problems and opportunities will be mastered by those best prepared to learn new skills and adapt. Curriculums, courses, and other learning experiences that provide the engineering skills and mindset necessary to meet these future challenges are the focus of this conference.

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 will have first priority and may include topics related to the following:

- Innovative Curricula or Courses
- First Year Engineering Programs
- Organizational Structures to Promote Interdisciplinary Engineering
- Engineering Common Cores
- Teaching/Learning Practices: Past, Present, and Future
- Distance Learning in Engineering
- Ethics and Professional Practice
- Technologies for Efficient Learning
- Engineering K-12 Outreach Programs
- Engineering Learning Communities
- ABET Accreditation Projects
- Engineering Recruitment and Retention
- Partnerships
- Capstone Design Courses or Projects
- Engineering Professional Development

Authors may also address other topics of interest to the engineering education community. Guidelines for manuscript preparation are available via the Author Instructions at www.asee-se.org at the Conference page.

Papers will be accepted based on a peer review of manuscripts. Authors are expected to present their papers at the conference to facilitate the transfer of knowledge through discussion and debate. All accepted papers presented by a timely-registered author will be included in the conference proceedings. 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 conference proceedings.

An author/co-author can be associated with as many papers/presentations as is appropriate, but a registrant can serve as the presenter of record on a maximum of three presentations.

A poster session in which undergraduates discuss their experiences in engineering education (design projects, research, etc.) is anticipated. Information about this session will be available in the fall.

SCHEDULE FOR SUBMISSION OF PAPERS AND ABSTRACTS

Friday, October 4, 2013	Abstracts submitted by authors for consideration
Friday, October 11, 2013	Authors notified regarding acceptance
Tuesday, December 3, 2013	Manuscripts due from authors for review
Friday, January 10, 2014	Reviewed manuscripts returned to authors
Friday, January 31, 2014	Final manuscripts and extended abstracts due from authors
Friday, February 21, 2014	Deadline for presenters to register for conference

Submit a 250-300 word abstract in doc, docx, or pdf file format by October 4, 2013
Conference paper submission site will be announced at www.asee-se.org

CONTACTS

Jerry Newman, Technical Program Chair, (901) 318-5614, jdnewman@memphis.edu
Hodge Jenkins, Conference Site Coordinator, (478) 301-2831, jenkins_he@mercer.edu

SCAN NOW!

To learn more about the
STRATEGIC PLAN
of the
COLLEGE OF ENGINEERING
at Tennessee Tech
or
visit our website

tntech.edu/engineering/strategicplan

21ST CENTURY
RENAISSANCE
ENGINEERS
REVOLUTIONIZING ENGINEERING

TENNESSEE TECH
UNIVERSITY

VISION

21st Century Renaissance Engineers
Revolutionizing Engineering
To Solve Societal Problems

MISSION

To graduate innovative Engineers
who solve technological challenges
to meet societal needs.

CORE VALUES

Aim High
Students First
Professionalism
Innovative
Recognition
Eminence