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2008 ASEE IL/IN Section Conference Schedule At-A-Glance

Thursday, April 3
12:00 p.m. - 6:00 p.m., Conference Check-in (Olin Hall Advanced Lobby)
1:30 p.m. - 5:00 p.m., Workshops (Olin Hall)
5:00 p.m. - 7:00 p.m., Opening Reception (HMU Kahn Rooms)

Friday, April 4
7:30 a.m. - 6:00 p.m., Conference Check-in (Olin Hall Advanced Lobby)
7:30 a.m. - 10:00 a.m., Keynote Breakfast (HMU Kahn Rooms)
10:00 a.m. - 10:30 a.m., Refreshments & Focus on Exhibits (Hadley Hall)
10:30 a.m. - 12:00 a.m., Concurrent Technical Sessions (Olin Hall)
12:00 p.m. - 2:00 p.m., Lunch & Panel Discussion (HMU Kahn Rooms)
2:15 p.m. - 3:45 p.m., Workshops (Olin Hall)
3:45 p.m. - 4:15 p.m., Refreshments & Focus on Exhibits (Hadley Hall)
4:15 p.m. - 5:45 p.m., Workshops (Olin Hall)
6:00 p.m., Dinner (HMU Kahn Rooms)

Saturday, April 14
7:30 a.m. - 12:00 p.m., Conference Check-in (Olin Hall Advanced Lobby)
7:45 a.m. - 8:30 a.m., Continental Breakfast (HMU Kahn Rooms)
8:30 a.m. - 10:00 a.m., Workshops (Olin Hall)
10:00 a.m. - 10:30 a.m., Refreshments & Focus on Exhibits (Hadley Hall)
10:30 a.m. - 12:00 p.m., Focus on Students and K-12 Sessions (Olin Hall and Hadley Hall)
12:00 p.m. - 2:00 p.m., Lunch Followed by IL/IN Section Business Meeting (HMU Kahn Rooms)
2:15 p.m. - 3:45 p.m., Concurrent Technical and K-12 Sessions (Olin Hall)
3:45 p.m. - 4:15 p.m., Refreshments & Focus on Exhibits (Hadley Hall)
4:30 p.m. - 7:30 p.m., Awards Banquet (HMU Kahn Rooms)

ATTENTION: Registration and Check-in is located in the Olin Hall Advanced Lobby. Please follow signs.

Welcome from the Chair

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On behalf of the Illinois/Indiana section of the American Society for Engineering Education (ASEE), I would like to welcome you to the 2008 IL/IN ASEE Conference: Engineering Education at the Crossroads, to Rose-Hulman Institute of Technology and to Terre Haute. We are excited to offer you what we believe to be an exceptional program packed with opportunities for learning ways to enhance the educational experiences of students and educators alike!

We are very fortunate to have Stuart Walesh, Consultant, Author, and Former Dean of Engineering, as our Keynote Speaker and Wayne Wagner, Executive Vice President of the Polyethylene Packaging Division of Bemis, as our Awards Banquet Speaker. Their talks are expected to be thought-provoking and lead to much discussion and action. The theme of the conference "Engineering Education at the Crossroads: Putting Dialogue into Practice" has lead to a somewhat out of the ordinary program being offered this year. To give all of us additional opportunities to practice, the program includes 14 workshops, a panel discussion of the costs and benefits of program assessment, and a track for K-12 educators and administrators. In addition we have 36 excellent peer-reviewed papers that will be presented in traditional technical sessions. Moreover, undergraduate students will be competing in both paper and poster contests.

In order to put together this diverse program, collaborative efforts of many have been required. It began with President Jakubowski bringing the conference to RHIT at the request of the IL/IN Section Officers. The involvement of the faculty and staff of Rose-Hulman Institute of Technology has been exemplary, in particular that of Diane Hanson, Conference Coordinator and the Technical Program Committee. The outpouring of support from the Terre Haute business and education community has been exceptional. The efforts by Patricia Carlson, RHIT Professor and PRISM Project Director, to put together an excellent K-12 program are much appreciated. The financial support of our sponsors and exhibitors has allowed us to provide you with quality materials, meals and refreshments. We hope you'll support them in return. We do thank the IL/IN ASEE Section officers for allowing us this opportunity to host the 2008 conference. We are grateful for the support of the national ASEE office, in particular President-Elect Sarah Rajala.

At the risk of failing to mention everyone who has played a vital role in planning and preparing this conference, I gratefully acknowledge the contributions of the following:

- The registered attendees
- Our workshop presenters
- Our paper authors and presenters
- Our student authors and presenters
- Our K-12 session presenters
- Our Keynote Speaker, Stuart Walesh
- Our Awards Banquet Speaker, Wayne Wagner

- Our Assessment Panelists David Finley, Jerry Jakubowski, Richard Johnson, James Lowes, and Sarah Rajala and Moderator: Julia Williams
- Our abstract reviewers
- Our manuscript reviewers
- Our session moderators
- The IL/IN Section Awards Chair, Robert Rhofinger, and Committee
- The Student Competitions Awards Committee
- The Technical Program Committee:
    - Bruce Black (Workshop sub-committee)
    - Patricia Carlson (K-12 Chair, Workshop sub-committee, Assessment Panel sub-committee)
    - Glen Livesay (Student Competitions sub-committee)
    - David Miller (Student Competitions sub-committee)
    - Lori Olson (Chair, Student Competitions Coordinator)
    - Kevin Sutterer (Abstract and Paper Review Coordinator/Editor)
- RHIT President Jerry Jakubowski, who brought the conference to RHIT, for his continued and invaluable moral and financial support of ASEE at RHIT
- Dean of Faculty Art Western for his invaluable moral and financial support of ASEE at RHIT
- Diane Hanson, Conference Coordinator, whose contributions are too many to list
- The efforts of the RHIT Development Officers: Dick Boyce, Elaine Lee, William Foraker
- The website development and graphic designs of Hyung-Jung Chang and Bryan Taylor
- The administrative assistance of Kathy Tuxbury, IRPA, and in particular formatting and editing the program booklet.
- The technical support of Timothy Chow, Director of Institutional Research
- The expertise and advice of Julia Williams, Executive Director of IRPA
- Our student staff

If you need help during the conference, please go to our registration desk and we will be happy to assist you. We hope you enjoy your visit to Rose-Hulman Institute of Technology and Terre Haute. Best wishes for a meaningful, educational and enjoyable conference experience!

Sincerely,

Sharon G. Sauer, Ph.D.
Conference Chair

Welcome from Rose-Hulman

April 3, 2008

To All American Society of Engineering Education IL/IN Section Conference Attendees:

Welcome to Rose-Hulman Institute of Technology!

As Past National President of ASEE, it gives me a special pleasure to see this group assembled here. I appreciate the importance of the work you will be doing, and know that this conference will be interesting and professionally rewarding. Please take advantage of these three days to learn all you can, to discuss the topics that will enrich us all, and to come to know your peers on a more personal level.

At the same time, please take the opportunity to look around our campus and to get to know more about Rose-Hulman. We are very proud of our facilities and our students, faculty and staff. We know you will be impressed.

I would like to thank Conference Chair Sharon G. Sauer and Conference Coordinator Diane Hanson for organizing this event and Kathy Tuxbury for her invaluable administrative support. They have assembled a stimulating program for this conference, and have worked to make your stay on campus comfortable.

Once again, welcome to Rose-Hulman.

Sincerely,

Gerald S. Jakubowski

Gerald S. Jakubowski, Ph.D., P.E.
President

Conference Highlights

Friday Keynote Breakfast Speaker: Stuart G. Walesh, Ph.D., P.E., Hon.M.ASCE

Presents, 'Fork in the Road: Choosing a Bright Future for Engineering'

Improvements to, and in some cases reformation of, U.S. engineering education have been studied and discussed for decades. While progress occurred, it has fallen short of reform. However, the profession recently reached a tipping point in that some elements of the engineering profession have seen a definitive fork in the road and are going in a new direction. They have seen "two roads diverged" and are taking the "one less traveled."

This presentation reviews some of the forces driving reform with special mention of the stewardship factor. Then the presentation demonstrates that significant elements of U.S. engineering are heading in a new direction regarding the formal education and early experience of engineers. Specific reform actions and their significance are noted. Finally, the presentation encourages current non-participants, whether they be individuals or organizations, to proactively participate and suggests how.

Panel Discussion: What Do We Gain by Assessment? Cost/Benefit Perspectives

Many educators question whether the costs of program assessment outweigh the benefits. In this panel discussion to be held on Friday, we will hear the opinions of panelists who have served as part of the assessment process from faculty member to evaluator to President of ABET. Both industrial and academic perspectives will be presented. Panelists will share a short synopsis of their opinions followed by a time of question and answer. There will be opportunity for questions from the audience so pull out that pen and paper and start jotting down your questions!

Focus on K-12

On Saturday, a track especially designed with the K-12 educator and administrator in mind consists of engaging activities that will inspire and inform. Workshops with materials that can be put to immediate use in the classroom will be presented along with informational sessions on various outreach programs in Illinois and Indiana. Making resources available is a key goal, and programs such as Pathways to Engineering and the ISTEM Network will be highlighted. The thought-provoking film Two Million Minutes will be shown and followed by participant discussion. We hope you'll find these opportuntiies as exciting and informative as we do!

Focus on Undergraduate Students

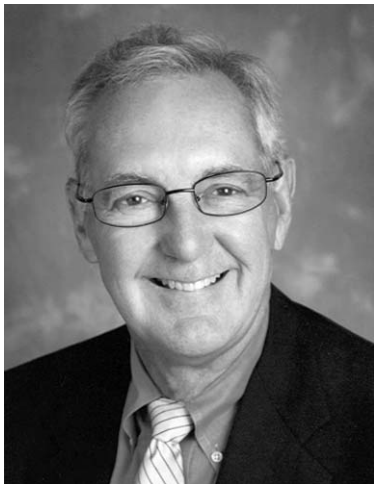
Why are we here? Primarily because we love to teach and want to ensure the best learning opportuntiies and environments for undergraduate students! Therefore, the conference is providing excellent opportunities for undergraduate students to showcase their research, design, and project work. We are very pleased to offer for the first time in the ASEE IL/IN section a student paper contest. Thirteen students will be competing for the honor of "Best Student Paper." In addition, a student poster competition is being held, and the posters will be available for viewing throughout most of the day on Saturday.

Saturday Evening Awards Banquet

Awards Dinner Speaker, Wayne Wegner, Executive Vice President, Bemis Polyethylene Packaging Division, will present, "Engineering Education as a Competitive Advantage in the Global Economy." And join us for the best meal of the conference as we recognize the 2008 Outstanding Educator in the IL/IN Section, the Outstanding Conference Paper, Outstanding Student Papers, Outstanding Student Posters, Section Outstanding Campus Representative and present the award for Outstanding Service to the IL/IN Section!

FRIDAY, APRIL 4 *8:30 a.m. - 10:00 a.m.*

KEYNOTE ADDRESS
HMU, Kahn Room



STUART G. WALESH
Consultant

Stuart G. Walesh is an independent consultant to engineering firms and public entities having previously worked in government; for an engineering firm; and in academia, as an engineering faculty member and dean. His professional interests include water resources engineering, education and development of engineers, and managing and leading.

He has served on and chaired various committees and other groups. For example, he was Chair of the ASCE Urban Water Resources Research Council, a member of the ASCE Task Committee on the First Professional Degree, and served on the Indiana Board of Registration for Professional Engineers. Most recently he was editor of the 2008 report Civil Engineering Body of Knowledge for the 21st Century.

In 1995, Walesh received the Public Service Award from the Consulting Engineers of Indiana; in 1998, the Distinguished Service Citation from the College of Engineering at the University of Wisconsin; in 2003, the Excellence in Civil Engineering Education Leadership Award presented by the ASCE Educational Activities Committee; in 2004, he was elected an Honorary Member of ASCE; in 2005, he was elected a Diplomate of the American Academy of Water Resources Engineers; and in 2007, he was named Engineer of the Year by the Indiana Society of Professional Engineers and received a Distinguished Service Award from the National Society of Professional Engineers.

Dr. Walesh earned his B.S.C.E. at Valparaiso University, his M.S.E. at The Johns Hopkins University, and his Ph.D. at the University of Wisconsin-Madison. He has authored or co-authored over 200 publications and presentations in engineering, education, management, and leadership and has facilitated or presented hundreds of workshops, seminars, webinars, and meetings. Dr. Walesh is the author or co-author of five books: *Urban Surface Water Management* (Wiley, 1989); *Engineering Your Future, Second Edition* (ASCE Press, 2000); *Flying Solo: How to Start an Individual Practitioner Consulting Business*, (Hannah Publishing, 2000); *Managing & Leading: 52 Lessons Learned for Engineers*, (ASCE Press, 2004); and *Managing and Leading: 44 Lessons Learned for Pharmacists*, (ASHP, 2008, co-authored with Dr. Paul Bush).

Fork in the Road: Choosing a Bright Future for Engineering

Abstract
Improvements to, and in some cases reformation of, U.S. engineering education have been studied and discussed for decades. While progress occurred, it has fallen short of reform. However, the profession recently reached a tipping point in that some elements of the engineering profession have seen a definitive fork in the road and are going in a new direction. They have seen “two roads diverged” and are taking the “one less traveled.”

This presentation reviews some of the forces driving reform with special mention of the stewardship factor. Then the presentation demonstrates that significant elements of U.S. engineering are heading in a new direction regarding the formal education and early experience of engineers. Specific reform actions and their significance are noted. Finally, the presentation encourages current non-participants, whether they be individuals or organizations, to proactively participate and suggests how.

1:00 p.m. - 2:00 p.m. **FRIDAY, APRIL 4**

PANEL DISCUSSION
HMU, Kahn Room

Panel Discussion: What Do We Gain by Assessment? Cost/Benefit Perspectives

Immediately following lunch.

Moderator: Julia M. Williams, Executive Director, Office of Institutional Research, Planning and Assessment and Professor of English, Rose-Hulman Institute of Technology

The Panelists

Dr. David Roland Finley
Vice-President of Academic Affairs
Tri-State Univeristy

Dr. David Roland Finley, Vice-president for Academic Affairs at Tri-State University since 2004, oversees academic programs in the five schools comprising the institution, which include engineering & technology, business, teacher education, arts & sciences, and professional studies. He also works with standing committees of the faculty, including Academic Assessment. During his tenure as VPA, Tri-State has hosted a General Review of the entire university by the Higher Learning Commission as well as a Focus Visit for new program approval in the School of Professional Studies. Tri-State also earned initial NCATE accreditation of its teacher education unit during this time. The institution is currently pursuing accreditation for its school of business.

Prior to his current appointment, Dr. Finley served as chair of the McKetta Department of Chemical Engineering and dean of the Allen School of Engineering and Technology. The institution hosted both an interim visit and general visit by ABET of programs in chemical, civil, electrical, and mechanical engineering during this period.

Dr. Finley completed undergraduate study at the University of Michigan and earned his doctorate at Wayne State University in Detroit. Finley is a member of the American Institute of Chemical Engineers and the American Society for Engineering Education; he is also a registered Professional Engineer in Indiana.

Dr. Gerald (Jerry) Jakubowski
President
Rose-Hulman Institute of Technology

Dr. Gerald (Jerry) Jakubowski is currently the President of Rose-Hulman Institute of Technology in Terre Haute, Indiana. He received his BSME, MSME and Ph.D. degrees from the University of Toledo in Toledo, Ohio. Before returning to the Midwest, Dr. Jakubowski served as Vice President and Provost of Arizona State University. Prior to his move to Arizona, he served for fourteen years as the Dean of the College of Science and Engineering and Professor of Mechanical Engineering at Loyola Marymount University in Los Angeles. In addition to his west coast appointments, Dr. Jakubowski held the positions of Interim Dean of Engineering and Associate Dean of Research and Graduate Studies in the Herff College of Engineering at Memphis State University (now University of Memphis) and was Assistant Dean of Engineering at the University of Toledo where he was responsible for the overall administration of the undergraduate engineering program. He also served as faculty member at the University of South Alabama.

Dr. Jakubowski is Past National President of the American Society for Engineering Education (ASEE) and Immediate Past Chair of the Engineering Accreditation Commission (EAC) for ABET. He has been a member of the EAC since 1999 and served in various roles on the Executive Committee since 2002. In addition to ASEE and ABET, he is active in the Society of Automotive Engineers (SAE) where he has been member of the ABET Relations Committee and served a two-year term as Chair of that Committee. He is a member of the American Society of Mechanical Engineers (ASME) and has been a Mechanical Engineering Program Evaluator since 1994. During his tenure as Dean of the College of Science and Engineering at Loyola Marymount University, the college underwent three engineering accreditation visits. Jerry has published and presented several papers on assessment and accreditation.

Dr. Richard T. Johnson
Dean of Engineering
Bradley University

Dr. Richard T. Johnson is currently the Dean of the College of Engineering and Technology at Bradley University. He is a mechanical engineer by training and has BSME and MSME degrees from the University of Missouri - Rolla and the Ph.D. degree in Mechanical Engineering from the University of Iowa. He has been an engineering educator for over thirty years and has held faculty positions at the University of Missouri - Rolla, Wichita State University, and Bradley University. At the University of Missouri – Rolla he was the Mechanical Engineering Department faculty member in charge of laboratories and developed all the instructional laboratories in the mechanical engineering program. He also developed the engine and fuels laboratory facilities and was the Director of the Institute for Flexible Automation and Robotics. At Wichita State University, Dr. Johnson was Chair of the Mechanical Engineering Department and again heavily involved in laboratory development and the experimental program. He has been Dean of the College of Engineering and Technology at Bradley University for eight years and is very much at home with the hands-on, experiential nature of Bradley's engineering and technology programs.

During his career, Dr. Johnson has been involved in the ABET accreditation process as a faculty member, a department chair and college coordinator, and a dean with both engineering and technology programs that are accredited. He was a member of one of the early study groups to review and promote change in the "check the box" ABET criteria and process of the 1980s and early 1990s. As department chair and then dean during the transition between the "old" accreditation criteria and ABET 2000, Dr. Johnson has initiated, observed, and dealt with many issues related to assessment and "closing the loop."

Mr. James (Jim) M. Lowes
Retired from Eli Lilly and Company
Indianapolis, IN

Mr. James (Jim) M. Lowes served as an ABET evaluator from 1995 through 2005. His primary responsibility was the evaluation of the B.S. chemical engineering program for accreditation. Mr. Lowes retired from Eli Lilly and Company in 2005 with over 35 years experience in planning, designing, constructing and operating bulk pharmaceutical manufacturing facilities worldwide. Since his professional experience was in industry, he brought a unique and much sought after perspective to the accreditation process.

Mr. Lowes is a 1970 graduate of Rose Polytechnic Institute with a B.S. in Chemical Engineering. He received his M.B.A. from Southern Illinois University at Edwardsville in 1973. A member of the American Institute of Chemical Engineers since 1970, his long service to the organization at all levels resulted in his being named a Fellow in 2005.

Dr. Sarah A. Rajala
President-Elect of ASEE and Department Head of Electrical Engineering
Mississippi State University

Dr. Sarah A. Rajala is currently professor and department head of electrical and computer engineering at Mississippi State University. She also holds the James Worth Bagley Endowed Chair. Prior to coming to Mississippi State University in December 2006, she served as associate dean for research and graduate programs in the College of Engineering at North Carolina State University. She joined the faculty at NC State in 1979 and has served as director of the Industry/University Cooperative Research Center for Advanced Computing and Communication from 1993-1996, associate dean for academic affairs from 1996-2002 and in her current role since 2002. From 1987-1998, she held a visiting appointment in the School of Electrical Engineering at Purdue University.

Sarah is the president-elect of ASEE, represents the ASEE as a member of the ABET Engineering Accreditation Commission, and is member of the ASEE Accreditation Activities Committee and the IEEE Committee on Engineering Accreditation Activities. While Associate Dean for Academic Affairs at NC State, she was very involved in the preparation for two ABET visits. She has also served as a program evaluator for a number of years. In addition, she co-edited a book on engineering assessment which was recently published.

She received her B.S. degree in electrical engineering from Michigan Technological University in 1974, and the M.S. and Ph.D. degrees in electrical engineering from Rice University in 1977 and 1979, respectively.

SATURDAY, APRIL 5 *4:30 p.m. - 5:30 p.m.*

AWARDS BANQUET GUEST SPEAKER

HMU, Kahn Room

Engineering Education as a Competitive Advantage in the Global Economy

Wayne Wegner

Executive Vice-President,
Bemis Polyethylene Packaging Division
Terre Haute, IN

Bemis Company, Inc.

Wegner has been the Executive Vice President of Bemis' Polyethylene Packaging Division in Terre Haute, IN since 2003. The Bemis Company is the largest flexible packaging company in North and South America as well as developing a growing presence in Europe and Asia. He has responsibility for the manufacturing, engineering and product development departments of the three facilities of the Polyethylene Packaging Division (Terre Haute, IN, Hazleton, PA and Flemington, NJ).

Prior to joining Bemis, Wegner was a senior operations manager and team leader with Presto Products, a subsidiary of the Alcoa Consumer and Packaging Division of Alcoa. Presto Products (headquartered in Appleton, WI) is the leading manufacturer of private label disposer bags, reclosable bags and plastic wraps in North America. He held progressively more responsible leadership roles ranging from Manager of Research and Development, Vice President of Manufacturing, Vice President of Specialty Products and Vice President of Operations.

A native of Milwaukee, WI, Wegner earned his Bachelor of Science in Chemical Engineering from the University of Wisconsin in 1977.

Rose-Hulman Institute of Technology at a Glance

Founded in 1874, Rose-Hulman is located on a 200-acre campus just east of Terre Haute, Indiana. The college offers a rigorous, hands-on education that stresses development of technical and interpersonal skills in an environment characterized by close personal attention for every student. The college has an enrollment of 1,800 undergraduate students. Degree programs are offered in applied biology, biomedical engineering, chemical engineering, chemistry, civil engineering, computer engineering, computer science, economics, electrical engineering, engineering physics, mathematics, mechanical engineering, optical engineering, physics and software engineering.

Many national guides to select colleges include Rose-Hulman. In 2008, for the ninth year in a row, U.S. News & World Report ranked Rose-Hulman as the #1 college in the United States specializing in engineering at the baccalaureate and master's level. Some of the nation's best students enroll at Rose-Hulman. The median SAT score of a first-year student at Rose-Hulman is 1300.

2008 Conference Organizing Committee

Sharon Sauer, Conference Chairperson
Rose-Hulman Institute of Technology

Diane Hanson, Conference Coordinator
Rose-Hulman Institute of Technology

Kathy Tuxbury, Administrative Assistant
Rose-Hulman Institute of Technology

2008 Conference Program Committee

Lorraine Olson, Chairperson
Rose-Hulman Institute of Technology

Bruce Black
Rose-Hulman Institute of Technology

Patricia Carlson
Rose-Hulman Institute of Technology

Glen Livesay
Rose-Hulman Institute of Technology

David Miller
Rose-Hulman Institute of Technology

Sharon Sauer
Rose-Hulman Institute of Technology

Kevin Sutterer
Rose-Hulman Institute of Technology

Acknowledgements

Numerous faculty members from many institutions across the disciplines generously gave their time and talent to contribute to the peer review process. We thank them for their participation in this essential task and their dedication to ASEE!

We would also like to extend our sincere appreciation to the Rose-Hulman Community for their dedication to creating a quality conference experience for our attendees.

An extra special "THANK YOU!" to our colleagues in:
Academic Affairs
Aramark Catering
Business Office
Development
Facilities Operations
Instructional, Administrative & Information Technology
Institutional Research, Planning & Assessment
President's Office
Print & Copy Services
Publications

THURSDAY, APRIL 3 *1:30 p.m. - 3:00 p.m.*

WORKSHOP

Sexual Harassment in Academia: Mentoring the Female Engineering Student

Deborah Walter, Rose-Hulman Institute of Technology
Carlotta Berry, Rose-Hulman Institute of Technology
Tina Hudson, Rose-Hulman Institute of Technology
Jessica Fischer, Indiana State University
Olin Hall O157

Workshop Abstract
This mini-workshop will be an interactive, engaging presentation to build awareness among faculty and staff of unique female student experiences in academia. The focus will be on the challenges that female students face due to their interactions in a predominately male environment, typically encountered in Science, Technology, Engineering and Mathematics (STEM) majors. The challenges to be discussed include various levels of sexual harassment among peers and student/professor relationships including objectification, discrimination, and harassment. Our goal is to give attendees information and tools that will help them to mentor female students. Our long term vision is that faculty can positively impact the environment for female students in STEM majors through awareness and education about these issues, which may improve recruitment and retention of female students.

The workshop format will begin with the role play of typical scenarios based upon actual female student experiences. Following each skit, the presenters will define the challenges that the female student faces in terms documented by current researchers. The impact of these challenges on the student and common coping mechanisms will be described. Following these presentations, the scenarios will be used to initiate a dialogue among the presenters and members of the audience to discuss methods for mentoring the student. The goal of the discussion is to propose solutions and identify the larger societal impact of the actions of the mentor.

There is no level of expertise required for workshop attendance and faculty, staff and administrators of all disciplines are encouraged to attend. Materials to be disseminated include:

1) summaries of current literature documenting the challenges dramatized by the skits, including references,
2) summaries of the discussion proposing methods for handling specific mentoring situations, and the salient points of the larger societal impact of faculty actions.

Key Words
Diversity Recruitment, Diversity Retention, Learning Communities

1:30 p.m. - 5:00 p.m. **THURSDAY, APRIL 3**

WORKSHOPS

Engineering Education Proposal Writing and Project Management Workshop

Teri Reed-Rhoads, Purdue University
Olin Hall O167

Workshop Abstract
Participants will be engaged in proven strategies and techniques for writing engineering education proposals to and managing projects for programs such as, but not limited to, the National Science Foundation (NSF) divisions of Undergraduate Education (DUE) and Engineering Education and Centers (EEC). Through active discussions, collaboration, and sharing of experiences, participants step through an actual Request for Proposals (RFP) as they learn how to a) analyze a program announcement/solicitation, b) align their project ideas with program goals, c) identify relevant prior work, and d) craft responsive engineering education proposals. Participants will also look forward to receipt of an award and learn how to effectively manage an on-going project with due attention to budgeting, evaluation, sustainability, and reporting requirements. Discussion topics will range from the basic NSF requirements to the fine points of writing or using graphical presentations that catch a reviewer's attention. Some advice comes directly from NSF program directors and grantees including tips on writing in a way that allows reviewers to quickly and easily read and understand your proposal. Finally, the new engineering education research agenda will be presented and discussed. Workshop participants will receive a new handbook, fusing attention to research, engineering education, and project management into a seamless whole. In addition, handouts on the acronyms often utilized in engineering education communities and grant writing along with NSF educational programs that are considered development versus research opportunities will be shared with participants. The handbook, handouts and workshop build upon guidance developed by NSF program officers and grantees. This workshop is being offered as a project of the Center for the Advancement of Scholarship on Engineering Education (CASEE) of the National Academy of Engineering (NAE) consistent with its emphasis on enhancing excellence in engineering education including education research.

Key Words
Interdisciplinary Approaches, Diversity Recruitment Programs, Diversity Retention Programs, Education Methods, Other: Writing engineering education grants and management of projects

Very Easy 3D Modeling in AutoCAD that Everyone Should Know

Douglas Acheson, IUPUI
Olin Hall O203

Workshop Abstract
This workshop will in simple terms outline 3D generation and rendering in AutoCAD. Despite more powerful 3D softwares used in industry, AutoCAD still has a resounding market share of installed seats of all CAD packages in virtually every geographic location. Additionally, most educational institutions already have access to AutoCAD as well. However, most educators and industry professionals do not exploit the capabilities of this common software package, in part because they are not aware of the power and ease-of-use it affords. Since nearly every other CAD software is written to accept AutoCAD's native .dwg format or their .dxf (Drawing Exchange Format) files, it stands to reason that even the competitors acknowledge AutoCAD's user base. Unfortunately, most industry users and educators alike cannot afford to take the time to learn AutoCAD's 3D functions and are satisfied with continuing to use it (AutoCAD) as a solely 2D Drafting package.

This very practical, hands-on workshop will equip the participants to utilize this tool (AutoCAD) to embellish their various curriculums with 3D geometry intertwined throughout. From lab layouts to compelling visuals for courses that could benefit from 3D imagery, AutoCAD could be leveraged by all engineering/technology faculty. For an example, perhaps an on-line manufacturing processes class is attempting to explain the concept of a counterbore. Wouldn't it be handy if the author was familiar enough with AutoCAD's 3D capabilities to quickly model this scenario in order to include a graphic representation of this concept? Much like using clip art, AutoCAD could be used as a communication tool rather than just strictly as a drafting tool. From the author's perspective, the mystery shrouding the use of AutoCAD's 3D functions should not be. It's much easier than most think, and this workshop aims to introduce its participants (more than introduce, but rather build confidence) in the use of plain ol' AutoCAD to create accurate, relatively complex and compelling-appearing geometry.

In addition to creating 3D geometry from scratch, this workshop will also instruct its participants in using existing 2D legacy data to generate 3D geometry. This in itself is an extremely valuable skill to introduce students to as many firms in industry have multitudes of 2D drawings on file that are in need of conversion to 3D. Without entering any additional values or dimensions, the existing 2D data can be manipulated in such a way as to create true 3D geometry (useful for RP, CNC, VR, FEA, etc.) in an incredibly easy fashion. Finally, an introduction to photo-realistic lighting and rendering within AutoCAD will be included in this workshop.

Bottom line – AutoCAD is and will continue to be the "common man's" CAD package of choice. Instead of ignoring its 3D capabilities or transitioning to a more complicated, expensive 3D modeler, existing users should become aware of what this package can do.

Maximum number of participants for this workshop is 25. AutoCAD 2004 will be used.

Key Words
Engineering Technology Curricula, Lifelong Learning, Other: 3D Modeling

Create Instructional Screencast Videos with Camtasia Studio

Ed Doering, Rose-Hulman Institute of Technology
Olin Hall O259

Workshop Abstract

With the proper software tools you can easily capture your computer screen activity to video, add voice narration as audio, and deliver the video from your web page as a "screencast." A screencast video offers a superior way to show your students how to use computer-based tools, and with a tablet-based interface you can capture handwriting and diagrams to emulate whiteboard activity in classroom. Students can view the screencast anytime, and can adjust the playback according to their learning needs by pausing, repeating sections as needed, and quickly searching for content of interest.

In this workshop learn how to use TechSmith's Camtasia Studio to capture your computer screen activity as a video, add value to your video with callouts, titles, captions, and audio narration, and produce your video for distribution on your webpage. In addition, learn how to use Alias Sketchbook and Windows Journal on the Tablet PC to capture handwriting and drawings to a video, a useful technique to create animated lectures and homework solutions with audio narration.

The following websites demonstrate what can be accomplished with the tools and techniques to be presented in the workshop:

-- Lectures and demonstrations: www.cnx.org/content/m15442
-- Homework solutions: www.rose-hulman.edu/cleo/
-- CAD tool tutorials: www.rose-hulman.edu/~doering/PLD_Oasis/video_tutorials.htm

Workshop attendees will take home a video of their own creation suitable for posting to a website, a tip sheet with recommendations to optimize your learner's experience, as well as your own production effort, and hardcopy of presentation slides. Attendees should bring a thumb drive, and are welcome to bring a laptop computer (please contact the workshop presenter for instructions regarding required software to be installed prior to the workshop). No prior experience with table PCs is required.

Key Words
Education Methods, Innovative Teaching Methods, Technology in the Classroom

THURSDAY, APRIL 3 *3:30 p.m. - 5:00 p.m.*

WORKSHOP

A Model Project for Making Industry Meaningful In College

Dorene Perez, Illinois Valley Community College
Jim Gibson, Illinois Valley Community College
Rose Marie Lynch, Illinois Valley Community College
Olin Hall O159

Workshop Abstract
A multi-disciplinary project entitled Making Industry Meaningful In College (MIMIC) at Illinois Valley Community College places students in engineering design, electronics and a variety of business fields into student "companies" to design, prototype, manufacture, market and sell products on campus. The one-semester project, supported by a National Science Foundation grant, emphasizes teamwork, critical thinking, problem solving and communication skills.

MIMIC is a highly adaptable project since it utilizes existing courses. The engineering design students are enrolled in Design Projects; electronics students are enrolled in Motors and Controls II; and business students are in Integrated Business Operations. The three courses are scheduled to meet at a common time, which allows them to meet in their teams or "companies" once a week.

This workshop is designed for instructors and administrators, at any level, who are interested in establishing a simple, cost-effective, multi-disciplinary project that engages students in simulated workplace experiences. In addition to providing opportunities to polish technical skills, a multi-disciplinary project built on the MIMIC model can be very effective in teaching and reinforcing skills in teamwork, critical thinking, problem solving and communication, as well as assisting students in making career decisions and preparing them for internships. Workshop participants will learn how to adapt the MIMIC model to include students from various disciplines and to organize and assess a similar project.

In this workshop, presenters will briefly describe

- The MIMIC project including organization, scheduling, typical products, costs, student and project assessment
- How MIMIC is becoming the focal point of the engineering technology program as the design and reengineering of MIMIC products is introduced into a number of technical courses
- Spin-off projects built on the MIMIC model, illustrating adaptability of the model.
- Student and project evaluations and industry feedback about the project.

Participants, working in small groups, will brainstorm and discuss ideas for developing MIMIC-like projects at their colleges and schools. They will also discuss the possibility of including industry partners. Participants will prepare an outline for a multi-disciplinary project, modeled after the MIMIC project, which could be organized at their college or school. And they will share those ideas with other participants at the workshop.

Key Words
Interdisciplinary Approaches, Education Methods, Engineering Technology Curricula, Entrepreneurial Opportunities, Innovative Teaching Methods

10:30 a.m. - 12:00 p.m. **FRIDAY, APRIL 4**

TECHNICAL SESSION
Sustainable Development in Science and Engineering Education
Moderator: Roger N. Olson, Rolls-Royce
Olin Hall O157

Educating Undergraduate Engineering Students on Sustainability – Current Status and a Body of Knowledge

Michael Robinson, Rose-Hulman Institute of Technology

Abstract
The engineering community, both professionals and educators, have an ethical responsibility to address sustainable development in their practice and in the education of future engineers. The American Society of Civil Engineers through the first Fundamental Canon in its Code of Ethics creates an ethical responsibility for civil engineers : "Engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties." The American Society for Engineering Education creates an ethical responsibility for engineering faculty by stating that "Engineering students should learn about sustainable development and sustainability in the general education component of the curriculum as they are preparing for the major design experience." Many educational leaders through endorsement of either the American College and University Presidents Climate Commitment (426 signatories) or the Talloires Declaration (350 signatories) have created an ethical responsibility upon their institutions to incorporate sustainability into their curriculum. Although a noble goal, the devil is in the details. Sustainability within a curriculum can range from creating student awareness (knowledge of the problem) to providing students sufficient knowledge to incorporate sustainability into their decision making process (analysis, synthesis, and evaluation of solutions to the problem). There is no consensus as to what level of student learning on sustainability is optimal. Within engineering programs there may be significant differences among various disciplines. Several attempts have been made by organizations over the last few years to determine the status of sustainability within the engineering curriculum. Despite this there has been increased activity, especially at the graduate level, to provide students educational and research opportunities related to sustainability. However, at the undergraduate level there is much less activity. This paper will provide a review of the current status of sustainability within engineering curriculums in both undergraduate and graduate programs and research programs / centers. More importantly, the paper will provide discussion of a proposed body of knowledge for sustainable engineering at the undergraduate level. A body of knowledge defines both student learning outcomes and associated cognitive levels of learning for each outcome. The idea of defining a body of knowledge for an engineering discipline has seen increasing interest among many engineering disciplines. By proposing a body of knowledge for sustainability in engineering, perhaps better termed sustainable engineering, a more systematic view of what engineering faculty need to do to meet their ethical responsibility to educate tomorrow's engineers on sustainability will be achieved.

Key Words
Educating for Sustainable Energy, Engineering Curricula

A Student Project to Quantify Machinability of Plastics Using Corn Ethanol Co-Products as Biofiller – An Educational Perspective for Green Manufacturing Applications

Andrew Otieno, Northern Illinois University
Kurt Rosentrater, USDA
Pratyusha Melampati, Northern Illinois University

Abstract
Corn ethanol processing by-products are primarily used as animal feeds. Other potential applications include the manufacture of biodegradable plastic composites. This, however, requires subsequent processing, adding cost to the final product. Thus, it is necessary to investigate alternative methods by which these co-products can be utilized. Recent research collaborations between Northern Illinois University and the USDA-ARS have utilized these co-products as plastic filler materials. Preliminary results have indicated the viability of incorporating these into a phenolic-based thermoset polymer using a compression molding process. Although the mechanical properties of these novel materials have been analyzed, manufacturing properties, in particular, machinability, are yet to be studied. Conducting these tests has proven to be very appropriate as a student project. From an educational perspective, this project has allowed students to increase knowledge in the area of green manufacturing applications, by examining manufacturing methods for novel materials, such as biodegradable polymeric products. In addition, concepts of machining have been extended from metallic materials to polymers, opening new avenues for education and research into machinability of materials. This paper also presents a simple approach that can be used as a classroom tool for determining manufacturability of innovative materials, and can readily be implemented in manufacturing courses.

Key Words
Interdisciplinary Approaches, Educating for Sustainable Energy, Fostering Undergraduate Research, Industrial Partnerships, Innovative Teaching Methods

Zero-Energy and Carbon-Neutral Construction: Where and How to Start Integrating the Concepts into Construction Education

Erdogan Sener, IUPU-Indianapolis

Abstract
Buildings in developed countries account for 40% of the total energy consumption today and in parallel account for 40% of global greenhouse gas emissions even though buildings themselves do not emit carbon dioxide directly.

Despite the fact that green, carbon-neutral, and zero-energy issues have been heavily design-focused so far, it is inevitable that construction engineering professionals will also play a major part in these undertakings in due time. Hence the need to include and integrate these core concepts into construction engineering and management education and related curricula. This will ensure that these fundamentals are conveyed to the future generation of professionals who will surely play a major role in the implementation of the core concepts.

This paper focuses on starting, however slowly, with the coverage of the core issues behind zero-energy, carbon neutral and sustainable design/construction. Work is being undertaken by U.S. Green Building Council (USGBC) and others to rate new buildings and renovations have been used as a basis for conveying of the fundamental concepts. Typical technologies and methodologies that have been implemented so far towards this end are touched upon. Examples of how the fundamental concepts have been integrated into typical courses are covered.

Key Words
Educating for Sustainable Energy

Topics in Energy and the Environment: Opinions and Evaluations of the Classroom Experience

Jessica L. Anderson, Rose-Hulman Institute of Technology

Abstract

This paper describes an elective course for teaching energy and the environment from an engineering perspective. One goal of this course was well stated by Hyde and Karney, "Environmental education for engineering students is intended to make them better environmental citizens." In addition, Splitt stated that "a fundamental change in engineering education [is] required to help the next generation of engineers learn to design for sustainable development and long-range competitiveness." Therefore, in addition to describing efforts in teaching this course, this study examines students' overall perceptions of the energy and environment challenges as they relate to engineering and how their perceptions have changed due to this course. This course is presented in a multi-media, active learning, project-based environment which increases the student's basic knowledge of a wide breath of energy/environmental topics. These topics included many fossil fuel-based technologies such as combustion of coal, oil, and natural gas, mitigation of carbon dioxide and other fossil fuel combustion byproducts such as carbon capture and sequestration, and renewable or carbon-free energy sources such as wind energy, wave and tidal energies, solar energy, biomass, nuclear, and hydrogen. Other topics included carbon balances, energy balances, and climate modeling for the Earth.

The winter quarter of the 2007-2008 school year is the first year a course like this has been taught at Rose-Hulman. Therefore, it is very important to become familiar with the successes and failures of this course as it was taught. Additionally, it is important to assess student learning not only in their group discussions, quizzes and projects, but also in their perception of energy and the environment. The class was composed of a mixture of juniors and seniors, with one graduate student, in several engineering majors including chemical engineering, civil engineering, and engineering management. A total of 19 students took the course in this it's first offering.

Key Words

Engineering Curricula

FRIDAY, APRIL 4 *10:30 a.m. - 12:00 p.m.*

TECHNICAL SESSION
Learning Pedagogy
Moderator: Kevin Sutterer, Rose-Hulman Institute of Technology
Olin Hall O159

Intellectual Development and Critical Thinking Skills in Biomedical Engineering and Applied Biology Students

Jennifer O'Connor, Rose-Hulman Institute of Technology

Abstract
The three courses of the general biology sequence at Rose-Hulman Institute of Technology serve as the foundation for the education of both biomedical engineering and applied biology majors. The first biology course, cell structure and function, is normally taught entirely in a lecture format with handouts of lecture notes provided to help students in their study. Exams in this course consist of questions falling into the knowledge or comprehension level of Bloom's taxonomy of knowledge. Recently, one of the four sections of this course has implemented several activities to facilitate the development of skills related to learning and to practice asking complex questions and performing critical thinking. The third biology course, evolution and diversity, incorporates active learning exercises to help the students develop skills necessary for success in the sophomore curriculum. Students in this course are introduced to application level questions (according to Bloom's taxonomy) on the exams. In the third course, students have had difficulty developing critical thinking skills (as demonstrated by performance on application level problems) and, the overall performance measured by student grades declined from the first course. In addition, students have exhibited a negative attitude towards this course and its content. These observations led to a research study examining intellectual development and critical thinking skills in students enrolled in the general biology courses. A survey was designed to measure 1) student attitudes towards biology, 2) student confidence regarding performance in biology, 3) intellectual development according to the Perry scheme of cognitive development, and 4) critical thinking skills among students enrolled in biology courses. The survey was administered to students enrolled in the first course of the general biology sequence in fall, 2007. The same students will participate in similar surveys in the third biology course and the genetics course (a requirement for biomedical engineering and applied biology majors). Data collected from students in the section incorporating the learning exercises will be compared to data from students in the other sections to determine the effect of an earlier introduction of study skills and critical thinking activities on student development in future biology courses.

Key Words
Education Methods, Lifelong Learning

The Development and Use of Teaching-Oriented Rubrics to Extend the Role of Classroom Problem Solving Sessions

David Benson, Kettering University

Abstract

One of the more difficult aspects associated with introducing group activity and problem solving sessions to the undergraduate classroom is the question of content sacrifice. With group activities there is often the concern that the price paid for introducing these types of activities in a tight, content-driven class is the loss of some of the essential content for the term. Another major concern that arises in relation to transforming class lecture time in to group time is the question of overall usefulness of the activity. This is of special concern in the light of the potential for this type of activity to deteriorate in to a glorified homework help session (recitation) and when solution manuals for most textbooks are readily available to students.

To address these concerns, a series of rubrics have been developed for use in both introductory and advanced engineering classes to broaden the objectives of small group (in-class) activities beyond the completion of a set of representative problems. These rubrics have been designed to transform student understanding of the material and to extend the educational impact of the activity beyond the borders of the small group. With these rubrics, students are challenged to both improve their understanding of a concept and to then reformulate their understanding so as to educate their peers. The different levels of performance outlined in the rubric guide the students away from their initial utilitarian approach and towards a deeper understanding of the underlying concepts by encouraging the incorporation of visual elements, insightful asides, concept map connections and process education elements. Student reactions to the activities, methods used to redistribute content to block time for activities, instructor reflections and examples of student product will be presented to illustrate the impact of the rubrics on the small group project.

Key Words

Innovative Teaching Methods

Preliminary Results from Teaching Students How to Evaluate the Reasonableness of Results

James Hanson, Rose-Hulman Institute of Technology
Patrick D. Brophy, Rose-Hulman Institute of Technology

Abstract

For the past two years, the authors have combined training on metacognition with skills identified by practitioners to teach undergraduate civil engineering students how to evaluate the reasonableness of structural analysis results. Metacognition is a sequence of steps followed by a person to monitor and improve that person's own cognitive performance in an area. The practitioner skills taught fall into three categories: fundamental principles, approximations, and features of the solution. When combined, the training has resulted in a measurable increase in student ability to evaluate the reasonableness of results. This paper summarizes how the training was incorporated in the classroom and homework assignments. Results from surveys, observations from interviews, and exam scores are presented to show the effect of the training on attitude, behavior and cognition. The paper concludes with suggestions on how the training might be applied in other fields of engineering.

Key Words

Education Methods, Innovative Teaching Methods

Putting Theory into Practice: Supplemental Learning Opportunities That Match Student Learning Styles

Kay C Dee, Rose-Hulman Institute of Technology
Allen White, Rose-Hulman Institute of Technology
Glen Livesay, Rose-Hulman Institute of Technology
Phil Cornwell, Rose-Hulman Institute of Technology
Don Richards, Rose-Hulman Institute of Technology

Abstract
The "matching hypothesis," or the idea that learning is maximized when key aspects of the learning environment matches the preferred style of the learner, is a well-known theory. To best put this theory into practice, however, a number of questions have yet to be answered. For example, what critical aspects of the learning environment and a student's learning style should be matched, and how best could this matching occur? We are investigating these questions by comparing effects of Supplemental Learning Opportunities (SLOs) which engage different learning styles. The first type of SLO consists of a well-structured classroom lecture environment with on-paper, engineering problem-solving exercises. The second type of SLO is a hands-on laboratory environment with integrated on-paper, engineering problem-solving exercises. The structures of both SLOs are strongly aligned with well-accepted (but different) theories of how to help students learn. Both SLOs are designed to reinforce material from the foundational course of a multidisciplinary sophomore engineering curriculum, which emphasizes both mathematical skills and physical insight. Two groups of engineering students (n = 50), well-matched in mean and median grade point averages, gender proportions, course instructors, intended majors, and learning styles (as assessed by the Index of Learning Styles and the VARK instrument) participated in ----+_the SLOs one hour each week for at least four weeks. Neither SLO group consistently outperformed the other group on the assessments, and assessment scores were generally similar across both sections. Assessments that were administered before and after SLO sessions showed improved post-session scores, indicating that students learned from both types of SLOs. Students classified as active learners by the Index of Learning Styles appeared to benefit from both environments. Our preliminary results indicate that matching student preference for sensory/intuitive learning with the SLO teaching environment may have benefited student learning (i.e., sensory learners generally performed better in the hands-on active SLOs, and intuitive learners generally performed better in the classroom-active SLOs). Further investigation is currently ongoing, but these results support the general idea of using varied teaching styles/approaches within a given course to help students with a broad range of learning styles.

Key Words
Education Methods

10:30 a.m. - 12:00 p.m. **FRIDAY, APRIL 4**

TECHNICAL SESSION
New Approaches to Traditional Courses
Moderator: Daniel G. Coronell, Rose-Hulman Institute of Technology
Olin Hall O167

What is the Role of Mathematical Modeling in Core Mathematics Courses for Engineering Students?

Yosi Shibberu, Rose-Hulman Institute of Technology

Abstract
The importance of mathematics to engineering is not in dispute. Engineering majors are required to study far more mathematics than most other majors are required to study. There often are, however, disagreements between mathematicians and engineers on the best way to teach mathematics to engineering students. We describe possible reasons for these disagreements. We provide an example of how mathematical modeling can be used as a bridge to an abstract mathematical concept known to mathematicians as the implicit function theorem, but referred to by engineering students as "you got to have as many equations as unknowns." We illustrate how mathematical modeling highlights mathematical subtleties often overlooked by students.

Key Words
Interdisciplinary Approaches, Education Methods

A Different Kind of "Statics" Project

Lorraine Olson, Rose-Hulman Institute of Technology
Richard Stamper, Rose-Hulman Institute of Technology
Zachariah Chambers, Rose-Hulman Institute of Technology
Jerry Fine, Rose-Hulman Institute of Technology

Abstract
Many freshman statics courses involve course projects, but most involve bridge design in one form or another. We have developed a freshman class that involves both statics and elementary mechanics of materials, and have created a course project/contest which includes both of these topics.

The course content includes traditional statics topics, except for second moments of areas (moments of inertia) and internal forces in beams. To replace these topics, we incorporate simple 1-D stress/strain concepts from a traditional mechanics of materials treatment. (We cover the first six chapters of **Statics and Mechanics of Materials**, by Riley, Sturges, and Morris.)

This arrangement allows us to integrate a project/contest which incorporates the failure of a link into the course. Student teams are given a goal—they must design the lightest possible dog-bone link to carry the load created by a blade spinning at 1300 rpm. Their final designs are submitted as graphics files, and cut from nylon sheet with a laser cutting machine. On “contest day,” the links are tested, and the lightest link to survive the test is the winner. Contest grading is based on performance—A for the top third of the class, B for the middle third, and C for the bottom third. Failed links receive an F for the contest portion. Overall project grading consists of a grade for documentation as well as the contest score.

The goals of the project were to:

- Add another “real mechanical engineering” experience to the freshman year
- Break students out of the “topic of the day” mold into a broader design view
- Incorporate previously learned concepts from freshman graphics, computer applications, physics, and calculus
- Emphasize the importance of checking calculations
- Reinforce factor of safety concepts
- Develop student teamwork skills

Overall, the project was extremely successful in accomplishing our goals, and we will discuss the project/contest and the student responses to it in more detail in our presentation.

Key Words
Engineering Curricula, Freshman Engineering Programs

Experiential-Based Curriculum to Increase Retention and Graduation

Constantin Apostoaia, Purdue University Calumet
Donald L. Gray, Purdue University Calumet
Edward S. Pierson, Purdue University Calumet

Abstract
Two things have combined to encourage a significant change in the engineering curricula at Purdue Calumet: (1) a desire to improve student retention and graduation rates, and (2) a faculty-based decision to require that all PUC graduates have at least two experiential-based courses, and the availability of small grants to support this development.

This resulted in a funded proposal to introduce experiential education into the first-semester ENGR 190-Elementary Engineering Design course. The intention is to increase the hands-on component and the excitement level of the course to help retention and learning. In addition, this will provide a basis to build on for upper-level courses using the same hardware and software.

An Experiential Education Design and Development Award was received, and LEGO Mindstorms NXT robotic education kits have been purchased for use in ENGR 190 starting fall 2007. The students were introduced to the robots in the electrical part of ENGR 190, where they are exposed to team-based, hands-on experiential learning and project-oriented activities. These will provide a basis for more-advanced projects and will allow the engineering departments to modify the curriculum to extend experiential learning using the robotic kits to upper-level courses. This paper presents some of the lab experiments that were introduced to start using the LEGO robotic kits in the freshmen class.

A set of lab experiments was added in ENGR 190 to allow students to learn and understand the fundamental concepts used in the Electrical and Computer Engineering programs. First the students are introduced to the basic concepts of dc resistive circuits. Then the resistor color code is explained and the breadboard used to construct simple resistive circuits. The students learn to do resistance and voltage measurements using the lab equipment and instrumentation. Then, the students are required to make a comparison between the experimental results and the theoretical solutions obtained by hand calculation. The next step is a brief introduction to simulation tools for electric circuits with software such as PSpice. The students finish with the comparison between measured, calculated and simulated resistances, voltages, and currents by using simple lab reports.

When the students have received enough circuit construction and instruction, simple lab experiments are added to help understand the construction and the use of sensor input circuits associated with the LEGO robotic kit light, sound, touch, rotation, and ultrasonic sensors. Another set of applications are related finally to the output ports of the NXT robots using their dc motors and simple loads such as lamps, LED's and relays. All the applications are intended to develop in parallel the students programming skills using the NXT-G graphical environment provided with the Lego robotic kit.

Key Words
Interdisciplinary Approaches, ABET Accreditation, Diversity Retention Programs, Education Methods, Engineering Curricula, Freshman Engineering Programs, Innovative Teaching Methods

Differential Student Engagement with Hands-on Activities

Allen White, Rose-Hulman Institute of Technology
Glen Livesay, Rose-Hulman Institute of Technology

Abstract
As part of a larger study in supplemental instruction, the authors developed and delivered five, one-hour supplemental learning experiences to a group of ~25 students over the course of the fall quarter. Over the course of the five supplemental instruction periods, students (in groups of about 5) participated in a total of 17 hands-on activities, ranging in length from 5 to 20 minutes each. The primary objective of the hands-on activities conducted during the supplemental instruction periods was to emphasize pertinent concepts that students were learning about in a transport phenomena course. The motivation for the supplemental activities is to provide direct experience with very physical notions (e.g., conservation of mass, linear momentum, angular momentum, energy, etc.) that are covered in the class but with which many students may lack direct experience. The hands-on activities were developed to engage students in exploring the physical phenomena behind the concepts, and in this way to provide an improved context for their learning in the course. A secondary objective for the developed activities was to illustrate concepts with objects/activities that would be common to students' own experiences to improve the perceived relevance to the students.

The student response was often counter to the anticipated interest level with flat responses where enthusiasm was expected and tremendous enthusiasm and exploration where mere participation was expected. No clear causal relationship between engagement and activity type was clear at the conclusion of the supplemental instruction. For example, why do students enthusiastically experiment with a toilet mounted on wheels to allow students to see its functionality, but show little interest in a similar example involving a bathroom sink on wheels? Why is a syringe (without needle) more exciting than a hair dryer? For planning future activities, understanding the factors affecting student receptivity will enable the authors to develop examples that are at once illuminating and engaging. In this presentation and the accompanying paper, the authors will report on their conclusions regarding the factors underlying student enthusiasm and engagement with the hands-on activities.

Key Words
Education Methods, Innovative Teaching Method

FRIDAY, APRIL 4 *10:30 a.m. - 12:00 p.m.*

TECHNICAL SESSION
Issues and Challenges for New Curricula
Moderator: Sudipa Kirtley, Rose-Hulman Institute of Technology
Olin Hall O169

Overcoming the Communication Challenges in International Student Design Projects

Rachel Howser, Rose-Hulman Institute of Technology
Jeffery Gauthier, Rose-Hulman Institute of Technology
Nathan Bloss, Rose-Hulman Institute of Technology
J. David Fields, Rose-Hulman Institute of Technology
Eman Emil Gad, Sudan University of Science and Technology
John Aidoo, Rose-Hulman Institute of Technology

Abstract
As part of the capstone design experience, the Department of Civil Engineering at Rose-Hulman Institute of Technology teamed five seniors to design an educational complex in Khartoum, Sudan. This is the department's third international project as part of its 20-year-old senior design program. This international experience provides students many opportunities including partnering with international organizations, exposure to international design codes, standards, and customs, as well as gaining experience in the global working environment. Despite the benefits, international projects also incorporate many challenges including differences in cultural and educational environments, difficulty obtaining necessary data for design, and challenges associated with the inability for the students to easily access the site. Therefore, a key aspect in the success of an international project is communication. This is especially imperative when design standards and customs are different from those used in the United States. Students need professional contacts with engineering knowledge to provide insight to the different engineering practices in other countries. Students must also make ethical decisions on whether to follow potentially unsafe design practices used regularly in other cultures. This paper discusses the students' efforts to overcome international communication barriers to produce the best possible solution for their design project.

Key Words
Education Methods, Engineering Curricula, Other: International Experiences

Improving the Curriculum via Directed Projects or Research using Undergraduate Students

Gene Harding, Purdue University
Christopher A. Long, Purdue University

Abstract
Many colleges do not have the option of using graduate students for teaching, research, grading, and other pedagogical activities. These include some satellite campuses of major universities, many private colleges that focus on undergraduate education, and community colleges. The dearth of graduate students, however, need not prevent directed projects and research activities. Many such activities can be performed by motivated undergraduate students, given appropriate guidance and supervision.

This paper describes the experiences of a professor and third-year student at one of Purdue University's satellite campuses as they developed a pair of animated graphical teaching aids to illustrate two key principles of Fourier series. This successful endeavor resulted in new teaching tools used in the curriculum for the first time during the fall 2007 semester, as well as a published journal article. We describe the genesis of the venture as a student project, the experience of managing and coordinating the work, lessons learned, and the costs/benefits involved for both parties. The conclusion offers suggestions to avoid pitfalls encountered by the authors, as well as encouragement to other faculty and undergraduate students who may be interested in pursuing similar projects.

Key Words
Education Methods, Engineering Curricula, Engineering Technology Curricula, Fostering Undergraduate Research, Innovative Teaching Methods, Technology in the Classroom

Form Follows Function: A Trial in Matching the Senior Engineering Course Environment to the Workplace

Steve Chenoweth, Rose-Hulman Institute of Technology
Victoria Bowman, Rose-Hulman Institute of Technology
Sándor Pethes, Rose-Hulman Ventures
Jonathan Labayo, Rose-Hulman Ventures

Abstract
How should senior engineering courses feel to undergraduate students? These courses are the last thing students take before moving into a workplace environment. One logical target is that the courses should feel like the workplace. After all, colleges do something analogous on the front end of engineering students' experience: the college environment carefully transitions them from high school. At present, however, graduating seniors face workplace environments often much different from their college classrooms, where the pedagogy remains essentially in the format of lectures and homework, followed by a well-defined team project. Instructors play a much stronger and crisper role in the outcomes than managers or mentors would in industry, and the coursework is set up so that good students exerting expected effort will achieve a specified level of success.

What would be involved in taking an existing senior engineering course and trying to match its students' future workplace environment, within that course? This paper describes one trial in converting such a course, from a standard lecture-and-project format, to a format including more specific elements of industrial workplaces. Those elements included teaching by instructors tied to industry, use of real projects involving system maintenance activities, hand-offs to other teams, close adherence to industry processes like risk management, increased progress reporting, a reduced amount of lecture, and instructors playing management and advisory roles to the teams.

Overall, outcomes were very encouraging, for the idea of employing an environment which resembles industry, in a senior-level course. New problems were introduced, such as student teams getting more unexpected results from their more realistic projects, versus pedagogically well-defined projects. Specifically, students were unaccustomed to achieving less than a high level of project success. Yet the students did learn to deal with realistic problems via their own teams, and using accepted processes. The results suggest that a senior-to-industry "impedance match" generally deserves increased attention in upper division courses. Specifically, they suggest that the pedagogy common to a school can be bent as students approach graduation, in favor of a learning environment more resembling industrial experience.

Key Words
Industrial Leadership, Education Methods, Engineering Curricula, Industrial Partnerships, Innovative Teaching Methods

Preparing for Substantial Change: The iFoundry Initiative and Collective Learning

David Goldberg, University of Illinois at Urbana-Champaign
Andreas Cangellaris, University of Illinois at Urbana-Champaign
Michael Loui, University of Illinois at Urbana-Champaign
Raymond Price, University of Illinois at Urbana-Champaign
Bruce Lictchfield, University of Illinois at Urbana-Champaign

Abstract
Many engineering curricula remain locked in a cold war time warp despite the best efforts of the National Academy of Engineering, the National Science Foundation, and various engineering societies to promote change. An initiative at the University of Illinois at Urbana-Champaign (UIUC) called iFoundry or The Illinois Foundry for Tech Vision and Leadership is aimed at overcoming the inertia of normal institutional decision-making procedures by permitting interdepartmental collaborative change in an experimental pilot unit. A companion paper reports on the two organizational obstacles to curriculum reform iFoundry is designed to overcome and the six elements of the iFoundry idea. This paper reports on the founding, development, and ongoing collective learning exercises of the iFoundry initiative.

The paper starts by discussing the humble origins of the iFoundry pilot unit and continues by summarizing the six key elements of the iFoundry idea. The paper continues by examining several concepts drawn from the theory of organizational change that have been particularly important in the development of iFoundry to date. It concludes by presenting the particular collective learning and visioning exercises executed in fall 2007 and spring 2008.

Key Words
Engineering Curricula

2:15 p.m. - 3:45 p.m. **FRIDAY, APRIL 4**

WORKSHOPS

Using DyKnow Vision and Tablet PCs in the Technical Classroom-Part I

David Berque, DePauw University
Olin Hall O259

Workshop Abstract
DyKnow software is used to foster student engagement in classrooms at the K12, college, and university levels. DyKnow software is being used by tens of thousands of students at a wide range of schools including Rose-Hulman. The software supports collaborative note-taking; interactive activities such as sharing student solutions to in class problems; and out of class note review and replay. Although the system can be used in varied hardware environments, it is optimized for use with Tablet PCs and other pen-based systems. This session will demonstrate the pedagogies associated with the use of DyKnow software and Tablet PCs with a particular focus on technical courses. Tablet PCs will be scattered through the audience to facilitate some of the demonstrations and discussions about pedagogy.

Key Words
Education Methods, Innovative Teaching Methods, Technology in the Classroom

Artifact Redesign Using Disassemble/Analyze/Assemble (DAA) Activities

Odesma Dalrymple, Purdue University
Ida Ngambeki, Purdue University
Demetra Evangelou, Purdue University
Richard Layton, Purdue University
Olin Hall O157

Workshop Abstract
This workshop is intended to introduce the concept of using Disassemble/Analyses/ Reassemble activities as a tool when teaching first-year students the concepts behind artifact redesign. One method commonly used in artifact redesign is Morphological Analysis, which will be the focus of this workshop.

From an engineering context, Morphological Analysis, which is also referred to as Concept Generation, is a method that can be used for clarifying the requirements of an artifact's design, and then using the requirements to generate alternative design ideas. The method involves the decomposition of the overall function of the artifact into essential sub-functions, followed by the identification of a variety of appropriate methods and/or components to accomplish each identified sub-function. Performing the aforementioned steps allows for the generation of multiple design concepts by recomposing the overall function using different combinations of sub-function implementations. One potential approach to helping engineering students conduct and understand the concept of Morphological Analysis involves the use of Disassemble/Analyze/Assemble (DAA) activities.

DAA activities are activities such as Reverse Engineering and Product Dissection, which involve the systematic disassembly of an artifact, and the subsequent analysis and possible reassembly of its components, for the purpose of understanding the physical, technological and developmental principles of the artifact. Providing opportunities for students to disassemble an artifact, analyze its internal components, and possibly reassemble the artifact, may allow them to validate, correct, or advance their understanding of the means used in a design to enable an artifact to achieve its intended functions. Geared with a more complete understanding of the internal and external workings of an artifact, students will be able perform a Morphological Analysis of the artifact, and consequently generate alternative designs ideas.

The workshop will begin with a brief introduction of the concepts surrounding DAA Activities and Morphological Analysis. Findings from research conducted with first-year students to determine the pedagogical effectiveness of DAA activities will also be shared. Participants in this workshop will be given the opportunity to engage in the disassembly, analysis and reassembly of an artifact, and will be guided through the Morphological Analysis of the artifact. The outcome of the Morphological Analysis will then be used by participants to generate ideas for the redesign of the artifact. At the end of the redesign activity, participants will be given the opportunity to share their critique of the DAA activity, choice of artifact, design of lesson, and design of handouts used. There will also be discussions around the adaptation of DAA activities for use in the classrooms of the participants.

Key Words
Education Methods, Freshman Engineering Programs, Innovative Teaching Methods

2:15 p.m. - 5:45 p.m. **FRIDAY, APRIL 4**

WORKSHOPS

Introduction to Discrete Event Modeling and Simulation: Arena and ProModel

Sam Guccione, Eastern Illinois University
Tom McDonald, Eastern Illinois University
Olin Hall O167

Workshop Abstract

This workshop introduces the concept of discrete event simulation of processes and systems found in the service industry, military, production, healthcare, and many other types of businesses and industry. Discrete event modeling is a mathematical procedure that is created to describe a dynamic process. Then the model is simulated so that it predicts possible situations that can be used to evaluate and improve system performance.

Discrete event modeling and simulation is used to create predictions of the system states during time intervals, which can be modified to examine what if situations. For example, a common use is to evaluate a waiting line, called a queue. The question that is often asked is how long on average would a customer have to wait in a line to get to a customer representative and if the wait time is excessive how it can be reduced. Adding additional customer reps is one solution but how many reps should be used is another common question. Modeling and simulation can help answer these questions without actually creating a physical situation that has to be measured which could be an expensive process.

Discrete event modeling and simulation is one of the newest computer software tools that can be used by managers and others who need to decide if a process or service is operating appropriately or can be improved and what should be changed to cause this improvement. Students in engineering and technology need to be aware of this new type of tool. Faculty is needed to teach this technology. Industrial managers need to know this tool is available to them to help them in their decision making process. This workshop will provide an introduction to modeling and simulation for this audience. Each workshop participant will be provided with evaluation disks for two software packages that are the two most popular discrete event modeling and simulation programs used in the US: Rockwell Automation Arena and ProModel Process Modeling (ProModel). Hands on work with each software including graphically oriented experiences, how to teach modeling and simulation, potential textbooks that can be used, suggested instructional project based instructional methods, example syllabi, and several specific case studies.

No specific knowledge is needed except for basic experience with a computer. Each participant must bring a windows based laptop to run the simulation software packages. Workshop is limited to 12 participants because of the number of evaluation software disks available.

Key Words
Industrial Leadership, Engineering Curricula, Engineering Technology Curricula

Understanding Individual Cognitive Differences of Your Students and How to Address Them in Teaching

Johannes Strobel, Purdue University
Olin Hall O259

Workshop Abstract

Individuals differ in traits such as skills, aptitudes and preferences for processing information, constructing meaning from information, and applying it to real-world situations. The topics discussed in this workshop will address various dimensions of individual cognitive differences, such as the level of knowledge or literacy, spatial abilities, cognitive styles, cognitive traits, and epistemological beliefs. The Workshop will explore how individual differences theory can be integrated into the design and teaching of classes. The focus of the workshop will be on instructional and pedagogical strategies to deal with cognitive differences of students.

Key Words
Education Methods, Innovative Teaching Methods

FRIDAY, APRIL 4 *4:15 p.m. - 5:45 p.m.*

WORKSHOPS

Using DyKnow Vision and Tablet PCs in the Technical Classroom: Part II

David Berque, DePauw University
Olin Hall O259

Workshop Abstract

DyKnow software is used to foster student engagement in classrooms at the K12, college, and university levels.

DyKnow software is being used by tens of thousands of students at a wide range of schools including Rose-Hulman. The software supports collaborative note-taking; interactive activities such as sharing student solutions to in class problems; and out of class note review and replay. Although the system can be used in varied hardware environments, it is optimized for use with Tablet PCs and other pen-based systems. This session will demonstrate the pedagogies associated with the use of DyKnow software and Tablet PCs with a particular focus on technical courses. Tablet PCs will be scattered through the audience to facilitate some of the demonstrations and discussions about pedagogy.

Key Words

Education Methods, Innovative Teaching Methods, Technology in the Classroom

FR101 – An Introduction to Fund Raising for Faculty

Bill Foraker, Rose-Hulman Institute of Technology
Olin Hall O159

Workshop Abstract

Finding funds outside typical budget lines to support teaching, research, and other professional development is an area of interest for many faculty. Corporations, foundations, government agencies, and private donors are all potential sources of funds for special projects, but each requires a different process. How do I find sources of funding, how do I apply, what are the pros and cons of government grants, what are the differences between gifts, grants, and contracts, what institutional approvals are necessary and how do I get them, when do I work with the Grants and Contracts office and when with the Development Office, how do I get around the red tape, and do I ask for the moon or my actual budget requirements are all common questions faculty have when they start on the process. This workshop will strive to bring some clarity to many of these and other issues and ultimately to introduce faculty to the field of fund raising in higher education.

Key Words

Other: Fund Raising Fundamentals

8:30 a.m. - 10:00 a.m. **SATURDAY, APRIL 5**

WORKSHOPS

Engaging Multiple Learning Styles in the Classroom

Kay C Dee, Rose-Hulman Institute of Technology
Glen Livesay, Rose-Hulman Institute of Technology
Olin Hall O167

Workshop Abstract

A variety of inventories and assessment instruments have been used to describe the ways people prefer to acquire and process information, or their learning styles. Mismatches between traditional teaching styles and common student learning styles may result in reduced learning and frustration for both professors and students. The Index of Learning Styles (ILS) created by Dr. Richard Felder and collaborators is a convenient framework to use in discussing aspects of how students internalize, process, recall, and understand information, as well as how teachers organize, present, and motivate information. The ILS is a short, easy-to-use questionnaire, which does not require professional scoring, and which is publicly available free-of-charge on the internet. The first paper to discuss the ILS [1] was the article most frequently cited in the Journal of Engineering Education between 1993 and 1997 [2]; the ILS has received increased attention in the educational literature as more information about the statistical validity of the ILS has become commonly available. This mini-workshop will provide an introduction to the learning style dimensions of the ILS, an overview of published student and faculty learning style profiles, information about the statistical validity of the ILS, and a discussion of how the ILS instrument should and should not be used. Teaching techniques that engage multiple learning styles in the classroom will be demonstrated, and specific examples from engineering courses will be provided. Participants will leave this mini-workshop with a broad selection of ideas for active learning exercises that can be easily applied across multiple academic subjects, and that fit into periods of classroom time ranging from 30 seconds to an hour.

References:
[1] Felder, R. M. and L. K. Silverman. Learning and Teaching Styles in Engineering Education. Eng. Educ. April:674-663, 1988.
[2] Wankat, P. C. An Analysis of the Articles in the Journal of Engineering Education. J. Eng. Educ. January:37-42, 1999.

Key Words
Education Methods

A Unified Approach to Engineering Science Education

Donald Richards, Rose-Hulman Institute of Technology
Olin Hall O169

Workshop Abstract

The goal of this workshop is to introduce the participants to the systems, accounting, and modeling (SAM) approach for organizing and teaching an engineering science curricula. The workshop is presented in an interactive fashion with presentation of material interspersed with active learning opportunities. The workshop is targeted at engineering faculty teaching both lower- and upper-division courses.

The workshop is organized into three different but related parts. In Part I, the participants explore the idea of a core engineering science curriculum and the motivation for change. As part of this discussion, the participants are introduced to recent research on teaching and learning: How People Learn (Bransford), Teaching Introductory Physics (Arons), and Cooperative Group Problem Solving in Physics (Heller & Heller). In Part II, the systems, accounting, and modeling (SAM) approach is presented as one possible framework for organizing and integrating a core curriculum. Participants are challenged to look for the common themes within engineering science based on their own experience. The SAM approach is then developed from these themes. Use of the SAM approach as a vehicle for introducing fundamental physical laws and as a problem solving approach are demonstrated. Finally in Part III, one implementation of this approach—the Rose-Hulman Sophomore Engineering Curriculum—is discussed. Based on the interest of participants, different aspects of the Rose-Hulman experience can be emphasized, e.g. curriculum development or student performance.

Key Words
Interdisciplinary Approaches, Education Methods, Engineering Curricula

OCAR- A Novel Instrument for Presentation and Analysis of Outcomes Assessment Data

Vinayak Kabadi, North Carolina A&T State University
Kunigal Shivakumar, North Carolina A&T State University
Olin Hall O257

Workshop Abstract
The goal of this workshop is to provide the attendees with an instrument for compilation, presentation and analysis of outcomes assessment data and results. The instrument is called "OutComes Assessment Report or OCAR," and typically entire results for an assessment cycle may be summarized in a set of OCARs one each for the ABET "a" through "k", and program specific outcomes. This instrument was developed as a result of the preparation of the Mechanical and Chemical Engineering programs at North Carolina A&T State University for the ABET accreditation visit in October, 2007.

For an ABET outcome most of the assessments are carried out in courses. The academic programs generally have a standing and continuously evolving matrix that cross lists the outcomes with the corresponding courses in which they are addressed. Additionally some outcomes assessment activities might be carried out outside the courses. An instrument "Faculty Course Assessment Report or FCAR" developed by John Estell (presented at Rose-Hulman Best Assessment Processes VII, April, 2005) provides an excellent avenue for presenting data and results for outcomes assessed in a course. For a typical outcome, the assessment data are spread over two to five courses (buried in course notebooks or in FCARs) and other non-classroom assessment reports. OCAR is an instrument developed to assemble, systematically compile, and collectively analyze the data for a specific outcome.

OCAR for an outcome is prepared by a committee of faculty who might be the instructors of courses that address that outcome. A typical OCAR consists of the following sections: (1) an introduction that lists the recommendations of the previous cycle and actions implemented as a result of the assessments during that cycle, (2) assessment data section that lists and summarizes the results of all indirect and direct measures of assessments conducted for that outcome. Assessment data from FCARs and non-classroom assessment activities are included in this section, (3) data analysis section that compares the indirect and direct assessment data from different courses and arrives at some common conclusions on student learning, (4) section on loop closing recommendations: In this sections recommendations for program improvements are listed as action items for implementation in the next assessment cycle.

In this workshop, the instrument OCAR will be described to the audience. Examples and case studies will be presented. Attendees will be provided with templates on outcome-course matrix, FCARs, and OCARs and will be led through the process of entering assessment data in FCARs, and using these data to prepare an OCAR. Typically, 50% of the workshop will consist of presentation and instructions and other 50% will have hands-on exercises for the attendees. After participating in this workshop the attendees will have a new tool to compile and evaluate the outcomes assessment data in their academic programs. If they choose to adopt this instrument, it will assist in their ABET outcomes assessment process and in their quest for continuous improvement.

Key Words
ABET Accreditation, Education Methods, Engineering Curricula, Innovative Teaching Methods, Outcomes Assessment

Interactive Lessons for Pre-University Power Education

Zeb Tate, University of Illinois at Urbana-Champaign
Jana Sebestik, University of Illinois at Urbana-Champaign
Olin Hall O157

Workshop Abstract
This workshop will focus on a process used to develop interactive applets and associated lesson plans designed to teach middle school students about power, energy, and the power grid. Following a 2007 site visit, the National Science Foundation cited our K-12 outreach efforts as one of the three notable accomplishments of the 5-year, multi-million dollar research center of which we are a part. Four aspects of our development process will be addressed: forming an effective development team, using a product-oriented approach, disseminating materials and obtaining useful feedback, and presenting the materials to the funding organization. The applets and lesson plans will be referenced throughout the presentation to demonstrate different aspects of the development process. Workshop participants are encouraged to bring their own laptops.

Key Words
K-12 Outreach, Interdisciplinary Approaches, Educating for Sustainable Energy, Innovative Teaching Methods, Technology in the Classroom

SATURDAY, APRIL 5 *8:30 a.m. - 10:00 a.m.*

UNDERGRADUATE PAPER SESSION I
Moderator: Scott McClellan, Rose-Hulman Institute of Technology
Olin Hall O167

Comparative Study of the Abrasion Resistance

Radu Apostoaia, Purdue University Calumet
Jose Pena, Purdue University Calumet

Faculty Advisor: Jose A. Pena, Purdue University Calumet

Student Paper Abstract
A series of concrete mixes were prepared and tested in the laboratory installations at Purdue University Calumet to determine which mix would show higher resistance to abrasion. Tests were performed during summer and fall of 2007 on 16 mixes with two finishing conditions.

This investigation included preliminary testing on three different mixes. Early testing results showed the convenience of increasing the number of coarse aggregates to be tested and modifying the dossification of pozzolans. Physical characteristics of the aggregates including particle size distribution, unit weight, specific gravity, absorption and abrasion resistance were measured. The average compressive strength was obtained for each mix based on tests of five specimens per mix. Six specimens per mix were tested for each surface condition to measure abrasion coefficient by sandblasting. Additionally, averages of test performed on six specimens for the two surface conditions to measure weight loss by the rotating cutter method are presented. All tests were performed following standards recommended by the American Society for Testing and Materials.

All mixes were prepared with natural sand as fine aggregate. The maximum size of the fine aggregate was 4.75 mm (No 4 sieve). Four different coarse aggregates were used: small trap rock (STR), coarse trap rock (CTR), limestone (LS) and river rock or pea gravel (PG). Proportioning of all mixes was done following the American Concrete Institute Standard Practice.

Comparison of all mixes based on testing of their compressive strength, abrasion coefficient and weight loss was performed following testing standards recommended by the American Society for Testing and Materials. Comparison of all mixes based on the evolution of compressive strength, abrasion resistance, type of aggregate and surface condition for each mix and surface finishing is presented. Recommendations of the two mixes showing the higher expected durability for industrial floor subjected to high abrasion is given.

Key Words
Student Paper, Technology, Construction Management and Engineering Technology

Schedule Planning System Using a Database

Robert Williamson, Rose-Hulman Institute of Technology
Benjamin Campbell, Rose-Hulman Institute of Technology
Rex Chappell, Rose-Hulman Institute of Technology
Greg Zynda, Rose-Hulman Institute of Technology

Faculty Advisor: Sriram Mohan, Rose-Hulman Institute of Technology

Student Paper Abstract
The purpose of this project, the Rose-Hulman Four Year Planner, is to aid Rose-Hulman students in the creation of four-year schedules in a timely, efficient manner, despite varying combinations and numbers of majors and/or minors. The program will be produced economically and have a very minimal maintenance threshold. It will continue to facilitate and streamline the designed processes, and will continue to work in the future as long as degree requirements continue to be updated by the registrar.

Creating the entirety of a four-year schedule is very difficult and time consuming, especially for students with second majors and/or minors. The process requires tedious checking and rechecking of requirements by advisors, students, and the registrar. This program will alleviate the problems for all involved. Students will automatically be told if they have not fulfilled all requirements for their degree plan; once they have addressed any errors in their schedule, the registrar and the student's advisor can easily see that the person has fulfilled all necessary degree requirements of graduation. This will save time, and relieve frustration, for all three parties involved.

The program will also facilitate creating schedules for individual quarters. A schedule will be automatically generated for each quarter based on the classes saved in a student's four-year plan. The student can then edit the plan as required. The registrar can then use the four-year schedules to more logically select what classes would be offered depending on student demand, and to also help avoid schedule conflicts for people needing certain classes to be available.

By looking at a four- year schedule, the student's advisor can also easily keep track of when students are taking what classes and how they are progressing. If needed, the advisor can also advise the student as to necessary, or preferred, schedule modifications. Those advisors with students having minors or majors in different departments will benefit as the job of checking that all requirements will be met will be exponentially easier.

A program such as this would be valuable to virtually every educational institution no matter the level. The ability to view a snapshot of a student's progress toward a degree is invaluable to students, their advisors, as well as registrars and others involved in scheduling of classes. The potential for applications in other industries is also worth exploring, but at this juncture, it is apparent that this would be an economically viable application to market in the arena of higher education.

Key Words
Student Paper, Applied Biology, Computer Science, Math, Computer Science and Software Engineering

Highway Geometric Design Using Excel

Bradly McNair, IUPU-Fort Wayne

Faculty Advisor: Suleiman Ashur, Ph.D., P.E., IUPU-Fort Wayne

Student Paper Abstract

This paper presents the work that was developed as a project in the first offering of the transportation engineering class at the new Civil Engineering program at Indiana University-Purdue University Fort Wayne (IPFW). The project statement required the use of Excel in developing a program for highway geometric design; from simple curves to compound curves; both vertical and horizontal. In addition, the goal of this project was linked to two ABET outcomes (c) and (k) as well as to program outcomes. Outcome (c) addresses the ability of students to design a system, component, or process to meet desired needs within realistic constraints and, outcome (k) focuses on the student's ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The paper presents the process of developing the spreadsheet step-by-step, the command used, challenges, and skills and lessons learned by the author and other students in the class. As a result, a simple and efficient spreadsheet to design vertical curves and simple and compound horizontal curves, including default, values was developed.

The results of the survey suggested a major improvement of students' skills in Excel in general and in developing engineering design in particular. Major improvements were found in using functions and nested If statements. The least skills acquired were in using the Absolute and Sum commands and graphing in Excel. Most of the students either knew these commands before the class or they were familiar with them.

Finally, this project enabled students to advance their knowledge of spreadsheets while increasing their knowledge of transportation engineering issues as presented. The project helped achieve the outcome objective of the class as stated in the syllabus: 1) design basic horizontal alignment of the highway; 2) design basic vertical alignment of the highway; 3) use Excel as a tool for geometric design of highways. Finally, there was a strong consensus among the students that participated in this project that the skill obtained by manipulating the equations that were part of the spreadsheets provided invaluable training for future professional needs.

Key Words

Student Paper, Engineering and Technology, Engineering

Motor Speed Sensing with PIC Microcontroller

Brandon Upchurch, Olivet Nazarene University

Faculty Advisor: Dr. Rodney Korthals, Olivet Nazarene University

Student Paper Abstract

A system was designed and built to detect the speed and acceleration of a DC motor. Main components of the system were a single-chip microcontroller, a phototransistor and emitter, and a comparator. This system was designed to try to test the applications of a PIC chip processor. The abilities of the internal EEPROM memory of the microchip were also explored. Under the current class requirements of Olivet Nazarene University, the internal EEPROM was never explored, so this project was thought to be an excellent way to show students how the device can be applied in a real world system.

The system counted and stored fan motor blade crossing of the emitter/detector during 5ms intervals and stored the data to an internal EEPROM. The data was also displayed on an LED output for instant velocity monitoring. The EEPROM data can be read by the development tools and used to analyze the motor's acceleration. This can be used in the Automatic Controls Laboratory work at Olivet Nazarene University, to characterize a DC-motor. This project could also be helpful in the building of the Mini-Baja Car project, which is a design project given for seniors at Olivet. A speed sensor is not in the necessary requirements for the design of the car, but it might be helpful to measure torque and acceleration for the project.

Key Words

Student Paper, School of Professional Studies

EMC Modeling of AC Motor Drive

Christopher Valenta, Rose-Hulman Institute of Technology
Daniel Baker, Rose-Hulman Institute of Technology
Gareth Shields, Rose-Hulman Institute of Technology

Faculty Advisor: Edward Wheeler, Rose-Hulman Institute of Technology

Student Paper Abstract
Senior Design Teams from Rose-Hulman Institute of Technology and the Missouri University of Science and Technology are developing the electromagnetic compatibility (EMC) of an AC motor control system. EMC modeling and design require attention because FCC and foreign governments set limits on electromagnetic emissions. Additionally, EMC modeling and design can potentially lower the cost associated with electromagnetic interference mitigation and improve product performance. Modeling the coupling paths in a device before production can provide insight into the electromagnetic behavior of the device. It is important that engineers appreciate how geometries affect the electromagnetic behavior of the device as they develop schematics and consider layout options. The circuit geometry will have associated parasitic elements (inductances and capacitances) that can provide common-mode current paths and thus contribute to significant radiated emissions. Using computer simulation and laboratory measurements, circuit models can be augmented so that non-intended paths which result from the presence of these parasitic elements are included in the system models. When engineers have access to the complete circuit, including the parasitic elements, they can identify the major emission sources and work to reduce their effect early in the design process.

Two subtasks have dominated the EMC modeling process, modeling the IGBT package and modeling the motor and cables. The IGBT package is responsible for the majority of emissions due to large, fast-switching currents. This rich spectral content is coupled onto the cable and motor where it is effectively radiated. Modeling the IGBT package has required extracting parasitic capacitances and inductances from the geometry in the package. These geometries have been modeled in CST, a numerical electromagnetic solver, in order to determine their parasitic contributions. Laboratory measurements have been conducted with an impedance analyzer and network analyzer to then validate these simulations and refine models when necessary. The package schematic can then be updated with parasitic values to determine common-mode current coupling paths.

The motor can be modeled by a high frequency circuit using an impedance analyzer to take common mode and differential mode measurements. The cable's length and frequencies of operation dictate they be modeled as transmission lines. Their characteristic impedance is measured with a TDR so a transmission line model can be developed. The effect of ferrites on cable impedance and emissions is also being investigated by taking measurements with and without the ferrites and observing the effect of the ferrite's impedance on the emissions and cable impedance.

Key Words
Student Paper, Electrical Engineering, Electrical and Computer Engineering

10:30 a.m. - 12:00 p.m. **SATURDAY, APRIL 5**

UNDERGRADUATE PAPER SESSION II

Moderator: Sue L. Niezgoda, Rose-Hulman Institute of Technology

Olin Hall O169

A GUI Program for the Calculation of Mobility and Carrier Statistics in Semiconductors

Daniel Barrett, University of Notre Dame

Faculty Advisor: Dr. Debdeep Jena, University of Notre Dame

Student Paper Abstract

Researchers at the University of Notre Dame and elsewhere working on the development of high-speed semiconductor devices find it desirable to know how the mobility in these semiconductors (Silicon, GaAs, GaN, etc) varies as a function of growth parameters such as doping density and temperature. This information is crucial in the layer-structure design of ultrafast transistors. Up until now, there have been no software tools available to semiconductor device physicists and engineers to automatically do the calculations necessary to gain such information. Researchers are therefore forced to either look up data on similar materials which have previously been determined, go through the lengthy calculations themselves, or determine it experimentally.

My task was to create a program which would:

a) Calculate the mobility, carrier density, conductivity, and Fermi energy for any given semiconductor,
b) In an easily navigable GUI (Graphical User Interface) to allow the user to choose the semiconductor, doping densities, the temperature, and similar physical parameters, and
c) In addition, it was to calculate and plot mobilities and carrier concentrations as a function of temperature, ionized acceptor & donor concentration, and the activation energy of the donors and acceptors.

In order to achieve these goals, it was necessary to read and learn the methods by with others have calculated these values, and to alter them where the assumptions under which they operate are not valid for the range of parameters to be used by the program. I then created the program which was to do the calculations. This involved simultaneously numerically integrating and solving the charge-neutrality equation with Fermi-Dirac statistics for the Fermi energy, as well as compiling a table of known parameters of various semiconductors. I also created a GUI to interface between this program and the user.

This program is currently known to be in use by researchers at Notre Dame as well as two other universities, and is freely down-loadable at the Notre Dame website: www.nd.edu/~demand. It is called “Mobility”, and it currently calculates all the above quantities (mobilities, carrier statistics, etc) for a range semiconductors. The type of semiconductor, the doping densities are user-defined, and the entire software runs in an easy-to-use GUI mode. The next generation of the program will incorporate heterostructures and will enable the calculation of mobilities and carrier statistics in quantum wells and 2-dimensional electron gases, which form the backbone of the fastest transistors in existence today.

Key Words

Student Paper, Electrical Engineering

Comparison of Two Methods in Detecting Late-night Talk Shows using Pattern Recognition

Justin Miller, Rose-Hulman Institute of Technology
Joshua Burbrink, Rose-Hulman Institute of Technology

Faculty Advisor: Matthew R. Boutell, Rose-Hulman Institute of Technology

Student Paper Abstract
This paper presents two alternative approaches to detecting images taken from videos of Leno talk-shows: a Support Vector Machine (SVM) and an Eigen-classifier based on principal components analysis. On a testing set of 2952 images collected from 88 videos, the SVM approach produced an experimentally calculated 90.41% accuracy using color features. On the same set, the Eigen-classifier produced 97.37% accuracy employing thresholds derived from Eigen images. The paper describes strengths and weaknesses of both methods, as well as their potential use on the difficult problem of video copyright violation detection.

As internet based video websites, such as YouTube and Metacafe, continue to increase in popularity, the need for systems to detect and remove copyrighted material increases. Copyright owners often create their own websites to display advertisements along with their videos to earn money. Allowing the same material to remain on social video websites can reduce traffic to, and thus revenue earned from, the owner's website.

This paper focuses on one small example of copyrighted material: Jay Leno of the Tonight Show performing interviews. Due to the relative consistency, both in background and layout, of the images captured from Tonight Show videos, frames of these videos can be identified by both color analysis and principal components analysis. Using the ideas presented in this paper, it may be possible to develop a system that could detect almost any relatively static video clips, such as other talk shows, news programs, or other various shows with a consistent background.

Key Words
Student Paper, Computer Science, Computer Science and Software Engineering

Use of Recycled Tires as Partial Replacement of Coarse Aggregate in the Production of Concrete

Michelle Danko, Purdue University Calumet
Edgar Cano, Purdue University Calumet
Jose Pena, Purdue University Calumet

Faculty Advisor: Jose A. Pena, Purdue University Calumet

Student Paper Abstract
It is estimated that more than 270 million scrap-tires weighing more than 3 million tons are produced in the United States each year. This waste being non-biodegradable poses severe fire, environmental and health risks. Aside from tire derived fuel, the most promising use of recycled tires is in engineering applications as artificial reefs, erosion control and aggregates for asphalt and concrete.

The use of recycled tire rubber as partial aggregate in concrete has great potential to positively affect the properties of concrete in a wide spectrum. Concrete is one of the most popular construction materials. Due to this fact, the construction industry is always trying to increase its uses and applications and improving its properties, while reducing cost. In general, concrete has low tensile strength, low ductility, and low energy absorption. Concrete also tends to shrink and crack during the hardening and curing process. These limitations are constantly being tested with hopes of improvement by the introduction of new admixtures and aggregates used in the mix. One such method may be the introduction of rubber to the concrete mix. It is a perfect way to modify the properties of concrete and recycle rubber tires at the same time.

The objective of this research is to test the properties of concrete when recycled rubber from automotive tires is used as a partial aggregate. Special attention is being given to the use of modified surface rubber. Pre-treating the rubber with a sodium hydroxide (NaOH) solution modifies its surface, affecting the interfacial transition zone (ITZ) and allowing the rubber to better adhere with the cement paste. For this research, the recycled tires were surface-treated with a NaOH saturated aqueous solution for 20 minutes, then washed under running water and left to air dry. Compressive, splitting tensile and flexural strength was measured in concrete mixes with 10%, 15% and 20% substitution of natural aggregate by recycled rubber with no pretreatment and with surface modification.

Key Words
Student Paper, Technology, Human Resources, Construction Management and Engineering Technology

Development of Educational Undergraduate Course Modules for Interactive Reactor Physics

Nader Satvat, Purdue University
Shanjie Xiao, Purdue University
Kevin Muller, Purdue University
Charlton Campbell, Purdue University
Kevin Chesterfield, Purdue University

Faculty Advisor: Tatjana Jevremovic, Purdue University

Student Paper Abstract
The nuclear renaissance in our country is an expected response to the overall global changes and dramatic shifts in country's assurance for sustainable energy supply. Our School witnesses an exponential increase in the number of undergraduate students as much as other schools in the country. To stay competitive and modern the undergraduate course curriculum requires innovations in teaching styles and teaching materials. The reactor physics course is usually very boring for the students due to its abstractive nature. Visualization of the reactor physics phenomena is one of the interesting and inspirational ways to teach reactor physics effectively.

The web interface and web based interactive tools are under development for the undergraduate course on reactor physics. These interactive educational course modules assist students to learn about numerical reactor physics modeling remotely and with no additional software other than the regular web browser. To assure undergraduate students' broad understanding and competence in the important area of reactor physics and to achieve high educational standard in teaching reactor physics we are developing various modules in a modern interactive environments. The web interfaces created for the undergraduate courses on reactor physics give the students opportunity to study the abstract concepts through: learning (how) to run different reactor physics numerical codes, connect the course materials on diffusion theory with the direct application through writing small diffusion codes or running the diffusion codes provided in the module, and what is very important through extensive graphical visualizations of the neutron flux (scalar and angular), reaction rates and neutron currents provided in the modules for various reactor-specific cases to learn about these phenomena. The visualization tools are incorporated into the interactive modules that produce graphical outputs per student's selection. For example, the neutronics phenomena related to reactor kinetics are difficult concepts to visualize in the classroom. Training an artificial neural network (ANN) using training sets from state-of-the-art neutronic modeling tools such as Monte Carlo or AGENT calculations would permit a real-time calculation of criticality parameters to be performed with minimal error. The results of this calculation can then be used to simulate changes in reactor core operating conditions. Such module facilitates often boring classroom teaching on reactor kinetics. We are also taking advantage of our research reactor (PUR-1) and all modeling and calculations are thus directly benchmarked. The suggested interactive modules development is found to be important because it offers the students possibility of analyzing interesting and challenging areas of study related to nuclear engineering and safety through less conventional ways, thus contributing to expanding and advancing their knowledge and understanding of the abstractive reactor physics.

Key Words
Student Paper, Nuclear Engineering

Lumped Parameter Modeling of the Ideal Railgun: Examining Maximum Electromechanical Energy Conversion Efficiency

Victor Sung, Rose-Hulman Institute of Technology

Faculty Advisor: Edward Wheeler, Rose-Hulman Institute of Technology

Student Paper Abstract

Railguns, which accelerate projectiles through electromagnetic repulsion, have been gaining more attention for use in the next generation of all electric naval ships. The military has interest in railguns because they have several unique advantages such as the lack of explosives, extremely long firing ranges, and low cost compared to missiles. Typically, the efficiency of converting electrical energy into kinetic energy is between 10% and 50% for large scale research guns. These railguns operate from a stored energy source, such as a capacitor, in the range of 400 kJ to 32 MJ.

Because of the nature of this technology, many amateur scientists and hobbyists have tried to build their own small scale railguns in the energy range of 100 J to 20 kJ. Each of these amateur railguns, except one, has very poor efficiencies, often below 1%. To explain why only one amateur railgun performed well while the others have poor efficiencies, the author developed a mathematical model of an ideal railgun using lumped parameters in a pair of non-linear second order differential equations. Simulink software was used to solve these equations, and data gathered from tests were compared to the model. Additionally, analytic equations for efficiency were derived.

The result of the modeling shows that the amount of momentum transferred to the projectile is proportional to the action integral, which is the time integral of the current squared. High efficiency is obtained by a circuit that is capable of producing a large amount of action with minimal energy input; this is done directly by minimizing circuit resistance.

To verify the model, a small scale railgun was built using a 5 kJ electrolytic capacitor bank. This railgun was capable of firing solid metal armatures and plasma armatures. Current waveforms were captured using a Rogowski coil transducer and an oscilloscope. The railgun was able to fire a 500mg projectile with approximately 20J of kinetic energy using a plasma armature. However, solid metal armatures could not be fired with significant speed due high friction from metal on metal contact inside the railgun. This low performance was quantitatively predicted by the railgun model since the capacitor bank had a high internal resistance. As a result, an experiment is currently being conducted which will test the model's validity using a low resistance 20 kJ capacitor bank. The 20 kJ railgun has been constructed at Rose-Hulman Institute of Technology and is currently being prepared to fire.

The relationships derived, if proven valid through observation, could be used in the design of amateur railguns to help impove efficiency and performance. These relationships may be extended to improve future large scale railgun designs.

Key Words

Student Paper, Electrical Engineering, Electrical and Computer Engineering

SATURDAY, APRIL 5 *10:30 a.m. - 12:00 p.m.*

UNDERGRADUATE PAPER SESSION III
Moderator: Glen A. Livesay, Rose-Hulman Institute of Technology
Olin Hall O167

Comparison of Elbow Joint Angles for Male and Female Bat Swings

Elisha Gregory, Rose-Hulman Institute of Technology

Faculty Advisor: Renee Rogge, Rose-Hulman Institute of Technology

Student Paper Abstract

INTRODUCTION: Hitting has become one of the most studied aspects of the game of baseball. Many studies to date only focus on a specific group of players, like collegiate or major league players, but there have not been any studies comparing the male swing to the female swing. Additionally, most studies look at many different aspects of a swing at distinct times in the swing.

This study concentrates on determining the differences in elbow angle during a bat swing between a male and female hitter. Flexion and extension of the arm muscles control the elbow angle during the swing. Elbow flexion is studied because the bat swing works by first coiling the body and then uncoiling in an efficient way to obtain the highest bat speed at ball impact.1

Comparing the male swing to the female swing will show if the two sexes take a similar action and perform it differently. Clearly there is a difference in performance between the two sexes; males being able to swing faster and hit harder than females. One possibility leading to these differences in outcomes is a difference in elbow angles during the bat swing and ball contact. A difference found in the magnitude of the angle or the angle at which ball contact was made could explain why males have a faster and harder swing speed. Could it be possible that males make ball contact at the optimal elbow angle allowing them to get more power from their swing while females have not yet discovered this optimal angle?

CONCLUSIONS & RECOMMENDATIONS: As the results show, there is not a significant change in the angle of the upper and lower arm in male baseball swings and female softball swings. Both sexes have similar upper arm flexion throughout the swing especially at time when the bat contacts the ball. The only difference observed was the females swing showed a short period of increased elbow flexion before the upper arm would extend in the swing.

For future research, bat position, leg movement, or angular acceleration of the torso could be compared to see if there is a significant difference between a baseball or softball swing. Also, the resolution used in this study was able to record the entire female softball swing, however because of the quicker bat speed there were gaps in the data of the male baseball swing. Therefore, higher resolution cameras could be used in order to get a better capture the motion of a male baseball swing.

REFERENCES:

1. Welch, C. M. et al (1995). Hitting a Baseball: A Biomechanical Description, 22 (5), 193-201. The Journal of Orthopaedic and Sports Physical Therapy.

ACKNOWLEDGEMENTS: We would like to thank the Rose-Hulman Biomedical Engineering Department, who allowed us to borrow the motion analysis cameras. We also want to thank Dr. Renee Rogge and Dr. Glen Livesay who helped with our research.

Key Words

Student Paper, Biomedical Engineering, Applied Biology and Biomedical Engineering

Biodiesel Demonstration for Outreach and Education

Tony Huck, Purdue University

Faculty Advisor: Heather Cooper, Purdue University

Student Paper Abstract

The demand for alternative fuels is growing, and green fuels can help meet this need. With the rising cost of oil per barrel and the increasing amount of vehicles daily on the road, renewable fuels can help offset fuel costs and aid the environment by reducing carbon emissions, and other harmful gases. Both biodiesel and ethanol are the current answer to the alternative question.

This paper will describe the development of a small biodiesel demonstration apparatus for educational purposes. The process includes biodiesel production, a working model engine demonstrator, and its implementation in outreach activities. The production process which covered Fall 2007 includes a homemade setup to make 1 liter batches of biodiesel. The model engine demonstrator is a simple diesel model airplane engine mounted on wooden display. Outreach activities will hopefully spread the news of green energy in a way larger scale automobiles cannot. This demonstrator will be able to go into classrooms and conventions with the option to perform experiments including power output, efficiency of various fuels, and possibly emissions testing.

Key Words

Student Paper, Mechanical Engineering Technology

Species Migration Model

Mark Jenne, Rose-Hulman Institute of Technology
Chandler Kent, Rose-Hulman Institute of Technology
Derek Hammer, Rose-Hulman Institute of Technology

Faculty Advisor: Sriram Mohan, Rose-Hulman Institute of Technology

Student Paper Abstract

We aim to create a functional, relational model of large mammalian species interaction. A user will have the ability to define environmental disruptions on a preset landmass. The model will respond by predicting probable migration patterns of various species affected by the environmental event and update the state of the species throughout the landmass to reflect their movement. A web-based graphical user-interface will provide a medium for the user to visualize the changes taking place in the database as well as to control the state of the model.

The species migration model provides the interested user with the ability to predict species behavior within a large and climatically diverse setting. This model has the potential of providing the underlying foundation of a highly accurate and practical means of forecasting species movement in real-time. For instance, a feature within our model allows the user to specifically pinpoint and track the movement of a single species. Using the above feature, the population and behavior of an endangered species can be extrapolated into the near future to predict how the state of the species will change in the coming years. The insight gained from such analysis can be used to alleviate the species chance for survival.

The species migration model has the potential for becoming a heavily utilized tool within the scientific community, based on the value and nature of the data derived by the model. The insight into and relevant data obtained regarding movement patterns of varying species will be open to any user seeking access to such information, and could be specifically useful to scientists and researchers. This system will benefit any user seeking data on behavioral interaction among species, and could be useful among students attempting to collect such data for analysis.

Key Words

Student Paper, Chemical Engineering, Computer Science, Software Engineering, Computer Science and Software Engineering

A Micro-Controller Based 3-Phase 600 V Universal Phase Sequence Tester

Brandon Wright, Grand Valley State University
Jeff Wyatt, Grand Valley State University
Kevin VandenBerge, Grand Valley State University
Cato Clemens, Grand Valley State University
Ryan Lush, Grand Valley State University

Faculty Advisor: Dr. Azizur Rahman, Grand Valley State University

Student Paper Abstract
This paper presents a 32 bit microcontroller based three-phase, high voltage phase sequence tester compatible with global utility grid frequencies. This digital phase sequence tester was developed as a course project for EGR 330 Power Systems Analysis, a junior level electrical engineering course at Grand Valley State University. For 3-phase systems phase sequence is crucial while connecting two systems together. Also, in case of ac motors, phase sequence determines the clockwise or counter clockwise direction of rotation. Unlike the phase sequence testers available in the market, this tester does not need any rotating parts (e.g. ac phase sequence motor) to indicate phase sequence by direction of motor rotation. High voltage of 600V to low voltage (digital level) conversion is implemented by a simple star-connected resistor circuit. Analog to digital conversion and processing of this digital signal are implemented using ATMEGA32 micro-controller from Atmel. Output of a test (a-b-c or a-c-b phase sequence) is displayed by one of the two phase indicator LEDs. A 600V, 50-60 Hz phase sequence tester is designed to explain design procedure. Designed tester is simulated using PSPICE to verify its operation. Simulation test results on a 600V system are presented. A laboratory prototype has been developed and tested. Test data acquired on a 150V system has already been collected and will be presented in the final paper. The developed prototype has also been used on a live 480V, 60 Hz, 3-phase system application successfully. Simulation and prototype experimental results verify the operation of this phase sequence tester for a voltage range of 6V to 600V. The tester takes 70 voltage samples at a sampling rate of approximately 2800 samples per second on each phase. As enough samples are acquired this battery powered tester will also work with 50 Hz utility system. The microcontroller program can also be easily configured to a frequency range from 1 to 1400 Hz by either increasing the sample size (but this has memory constraints) or by changing the program to sample and analyze at the same time (with no memory constraints because we are only storing one previous value, and resetting a counter if the voltage is not rising). Future work will investigate into implementing this feature. This tester is cheaper than the testers available in the market and suitable for universal frequency applications. This innovative course project work experience has natural and very relevant connection to undergraduate engineering research and education.

Key Words
Student Paper, School of Engineering, Electrical and Electronics Engineering, Computer Science

Influence of Recycled Aggregates on Mechanical Properties of High Performance Concrete

Justin Benge, Purdue University Calumet
Jose Pena, Purdue University Calumet
Ivan Ortiz, Purdue University Calumet

Faculty Advisor: Jose A. Pena, Purdue University Calumet

Student Paper Abstract
The use of reclaimed concrete as aggregate for new concrete and its influence on the mechanical properties has been investigated. The replacement of both fine and coarse aggregate was tested. Three different mixes were prepared, the first mix, or control mix, was prepared with natural aggregate, two additional mixes were prepared with different percentage of substitution of coarse aggregates. Weight evolution of the concrete as a function of age was measured on 2”x2”x2” concrete cubes subjected to different relative humidity conditions. Compressive strength was evaluated on concrete cylinders (4” x 8”) at different ages: 3, 7, 14, 21 and 28 days. Porosity of different mixes with the same water to cement ratio is compared. The same procedure of testing was used with reclaimed concrete from existing structures (demolition products) and with concrete from laboratory testing. An analysis comparing physical and mechanical properties of the three mixes is presented.

Key Words
Student Paper, Technology, Construction Management and Engineering Technology

SATURDAY, APRIL 5 *10:30 a.m. - 12:00 p.m.*

UNDERGRADUATE POSTER SESSION
Moderator: Lorraine Olson, Rose-Hulman Institute of Technology
(Posters will be displayed through 4:15PM)
Hadley Hall 1st Floor Corridor

Workload Evaluation Using Multimodal Biometric Data

Tron Artavatkun, IUPU-Indianapolis
Sean Collins, IUPU-Indianapolis
Karthir Prabhakar, IUPU-Indianapolis

Faculty Advisor: Eliza Du, IUPU-Indianapolis

Student Poster Description

Biometrics is a cutting edge technology in the field of identification or verification. The iris pattern and facial structure are two of the human traits generally used in the biometric recognition system. Multimodal biometrics argues that a system consisting of multiple modals, when integrated into one system, will provide better accuracy than unimodal. The mental workload evaluation is an important process because it provides essential information which can be used to determine the working performance of an individual worker. The traditional mental workload measurement process is viewed as a time consuming and intrusive one. The major goal of this research project is to develop a biometrics system that can, in real-time, evaluate the mental workload of a human being by using both facial and eye measurement data characteristics. The process involves taking the characteristical data retrieved from the facial and eye measurements, and translating that retrieved data to scientific numerical values which combine the data retrieved from the facial and eye analysis modules.

Furthermore, the non-intrusive mental workload measurement concept was applied on this research. This methodology is less time consuming and less invasive than the traditional process. The eye tracking device had been developed and integrated with measurement functions in the software to observe the eye characteristics (the movement, the location and pupil dilation) in real-time. The evaluation process began when the thermal camera captured and analyzed the facial data of the subject in three stages: initial state (non-activity), active state (physical activity), and respite state (non-activity). Consecutively, the eye tracking device acquired the measurement's data and then analyzed the eye characteristics. The final numerical value is used to determine the different levels of the mental workload of the subject. An accurate measurement of mental workload level is necessary for ensuring the health and efficiency of the worker.

Key Words

Student Poster, Purdue School of Engineering and Technology, Computer and Information Science, Electrical and Computer Engineering

Nanoparticle Heating: Advancing Nanomedicine

Brett Bollinger, Rose-Hulman Institute of Technology

Faculty Advisor: Renat Letfullin, Rose-Hulman Institute of Technology

Student Poster Description

Metallic nanoparticles have recently become a topic of interest in the field of nanomedicine through their ability to concentrate heat after insertion in biomedia. Through the introduction of an ultrashort laser pulse, the metallic nanoparticles absorb energy by inverse Bremsstrahlung, heating the surrounding local biological material. Successfully killing a cell requires reaching a temperature high enough to denature cellular proteins, and so investigating the heating rates of various biological media holds importance. Additionally, various modeling techniques provide differing advantages, ranging from accuracy to flexibility under varying heating conditions. In light of these conditions, heating rates for various biological media will be examined, as well as two popular models for calculating heat transfer.

Key Words

Student Poster, Physics and Optical Engineering, Mechanical Engineering

Nanoclusters and Methods of Their Aggregation

Andrew Brush, Rose-Hulman Institute of Technology

Faculty Advisor: Renat Letfullin, Rose-Hulman Institute of Technology

Student Poster Description

Some methods currently exist to create nanoclusters but most of them haven't been designed for use in biological systems. As a result, further research and likely new methods are needed to develop a concrete method of aggregating nanoparticles into clusters. However, using calculated concentrations of nanoparticles has had some success at creating clusters. Other methods, such as the use of toluene solution, have created organized nanoclusters but fail to be applicable in a living body since toluene is a toxic substance.

Key Words

Student Poster, Physics and Optical Engineering

Novel Multi-Modal System Facilitates Simultaneous Chemical and Electrophysiological Recordings in Ischemic Stroke Model

Peter Ifft, University of Illinois at Chicago

Faculty Advisor: Dr. Patrick Rousche, University of Illinois at Chicago

Student Poster Description

Stroke is the third leading cause of death in the western world and the leading cause of disability in the United States. Nearly 80% of diagnosed strokes are ischemic, which is a type of stroke characterized by a complete or partial occlusion of a blood vessel in the brain. This blockage results in a cutting off of oxygen, called hypoxia, leading to an entire cascade of neurotoxic biochemical interactions. Typical means of studying strokes involve implanting a type of biosensor into the brain and receiving data for the minutes and hours following an induced stroke. Using a single probe, such as a microwire electrode, may not provide enough information for a thorough understanding of the chemical and physiological dynamics of this damaged living system to be reached. This study acknowledges the complexity of ischemic strokes and uses a more comprehensive, multi-faceted approach, integrating microdialysis as a means to obtain neurochemical data with real-time electrophysiological recordings from implanted recording electrodes. Microdialysis is a technique capable of quantifying the concentrations of neurotransmitters such as glutamate, aspartate, and taurine, each of which is important in the stroke cascade. This study uses a novel multi-modal system with a cranial platform designed through a rapid-prototyping technique specifically for use in a photothrombosis-induced ischemic stroke. Once fabricated, the platform was attached to the skull above the location of the craniectomy and a microdialysis probe, recording electrode, and fiber-optic light probe were lowered into or to the surface of the brain. In this study, we report microdialysis recordings obtained before, during, and after photothrombosis.

Findings indicate consistent increases from baseline concentrations to peak post-ischemic concentration in all three neurotransmitters assessed: glutamate, aspartate, and taurine. Peak post-ischemic concentration of each neurotransmitter was observed within 20 minutes of completion of photothrombosis technique. Glutamate and taurine showed nearly a 5 and 4 fold increases respectively from baseline to peak post-ischemic concentration while aspartate increased only 20% from baseline values. All three had sharp increases in concentration following the time of death. Data from baseline and post-ischemic concentrations not only confirms the work from previous studies but also establishes feasibility for the use of this cranial platform in the ischemic stroke model. Further work could include using competitive inhibitors to target the excitotoxic amino acids analyzed in this study NMDA receptors affected by hypoxia in the penumbra.

Key Words

Student Poster, Department of Bioengineering

The Extensible Versioning Files System - An Automatic, Customizable, Portable Data Versioning System

Brian Kelley, Rose-Hulman Institute of Technology

Faculty Advisor: Archana Chidanandan, Rose-Hulman Institute of Technology

Student Poster Description

SAlthough many solutions exist for data retention and versioning, there is no clear self-contained method for employing these concepts in an automatic and transparent fashion. Source code management software, such as Subversion, provides a very prevalent example of these concepts: files are never lost or permanently deleted and it provides the user access to old versions, or previous states, of files. The importance of these features is obvious in software development where losing code costs time and money. Even so, tools like Subversion are not automatic, as they require user invocation to capture the state of files. Despite the fact that specialized methods, including Subversion, have been developed and proven in their domain, transparent and automatic data versioning and retention still eludes the everyday user. For example, although Subversion works well for its purpose, it cannot be easily extended to be a general-purpose retention and versioning solution.

In this work we propose the Extensible Versioning File System (EVFS), which was designed and developed to deliver these capabilities to all users, regardless of their operating system, file system(s), or drive and partition configuration. This poster underlines the key differences between EVFS and other systems. EVFS solves the problems that prevent other solutions from being adopted, as described here. The proposed system does not replace the user's existing file system, but builds on top of it, making use of existing technology and tools while providing minimal interference with the existing system. Only the changes between files are retained; an entire copy of a changed file is not stored every time as this leads to massive disk consumption. Its highly modular design allows EVFS to be easily ported to other platforms while providing a native user interface, it gives power users the ability to swap the versioning engine to achieve different goals, and allows it to be extended to act as a general purpose back-up solution.

The poster also illustrates the data flow between EVFS' various modules that enable seamless file versioning in the user's environment. Also highlighted are the key design decisions that enable the software to be extensible and easily portable between many different platforms. It walks through user interaction, including the defining of predicates that describe the data versioning and retention policies. Finally, the poster shows user benefit by illustrating the ease in which lost data can be recovered, which is the key distinguishing feature of EVFS.

As more users and businesses use software to create and modify their assets, the need for data retention and versioning abilities becomes greater. Existing tools are either too domain specific or too cumbersome to use, causing many users forgo this valuable capability. Transparently providing this functionality while seamlessly integrating with the underlying platform is what EVFS aims to bring to the field..

Key Words

Student Poster, Computer Science and Software Engineering

SPR Effect as a Tool for Investigating Alloy Composition

Christopher Leibs, Rose-Hulman Institute of Technology
Ian Ross, Rose-Hulman Institute of Technology

Faculty Advisor: Maarij Syed, Rose-Hulman Institute of Technology
Azad Siahmakoun, Rose-Hulman Institute of Technology

Student Poster Description

We have performed surface plasmon resonance (SPR) experiments in the Kretchmann configuration on prisms coated with 500±10 nm single metal and alloy thin-films. The thin films are grown by magnetron sputtering and are binary alloy films (Nickel/Chrome with 80/20 concentration). In addition, for comparison we will also present results for pure metal films (Nickel and Chromium). We have observed a pronounce SPR signal at 41.24o ±0.01at 633 nm for the Nichrome film while neither of the metal thin-films (Ni or Cr) yields an SPR effect. We will compare and contrast the results from the alloy film to those from individual metal films. We will also show how SPR results can be better understood by analyzing the SPR data correlated with ellipsometric data obtained from these films as well as x-ray analysis (for composition and structure information), and AFM analysis (for surface topography).

Key Words
Student Poster, Physics and Optical Engineering

Studies on Protein Stability in Sodium Alginate Solution

Fuyue Li, Purdue University
Yinyan Zhao, Purdue University

Faculty Advisor: Michael T. Harris, Purdue University

Student Poster Description

Alginate is a naturally occurring polysaccharide, composed of (1→4) linked β-D-mannuronate residues and its C-5 epimer α-L-guluronate residues. There has been increasing interests in utilizing alginate as an effective encapsulation material for delivery of biopharmaceutical compounds. Therefore, the understanding of protein stability in sodium alginate solution and the investigation of protein-polysaccharide interactions have been important issues in this application. In this research, the effects of sodium alginate on the model protein's (Bovine Serum Albumin, BSA) stability were investigated. Several analytical techniques were used to monitor the physiochemical property changes of BSA. The hydrodynamic radius of sodium alginate solution and BSA-alginate mixture was characterized by using Dynamic Light Scattering (DLS) over a 6 day period. DLS results show there was no significant change of the coil size during this observation period. Different concentrations of BSA and BSA-alginate mixture were prepared in water at 25ºC and the secondary structures of BSA were characterized using Fourier Transform Infrared Spectrometer (FT-IR) equipped with Attenuated Total Reflectance (ATR). The FT-IR spectra show that the characteristic peaks of BSA at 1654 cm-1and 1638 cm-1which are due to the α-helix and β-sheets structures respectively did not shift after mixing BSA with the sodium alginate solution. This indicates that the secondary structures of BSA were not significantly damaged by the electrostatic interactions between the alginate chains and the protein coils. The effect of alginate on the hydrophobicity of BSA was further analyzed using High Performance Liquid Chromatography (HPLC). Therefore, this study provides insight into the potential pharmaceutical applications of alginate as a carrier for protein drugs delivery where the proteins retain their original characteristics and activity.

Key Words
Student Poster, Chemical Engineering

Kicking Mechanism for the Pioneer 3-DX Robot

Landry Nzudie, IUPU-Fort Wayne
Francois Mikobi, IUPU-Fort Wayne
Mark Macki, IUPU-Fort Wayne
Charles Craft, IUPU-Fort Wayne
Miguel Tostado, IUPU-Fort Wayne

Faculty Advisor: Yanfei Liu, IUPU-Fort Wayne
Jiaxin Zhao, IUPU-Fort Wayne

Student Poster Description

RoboCup is an international joint organization to promote artificial intelligence and robotics. The goal of the RoboCup project is to develop a team of fully autonomous humanoid robots that can win against the human world champion team in soccer, by 2050. IPFW and Raytheon have combined in a five-year project to promote robotics through the development of soccer playing automatons. The partnership has a larger vision to develop soccer playing robots that could compete in the Middle Size League (MSL) of the RoboCup competition in 2012. Raytheon has provided a Pioneer 3-DX robot base for the development of a RoboCup Middle Size League robot soccer player. Our team's mission is to design and build a kicking mechanism and a microcontroller based unit to interface and control the kicker with the provided base robot. When completed, the final robot should be programmed to locate an orange, size 5 FIFA ball on a green field, approach the ball, orient the ball towards the goal, and finally kick it in that direction. Several ideas of designs were initially generated; each of them was evaluated in order to generate the most optimal final design. The mechanical kicker of our final design will consist of two pneumatic cylinders utilizing compressed nitrogen, which will be engaged and controlled by a PIC microcontroller based interface unit. This interface unit basically includes three main sub-interfaces: the Serial interface between the PIC microcontroller and the Pioneer 3-DX robot microcontroller which will allow the command of the robot at a higher level; the driving interface with the PIC converting a PWM voltage to a current sending to the solenoid valves; and finally the proximity sensor interface with the PIC microcontroller to aid in the positioning of the robot with respect to the ball. This project will constitute one of the multidisciplinary senior designs in Department of Engineering at Indiana University – Purdue University Fort Wayne which extend over a one year period of time.

Key Words
Student Poster, Engineering

Card Reader for the Blind

Ryan Pepmeier, Rose-Hulman Institute of Technology
Nathan Scherwinski, Rose-Hulman Institute of Technology
Doug Howell, Rose-Hulman Institute of Technology
Adam Effinger, Rose-Hulman Institute of Technology

Faculty Advisor: James Baker, Rose-Hulman Institute of Technology

Student Poster Description

The Card Reader is a small device that will allow blind and visually impaired users to play card games independent of specialty products like Braille cards. The Card Reader works by having the user put a playing card into an image acquisition device which will capture a picture of the playing card. Then image recognition software will run on a microprocessor and will be used on the acquired image to identify the suit and value of the card. Finally, a voice signal describing the suit and value of the card will be sent to the user through headphones. Thus far, major accomplishments for the project include writing image recognition code in MATLAB, developing audio synthesis hardware and software, working with a processor board to run software, interfacing the processor board with other hardware, and developing a laptop based platform to serve as a prototype of the device. With the image recognition software we have developed, we can successfully locate and identify the value and suit of the card. We have recorded audio clips and have been able to play designated sound clips on stand-alone audio hardware. The next phase of the project is to interface the image acquisition device, the processor, and audio hardware.

Key Words

Student Poster, Rose-Hulman Ventures, Computer Engineering

Undergraduate Design of an Ethernet Controller

Anish Prithviraj, Purdue University
Matthew Ligocki, Purdue University
Michael Goodwin, Purdue University
Gregory Ross, Purdue University

Faculty Advisor: Dr. Mark Johnson, Purdue University

Student Poster Description

The purpose behind the Ethernet Controller project was to compose a team of students to work on a complex problem and take it from concept to fabrication. The final goal is to implement a complete Fast Ethernet Media Access Controller (MAC). The target application of this device is to provide Ethernet connectivity to an external microcontroller. This poster will provide an overview of what is being designed and the process used to implement the design. The poster will consist of the major elements of the design such as a functional block diagram, the layout of the chip being fabricated, major design decisions and trade-offs made, features, results and an outline of the FPGA test bed being implemented. The device is required to be able to attain an internal clock frequency of 50MHz. The chip is required to fit in an area of 3mmx3mm with a maximum of 40 pins. This design is unique in that is much more compact than a typical Ethernet controller without compromising the chip's overall throughput. The design makes use of three interface standards: IEEE 802.3 Ethernet Standard, ATM Forum UTOPIA Specification, and the I2C Bus Specification. The IEEE 802.3 Ethernet Standard (specifically the RMII interface) is used for communicating frame data between the MAC and Ethernet PHY. The UTOPIA interface is used for communicating data between the MAC and the external microcontroller. Finally, the I2C interface is used as a control line between the microcontroller and MAC.

Key Words

Student Poster, Electrical and Computer Engineering, Business and Management Sciences, IT Teaching and Learning Technologies

Table-Top Array of NASA's Deep Space Network

Jesse Randolph, Rose-Hulman Institute of Technology

Faculty Advisor: Robert Throne, Rose-Hulman Institute of Technology

Student Poster Description

The goal of the project is to design a preliminary model of NASA's Deep Space Network (DSN). Our model will consist of 3 satellite dishes that will simulate the motion of the DSN. Each satellite dish will have independent control as well as the ability to track as a group. The satellite dishes will NOT transmit or receive any data but only simulate that of a dish tracking an object in space. There will be several add-ons to the system including encoders to track the position of each dish and LEDs to display operational status. Software Implementation: Much of the project is software control and design. Software programming has been implemented on several different devices including a high level being run on a Linux machine as well as a low level on a Programmable Intelligent Computer (PIC). Each PIC has been programmed to transmit and receive data on the desired position and speed as well as data controlling status LED's Communication between these two levels is being handled via serial port.

RESULTS: The initial stage of design focused on making a working CAD model and then a prototype of that model. The first prototype has been completed and alterations have been made and a second prototype is being assembled for analysis before the final models are made and assembled. Programming, being a large portion of the project, has numerous areas completed. All of the control level (PIC side) has been completed as well as development of an Application Programming Interface (API) for the high level design. Communications has taken a lot of research, but we have successfully implemented a line that can talk between the PIC and the Linux machine.

CONCLUSION: The overlying goal of the project is to develop a base to be expanded on by a later group. This means that documentation, research, and analysis are very important to keep accurate and thorough. In order to maintain the integrity of the project many levels of organization have been taken and all research data, whether it is from a final revision or an early stage has been kept and will be used to document the development of the project. At the conclusion of the project, in addition to the working model, full documentation of all aspects of the research, design, and conclusions will be included for future groups' reference..

Key Words

Student Poster, Electrical Engineering, Electrical and Computer Engineering

Repetitive Stress Injuries Research Device

Steven Maynard, Rose-Hulman Institute of Technology
Samantha Dick, Rose-Hulman Institute of Technology

Faculty Advisor: Dr. Renee Rogge, Rose-Hulman Institute of Technology

Student Poster Description

The amount of computer use over the years has drastically increased the events of repetitive stress injuries (RSIs), including carpal tunnel system. There is a desire to create a device to track finger motion and wrist pressure during normal computer use for an extended period of time to research some of the possible causes of RSIs. The device must measure the position of all finger digit and wrist joints as well as pressure distribution as a function of time. Feasibility criteria include that the device must be able to function for the middle 90% of women's right hands, and allow for normal computer use. The device must be portable and cost less than $1,500. By considering other features that might be desired, merit criteria were determined. These include high resolution of the pressure distribution at the wrist, small size, not requiring a special keyboard or mouse, being easy to put the device on the participant, and quick setup time.

The final design for this device was developed and includes four subsystems: the finger motion subsystem, the wrist pressure subsystem, the hand attachment subsystem, and the hardware and software subsystem. The finger motion subsystem tracks the motion of each finger segment as well as the thumb and wrist using flex sensors. Flex sensors change resistance as they are bent which can be converted to a voltage change using a voltage divider. The wrist pressure subsystem captures an array of pressure points at the wrist using force sensitive resistors. These resistors work similarly to the flex sensors. The hand attachment subsystem connects the finger motion sensors and wrist pressure sensors to the hand. The subsystem consists of a fingerless glove with channels sewn on the fingers and pockets sewn on the wrist area to house the sensors.

Finally, the hardware and software subsystems digitize and store the data collected by the sensors and display the information in a user-friendly format. Using a printed circuit board (PCB), variable resistances change into analog voltage input for a data acquisition system. LabView calibrates the information and displays angle and force information to the user. Each subsystem was constructed separately and then the entire device was put together and tested. From the original design, there was only one major modification where the type of wrist pressure sensor changed. The original force sensor (CUI SF-5L) had a significant amount of drift under static loading, so a Tekscan Flexiforce force sensitive resistor was used in its place. Because of the sizing difference in the new sensors, fewer pressure sensors were used. Overall, this design project has been a success. All of the subsystems work independently and when put together. The device has been trial tested and it meets all of the original specifications. Hopefully, the device will be used to perform testing on repetitive stress injuries. This design project has been a good learning experience and recommendations have been made to create a better device in the future.

Key Words

Student Poster, Applied Biology & Biomedical Engineering, Biomedical Engineering

2:15 p.m. - 3:45 p.m. **SATURDAY, APRIL 5**

TECHNICAL SESSIONS
Planning Better Learning Experiences
Moderator: Kay C. Dee, Rose-Hulman Institute of Technology
Olin Hall O167

Targeting Report Expectations to Develop Presentation, Analysis, and Evaluation Skills in the Analytical Chemistry Curriculum

Luanne Tilstra, Rose-Hulman Institute of Technology
Daniel Morris, Rose-Hulman Institute of Technology
Penney Miller, Rose-Hulman Institute of Technology

Abstract
In our experience teaching Analytical Chemistry, our expectations concerning laboratory reports have been disconnected from student performance. Instead of students advancing to the next level in their ability to present, analyze, and evaluate scientific data commensurate with consistent professional development through their chemistry curricula, students' abilities in these areas appear to plateau. Therefore, we established a series of laboratory exercises that require graduated performance with each subsequent assignment. Specifically, we expect students to complete worksheets targeted to build specific skills for a given week (e.g., data representations in figures, construction of tables, error propagation, etc.). On a less frequent basis, we require that students write a report, which encourages them to integrate skills acquired from the worksheets into a formal writing assignment. To assess and foster student improvement in data presentation, analysis, and evaluation, we have developed a set of rubrics that are shared with students. After one quarter of implementation, we have observed advancement in student performance in some areas.

Key Words
Education Methods

Facilitating Team Activities in a Project Management Course

Joe Ashby, Indiana State University

Abstract
The use of team oriented approaches for technical problem solving has developed such that project management can be considered a core competency for engineering and technology students. Courses that specifically address the topic of project management allow students to become familiar with traditional and contemporary project management practices, the use of project management tools, and the study of human interaction within the framework of the project team.

This paper describes the evolution of delivery methods for an engineering technology project management course. The course brings together multiple disciplines of students and further addresses the global issue of project teams comprised of local and distance team members. The project management practices and tools used in the course are briefly reviewed. The educational approaches and challenges involved in forming and mentoring a practical team project activity, in the context of a one semester university course, will be discussed in detail. Team project topics developed for the course will be described.

Key Words
Engineering Technology Curricula

A Method for Determining Minimum Appropriate Lengths of Play for Classroom Strategic Management Simulations

John Mott, Purdue University

Abstract

The computer-based strategic management simulation has become a popular teaching tool in recent years, and is considered a useful complement to the traditional case studies conducted in many collegiate Engineering Management and Organizational Leadership curricula. A question that often arises with the conduct of computer-based simulations in the classroom is that of an appropriate length of time to devote to the operation of the simulation. Once specific parameters have been chosen to allow evaluation of the outcome of the simulation, over what period of time must those parameters be measured in order for the instructor to be reasonably assured either that learning has occurred or that the majority of learning that will occur has taken place?

This paper summarizes a method for determining the minimum appropriate length of play of an airline management simulation that was conducted by the author in a capstone undergraduate course during a one-semester period at Purdue University. The method employs the use of a first-order autoregressive estimator to predict future values of a single performance measure, that of the “stock price” of each airline being operated by students. When the mean squared errors between the estimated values and actual values for all students lie within a chosen bound, it is surmised that an appropriate degree of consistency on the part of students in the skills being learned is present, and that this point should be considered a minimum length for the conduct of the simulation. This result was then compared with a survey of the students participating in the course to determine the earliest point at which they felt their airlines were operationally consistent, and a reasonable degree of correlation was found between these two measures.

Because operational consistency does not necessarily imply learning to the extent that the performance measures of the simulation do, it should be noted that the method developed herein should be considered a means of determining a necessary condition for learning that must be used in conjunction with other performance measures to ensure that the desired degree of mastery of the simulation objectives has been achieved.

Key Words

Education Methods, Engineering Technology Curricula, Innovative Teaching Methods, Technology in the Classroom

How to Design Homework Assignments for Students Who Use Search Engines Instead of their Textbooks

Barry Dupen, IUPU-Fort Wayne

Abstract

In a survey course such as Introduction to Materials, homework assignments are often based on readings from the textbook. However, many students find it easier to use search engines to look up the answers on the internet. Rather than obstruct this natural tendency, instructors can take advantage of it by assigning questions that require intelligent use of internet resources. Solutions lead to class discussions about the meaning of the results. This paper discusses several materials homework assignments requiring internet research. Students learn that some answers are very difficult to find, and that accuracy of data on the internet is not guaranteed. Students also learn how materials data affect design, economics, and public policy.

Key Words

Innovative Teaching Methods

2:15 p.m. - 3:45 p.m. **SATURDAY, APRIL 5**

TECHNICAL SESSIONS
Interdisciplinary/Multidisciplinary Learning
Moderator: Andrew W. Otieno, Northern Illinois University
Olin Hall O169

Dissemination of Capstone Design Projects through Interdisciplinary Collaboration

Carlos Pomalaza-Raez, IUPU- Fort Wayne

Abstract
This paper describes an innovative interdisciplinary collaboration where students in the Division of Organizational Leadership & Supervision (OLS) worked with engineering senior design teams on developing multimedia presentations and posters highlighting the various design steps and the final prototypes. The OLS students were enrolled in a junior level course in their program that required them to create that type of material to fulfill the service learning component of the course. Each engineering design team, which has on the average four students, became in effect a "client" of an OLS student for the purposes of marketing their prototype and disseminating the results of the project to a technical and non-technical audience.

The final products of this collaboration were of a poster and a multimedia presentation for each project which were evaluated by faculty from the engineering and OLS departments. Each OLS student was also to write a paper commenting on the project itself and the interaction with the engineering students. This material was then used to disseminate the results of these projects to a diverse audience.

The benefits of this pilot collaboration went far beyond the final product. Both groups were able to experience the dynamics of working on an interdisciplinary team. This was a challenging experience for them at first because they had to learn how to communicate effectively with students outside of their own discipline. Ultimately, they realized that an interdisciplinary team has a larger skill set to work with to master their common goals. This collaboration also provided them with a teamwork experience that is more indicative to what they will encounter in the diverse workforce.

Key Words
Interdisciplinary Approaches, Technology in the Classroom

Integration of Knowledge for a Multidisciplinary Research Project in Engineering and Science Undergraduate Majors

Matt Rubin, IUPU-Indianapolis
Tyson Fish, IUPU-Indianapolis
Luke Thomas, IUPU-Indianapolis
Maher Rizkalla, IUPU-Indianapolis
Hasan Akay, IUPU-Indinanapolis

Abstract
This is a multidisciplinary research project model that combine elements form electrical engineering, computer engineering, mechanical engineering, and science. The project topic was chosen in the solid state area targeting solar energy application. The solving approach inquires mathematical model, CAD simulation, and experimental verification. The paper details the educational aspects of the project and the integration of knowledge in various fields. The project investigates a unique design for a high efficiency photovoltaic device using composite semiconductor materials interfaced to a diamond metallic substrate. The research also deals with optimizing the thermal response of the semiconductor metallic interface. The proper widths of the various semiconductor and metallic layers of the device will lead to maximum transmission for the thermal carriers throughout the device.

Key Words
Other: undergraduate research

A Truly Interdisciplinary Course Grounded in Computer Science

Stephen Blythe, Southern Illinois University-Edwardsville
Greg Littmann, Southern Illinois University-Edwardsville
Zixue Tai, University of Kentucky

Abstract
We present a truly interdisciplinary version of a course in Information Technology, Ethics, and Society. A single offering of this course is taught by faculty from two unique disciplines, with one being a Computer Science faculty member from the School of Engineering and the other varying with time but always representing a separate school within our university. Most recently, full-time faculty from Philosophy and Mass Communications departments have represented the complementary half of the interdisciplinary nature of the course.

The course itself is open to all majors from across our entire university and requires no prior computing background of its enrolled students. Interestingly, our university requires all of our undergraduate students to complete at least one course designated as interdisciplinary before graduating. The primary goal of this course requirement is to engage students in an interdisciplinary approach to subject material; students are expected to see and explore the bridge between the disciplines involved in the course. This tends to challenge all students in the course, even if they are actively studying one of the directly involved disciplines.

As the course is open to students who may not have any computing (or engineering) background, one of the primary topics needs to be an introduction to various computing technologies - from both a utilization and a technical perspective. The course also includes coverage of ethics as it relates to information technology, making it pertinent as a practical course in applied ethics. Furthermore, the course covers legal ramifications of technology usage, thus also grounding students in the legal facets of technology usage and development.

The course has been offered regularly over the past few years at our institution, utilizing dedicated full-time faculty from both Computer Science and two other non-engineering departments. This paper outlines our course, including the background to the development of the course, basic topics covered by the course, teaching methodologies utilized in the classroom, and a discussion of the course's outcomes.

Key Words
Interdisciplinary Approaches, Education Methods

Helping Engineers Appreciate the Wider Implications of Technology

Normand Laurendeau, Purdue University
Peter Meckl, Purdue University

Abstract
For over 30 years, the School of Mechanical Engineering at Purdue University has been offering a course entitled "Technology and Values" to its undergraduates. As we begin transitioning from one instructor to another, it is a good time to describe the unique aspects of this course and reflect on the role it can play in making engineers good citizens in today's world.

The course deals with the influence of science and technology on personal and societal value systems, as well as with the formulation of practical means by which human values can guide technological development. Special consideration is given to societal problems with a strong technological component. Examples include environmental degradation, energy utilization, underemployment, scientific misinformation, and sustainable development. Interdisciplinary approaches to technological problem solutions are stressed, including remedies provided by the law, economics, and politics.

The class meets once a week for three hours to facilitate discussion on a variety of books. The book list is divided into two parts, a set of five required books that everyone reads, and a list of nine optional books, each of which is assigned to two students, who are asked to summarize the contents of the book from either a pro or con viewpoint to the rest of the class. Supplementary articles covering similar concepts are made available to the whole class during the week that an optional book is assigned. In this way, the total amount of reading per student can be kept manageable while still being able to cover a wide range of materials.

Each week, short writing assignments are also provided, to give students practice in thinking through the concepts and in formulating their analysis of a given ethical dilemma. These assignments include summaries of an assigned short article, responses to questions posed in the major textbook for this course, and analysis of an ethics case. Students must complete a certain number of writing assignments of each type for the semester, but they have the opportunity to write more than this minimum. In this way, they can redo an assignment that gave them trouble earlier on, and they can distribute their work throughout the semester to fit into their schedules.

The course culminates in a 5000-word term paper on a topic of their choice that involves both a technological and a value component. In discussions between the instructor and the student, this topic is refined so that it has sufficient breadth to be interesting, but with enough focus to make the analysis manageable. Overall, students who take this course have come away with a new perspective on their careers and their future goals. By making them aware of issues that accompany the development and use of technology, the course provides them with a toolkit of concepts from philosophy, economics, politics, and sociology that they can use to make informed decisions for a better world.

Key Words
Educating for Sustainable Energy, Innovative Teaching Methods, Other: Engineering Ethics

SATURDAY, APRIL 5 *2:15 p.m. - 3:45 p.m.*

TECHNICAL SESSIONS
Innovative Applications in Experiments and Design
Moderator: Jessica Anderson, Rose-Hulman Institute of Technology
Olin Hall O257

Further Integration of 3D Modeling into Tool and Fixture Design

Wilson Liang, Purdue University of Fort Wayne

Abstract
At the 2006 ASEE annual conference the author of this paper presented his work on solid modeling implementation in the fixture design course. His manuscript received good comments from the reviewers and presentation interested some in the audience. In the fall semester of 2007 the author made some significant changes in application of solid modeling in fixture design to implement better design strategy. The newer development is in two areas. The author changed the solid modeling sequence from placing the workpiece on the locators to placing locators around the workpiece. The author also enhanced design parts associativity using multiple solid modeling tools including simple mathematical equations among dimension and position variables. The paper first reviews the original approach prior to the fall semester of 2007. It then discusses the newer approach in the fall semester of 2007. At the end, the paper addresses the assessment concern.

Key Words
Engineering Technology Curricula, Innovative Teaching Methods

A Kicking Mechanism for an Autonomous Mobile Robot

Yanfei Liu, Indiana - Purdue University Fort Wayne
Jiaxin Zhao, Indiana - Purdue University Fort Wayne

Abstract
AIn August 2007, the College of Engineering, Technology and Computer Science at Indiana University - Purdue University Fort Wayne and Raytheon Co., Fort Wayne initiated a 5-year project to promote robotics, artificial intelligence, and software engineering in the college curricula. The main goal is to build a robot team to compete in the Robocup competition (http://www.robocup.org). This project also aims at introducing robotics into a variety of computer science and engineering courses. As part of the first year plan, a Pioneer 3-DX robot equipped with a Canon VC-C50 Pan-tilt-zoom (PTZ) camera has been purchased. Using this robot as a development platform, the first task is to design and build a kicker. In order to accomplish this task, a team of senior engineering students have been asked to design and build a kicking mechanism that is seamlessly connected and interfaced with this Pioneer 3-DX robot. This is a two-semester multidisciplinary capstone senior design project conducted by one computer engineering student, two electrical engineering students, and two mechanical engineering students. In the fall of 2007, the students started with the formulation of the problem and then the generation of conceptual designs. After evaluating the conceptual designs, they completed a detailed design of the best conceptual design. In the spring of 2008, the students will first build the kicking system, and then conduct experimental testing.

The kicking system is composed of a kicker, a microprocessor based control and driving unit, and software design. The Pioneer 3-DX robot and its attached kicking system shall be able to locate a soccer ball, approach the ball, and control it. It should also be able to kick the ball in a particular direction for a minimum of 5 meters through preprogrammed kicking strategies. The kicking mechanism should be designed to work under the limitations and rules specified by the Robocup organization. Robocup provides rules regarding the size limitations of the robot for specific leagues. These size restrictions together with the given dimensions of the Pioneer robot will determine the allowable size and weight of the kicking system. The microprocessor based control and driving unit shall be able to provide enough power to drive the actuators of the kicker.

Other than the technical aspects of the kicking mechanism, this paper also describes several different assessment approaches used throughout the project. The faculty members from the Department of Engineering and the local sponsors conduct the assessment. These assessments are based on either written reports or oral presentations by each design team. This paper also presents the ongoing and future effects in the curricula development brought by the Robocup project.

Key Words
Interdisciplinary Approaches, Other: capstone senior design projects

A Unique Horizontal Shaft/Slider Apparatus Capstone Design Project for a Hands-On Senior-Level Laboratory Design Experience

Yin-ping (Daniel) Chang, Oakland University

Abstract
This paper describes a particle kinetics work/energy measurement experiment for the senior level Engineering Mechanics – Dynamics course. This course is geared towards introducing students to the fundamental principles of kinematics and kinetics of particles and rigid bodies, including displacement/velocity/acceleration kinematic relationships and kinetic analyses through Newtonian laws of motion, work/energy conservation laws, and impulse/momentum principle approaches. It has been the Mechanical Engineering Department's philosophy that theory learned in the classroom be augmented by experiential knowledge gained by hands-on laboratory experience. In this light, laboratory experiments have been developed that are integrated with the course material. This paper presents a unique experimental apparatus, designed and built at Oakland University, which is a precursor to the Capstone Design Project at Oakland University, to introduce students to particle kinetics properties measurement techniques to measure particle displacements, energy transfer and dissipation, and the coefficient of friction on a horizontal shaft/slider apparatus. The Capstone Design Project is geared to taking students through the entire taxonomy of the design process; from knowledge, comprehension and application, to synthesis, analysis, and finally evaluation. The experiment covers basic concepts of kinetics of particles, specially focusing on work/energy conservation related principles. A slider/collar was mounted on a horizontal shaft in this apparatus. The sliding collar deflected a spring at one end of the shaft to temporarily store the potential energy, and released to transform the potential energy into kinetic; traveling on the horizontal shaft, the friction dissipated part of the energy, and then the collar met and deflected the other spring at the other end of the shaft and bounced back. A non-contact linear displacement sensor and LabView based data acquisition system were implemented to facilitate the complex measuring and to increase the accuracy of the data in this experiment. The students were asked to validate the particle kinetics principles of conservation of energy. Results of the students' experiences will be presented in this paper.

Key Words
Engineering Curricula

A Unique Pendulum Impact Apparatus Capstone Design Project for a Hands-On Senior-Level Laboratory Design Experience

Yin-ping (Daniel) Chang, Oakland University

Abstract
This paper describes a particle kinetics work/energy and impulse/momentum measurement experiment for the senior level Engineering Mechanics – Dynamics course. This course introduces students to the fundamental principles of kinematics and kinetics of particles and rigid bodies, including displacement/velocity/acceleration kinematic relationships and kinetic analyses through Newtonian laws of motion, work/energy conservation laws, and impulse/momentum approaches. It has been the Mechanical Engineering Department's philosophy that theory learned in the classroom be augmented by experiential knowledge gained by laboratory experience. In this light, hands-on laboratory experiments have been developed that are integrated with the course material. This paper presents a unique experimental apparatus, designed and built at Oakland University, by senior-level students involved in a design project. The purpose is to introduce students to particle kinetics properties measurement techniques to measure particles' velocities, energy transfer and dissipation, and the coefficient of restitution during impact phenomena in a pendulum impact system. The experiment covers basic concepts of kinetics of particles, specially focusing on impulse/momentum related principles. Two objects were used in this impact apparatus. One object was set up as a pendulum, being raised up and swung down to impact a stationary object. The first object was raised up to store the gravitational potential energy, and then swung down to transform the gravity potential energy into kinetic energy; this object then impacted the other object, transferred part of the momentum to the other object, the other object gained the momentum and transferred it into kinetic energy. The energy was then dissipated by friction when the object traveled on a flat surface. The students were asked to validate the particle kinetics law of conservation of energy and impulse/momentum principles. Results of the students' experiences will be presented in this paper.

Key Words
Engineering Curricula

DSP Communications Experiment

Gale Allen, Minnesota State University, Mankato

Abstract

A sampling circuit combined with digital implementation of analog communications functions and the evolution of experiments for a digital communications course for technology students are described in this paper. The laboratory work for a digital communications course had involved use of commercial trainer equipment consisting of pre-built circuits packaged in closed modules. Students said many circuit details were hidden and remained a mystery. As a change, students built and tested circuits in which many of the digital functions were implemented in integrated circuits. Students made positive comments about the new experiments, but they spent many hours troubleshooting and much of the function details were hidden in the chips. Now, students implement each core function with a few simple chips and use test equipment to implement the rest of the experiment circuitry. The experiments and evolution are described.

In Fall07 work was started on developing a new experiment that involves digital implementation of synchronous AM detection followed by PC stereo sampling circuits and signal processing programs. The Fast Fourier Transform and digital filters are used to eliminate interference and extract the audio signal. The technique has recently become available in amateur radio equipment. The experiment is useful in both digital and analog courses.

The DSP Experiment seems to be a useful addition to the experiments used in the digital communications course. Students were very interested in learning about digital signal processing and its use in amateur radio equipment. Students enjoyed building and testing the detector kits. Areas to examine include deciding how much effort to spend on transforms and assessing what students are learning.

Key Words

ABET Accreditation, Education Methods, Engineering Technology Curricula, Innovative Teaching Methods, Technology in the Classroom

SATURDAY, APRIL 5 *2:15 p.m. - 3:45 p.m.*

TECHNICAL SESSIONS
Classroom Technology
Moderator: Mark C. Johnson, Purdue University
Olin Hall O267

Concept Learning Experiment in Electronics

Gale Allen, Minnesota State University, Mankato

Abstract
The use of a circuit simulator as a concept-learning tool in an electronics course is discussed in this paper. Can student learning be improved if students see the big picture first using simulation? In this two-semester sequence students study diodes, transistors, and a series of common circuit configurations including clippers, clamps, amplifiers, active filters, regulators, power amplifiers, differential amplifiers and operational amplifiers. They use algebraic tools to predict the amplitudes and phase angles of voltages and currents at various points in the circuits for a range of the frequency and amplitude values of an input signal source. Some have difficulty performing the analysis and fail to get the big picture; i.e., the function and operation of the circuit. In the past, quizzes and exams uncovered issues and material was repeated, usually without much improvement. The availability of computer resources and simulation tools affords trying a different approach. This year a computer room is being used for the lecture class. During lecture each student simulates the component or circuit and "sees" how the component or circuit operates by observing voltages and current displayed on the computer screen. The students make changes and observe the effects of changes. Then they learn how to analyze the circuit and predict the details of voltage and current waveforms. The active-learning simulation process takes time away from lecture, but there may be improved learning and improved retention. Initial test results are encouraging. The use of prior year's test material is being investigated to help quantify the results. The paper covers the lecture process, test results, student evaluations, and details of simulations that have been developed to support this approach to electronics learning.

Key Words
Education Methods, Engineering Curricula, Engineering Technology Curricula, Teaching Methods, Technology in the Classroom

Assessment of the Pedagogical Value of an Innovative E-Learning Environment That Uses Virtual Reality

Eugenia Fernandez, IUPU-Indianapolis
Jamie Workman-Germann, IUPU-Indianapolis
Hazim A. El-Mounaryi, IUPU-Indianapolis
Chirag Padalia, IUPU-Indianapolis

Abstract
The pedagogical value of an innovative e-learning tool, the Advanced Virtual Manufacturing Laboratory (AVML), is assessed by determining its effectiveness in student learning. The AVML is a collaborative web-based e-learning environment for integrated lecture and lab delivery which focuses on advanced machining using Computer Numerically Controlled (CNC) machine tools. Student learning using the AVML, which provides educational content for theory (lecture) and specific machine tool applications (laboratory) related to CNC machining, is evaluated using a quasi-experimental randomized study.

Students in two engineering-related courses at a large Midwestern university — one a graduate course in CAD/CAM Theory and Applications, the other an undergraduate course in Manufacturing Processes — served as subjects for the study. Both lecture and lab course content was taught using three teaching methods: traditional classroom, virtual using the AVML, and both. Various tasks encompassing lecture material (such as NC Programming and CNC Machining) and laboratory material (such as CNC operational procedures) were devised for students to be trained and evaluated on. Student learning was evaluated after each segment in both classroom and laboratory environments.

Analysis of variance was used to compare performance on both the lecture and lab tasks across teaching methods. A repeated-measures factorial ANOVA was conducted comparing student scores based on course component (lecture vs. lab) and teaching method (classroom, virtual or both). Significant main effects were found for course component and teaching method. Students performed better on the lecture component than the lab component and when both the AVML and classroom teaching were used) than either classroom or the AVML alone.

The results show that the AVML is an adequate alternative to classroom learning, but that hybrid learning (traditional classroom training combined with AVML based e-learning) provides the best learning outcomes. As such, it was concluded that the AVML does enhance student learning.

Key Words
Education Methods, Engineering Curricula, Engineering Technology Curricula, Innovative Teaching Methods, Outcomes Assessment, Technology in the Classroom

Using Tablet PC and DyKnow in a Mechanics of Materials Course

Patrick Ferro, Rose-Hulman Institute of Technology

Abstract
A Mechanics of Materials course was revised to include the use of Tablet PC and DyKnow software. Classroom assessment techniques were developed to utilize the capabilities of the Tablet PC and DyKnow software to provide feedback to the instructor. Exercises that worked well included drawing stress elements and Mohr's circles. The archiving capability of the software allowed students to save work and in-class examples. Challenges involved in implementing the technology in this type of course will be discussed.

Key Words
Education Methods, Technology in the Classroom

Interactive Learning Using a Tablet PC in Soil Mechanics

Kevin Sutterer, Rose-Hulman Institute of Technology

Abstract
The author is currently part of an initiative at his institute to explore opportunities for the use of tablet PCs equipped with appropriate software as interactive learning devices. Appropriate use of technology is a guiding principle for learning through the ASCE ExCEEd model. As a learning tool, the chalkboard offers a broad range of advantages for facilitating learning in a variety of ways. Even so, technology offers opportunities to develop interactive learning tools that can broaden learning activities in the classroom. As a strong proponent of chalkboard-facilitated learning, the author had joined the tablet research team as a skeptic collaborator.

The author used tablet PCs to facilitate nearly all classroom learning in junior-year Soil Mechanics. The instructor and students used pen-based tablets with collaborative note taking software in class to manage lectures, discussions, example problems, classroom learning assessments, practice problems, and spreadsheet-based problem-solving tools. Assessment of learning is being conducted on four levels: (1) assessments of the students' attitudes about using the technology and their learning; (2) independent, institute-level assessment at the beginning, middle, and end of the course; (3) evaluation of student performance on the final exam compared to prior course offerings; and (4) instructor reflection by the author.

The study found that students usually expressed a high acceptance of the learning process, believe both in class and out-of-class learning are improved, and expressed a desire to use the technology in other classes. Final institute assessment findings were consistent with student feedback, suggesting learning was equal or improved by the technology. Final exam test scores indicate no significant change in student performance on exams. The author has discovered the technology adds tools to facilitate interaction and immediate assessment of learning and is excited about the prospect of using the technology in more classes. In conclusion, it is recommended use of this technology be considered for similar courses, but only if the instructor is prepared to invest significant time for mastering the technology and for preparation of advance notes for their first offering of the course.

Key Words
Education Methods, Innovative Teaching Methods, Technology in the Classroom

SATURDAY, APRIL 5 *8:30 a.m. - 10:00 a.m.*

K-12 SESSION

Workshop: Interactive Lessons for Pre-University Power Education

Zeb Tate, University of Illinois at Urbana-Champaign
Jana Sebestik, University of Illinois at Urbana-Champaign
Olin Hall O157

Abstract
This workshop will focus on a process used to develop interactive applets and associated lesson plans designed to teach middle school students about power, energy, and the power grid. Following a 2007 site visit, the National Science Foundation cited our K-12 outreach efforts as one of the three notable accomplishments of the 5-year, multi-million dollar research center of which we are a part. Four aspects of our development process will be addressed: forming an effective development team, using a product-oriented approach, disseminating materials and obtaining useful feedback, and presenting the materials to the funding organization. The applets and lesson plans will be referenced throughout the presentation to demonstrate different aspects of the development process. Workshop participants are encouraged to bring their own laptops.

Key Words
K-12 Outreach, Interdisciplinary Approaches, Educating for Sustainable Energy, Innovative Teaching Methods, Technology in the Classroom

Rose-Hulman K-12 Outreach Programs

Moderator: Pat Ferro, Rose-Hulman Institute of Technology
Olin Hall O159

Description
An overview of three Rose-Hulman K-12 outreach programs briefly described below will be presented.

- Catapult
- Homework Hotline
- PRISM

Operation Catapult
Erik Hayes, Rose-Hulman Institute of Technology

Operation Catapult is a unique summer program conducted by Rose-Hulman Institute of Technology for high school students who have completed their junior year. Beyond providing a stimulating intellectual experience for students, there are three central objectives to Operation Catapult:

1. Integrate and supplement previous learning.
2. Explore fundamental scientific and engineering principles and systems.
3. Provide an opportunity for group living in a campus setting.

This program goes beyond the classroom into the realms of engineering and applied science. One of the important features of Operation Catapult is the exposure to engineering and applied science through project work. Each Catapulter works on a project, selected either from a list of suggestions or self-initiated because it presents a challenge to tackle. However, since few projects in the "real world" are handled solo, the project work in Catapult is done by groups of two to four students. In addition to the project experience, demonstrations, lectures (guest and otherwise), and field trips, including a tour of at least one industrial plant, are incorporated into Operation Catapult.

Neutron to Electron
Sine to Cosine
Homework Hotline has your students covered
Janie McNichols, Rose-Hulman Institute of Technology

Rose-Hulman Institute of Technology's Homework Hotline is a toll-free telephone tutoring service that helps Indiana middle school and high school students better understand mathematics and science concepts, and improve their problem-solving skills.

Homework Hotline tutors – Rose-Hulman students – are available to answer calls from 7 p.m. to 10 p.m. (Eastern Daylight Time), Sunday through Thursday, during the school year. The toll-free telephone number is 1-877-ASK-ROSE (1-877-275-7673). The Homework Hotline Web site is www.AskRose.org.

The tutors, specially chosen and trained to work with youth, have access to most math and science textbooks used by Indiana schools, which enables the tutors to work with youth on specific homework problems or section reviews.

The Homework Hotline is not an answer line, but rather an educational resource that reinforces classroom concepts and offers assistance. Educators will discover how to access free tools to promote this service to their students and how to encourage students to call.

PRISM – A Portal with a Purpose

Ryan Smith and Matt Davidson, Rose-Hulman Institute of Technology

We present an overview of PRISM, Indiana's premier portal for teachers of middle school STEM subjects. PRISM (http://www.rose-prism.org) is a free, web-delivered "window" on digital resources, providing learning tools to meet the demands of college and workplace STEM proficiencies. Using PRISM, teachers can quickly find standards-indexed, teacher-reviewed online resources. Begun in 2003, the project is hosted at Rose-Hulman Institute of Technology and is funded through the Lilly Endowment, Inc.

A major transforming agent for education in the upcoming years will be the rapid advancements in informational technology (IT) as used in the workplace. New tools for workers indicate that the next wave of educational reform may well require a focus on academic standards that incorporate emerging IT literacy needs into the traditional STEM curricula.

From the beginning, PRISM endeavored to distinguish itself from conventional resource portals. The PRISM team has been highly selective in the types of materials we have indexed to academic standards. The bulk of the portal's offerings are non-textual IT resources that mirror the digital tools used in the modern practice of STEM in the workplace and in higher education. Unlike other digital portals, PRISM specializes in highly interactive mind-ware, such as simulations, visualizations, modeling packages, cognitive skills games, and software that increases student task engagement and motivates learning.

The newest PRISM service is MOODLE (http://moodle.org/), an Open Source product that requires no licensing fee and has a number of leading-edge learning mediators. By integrating MOODLE, we are able to give our user community the features and functionality of other, similar commercial products (e.g. ANGEL, WebCT/Blackboard). Registered users of PRISM can set up a lesson or an entire course by creating or importing content, establishing a roster, sequencing activities (including online quizzes and other forms of assessment), and enable a peer-review feature so that students can electronically critique each other's work. Teachers can also create virtual student teams that can work together outside the classroom.

A recent study indicated that PRISM usage correlated with improved competency scores. Using well-known regression techniques, the statistical evidence for the project's assessment showed a direct (and statistically significant) relationship between the use of PRISM at a given school and their students' performance on the eighth-grade I-STEP math exam for the years 2003 and 2006.

In December 2006, PRISM was selected by T.H.E. Journal (Technology Horizons in Education) as one of the top 15 educational technology innovations in the U.S. (for K-12). The publication is dedicated to informing and educating K-12 senior-level district and school administrators, technologists, and tech-savvy educators within districts, schools, and classrooms to advance the learning process through the use of technology. Launched in 1972, T.H.E. Journal was the first magazine to cover education technology. Currently, the publication is the largest circulated education technology monthly publication in the U.S.

Key Words
K-12 Outreach

10:30 a.m. - 12:00 p.m. **SATURDAY, APRIL 5**

K-12 SESSION

Film Screening of Two Million Minutes

Moderator: Pat Fox, IUPU-Indianapolis
Olin Hall O157

Description
Screening of Two Million Minutes, a recently released documentary comparing the high school experiences of six students – two from Bangalore, India; two from Shanghai, China; and two from Carmel, Indiana, USA. "Observing the various pressures and priorities of these students, their schools and their families provides insight into the changing nature of competition in the knowledge economy… [The] title alludes to the amount of time high school students have to build their intellectual foundation and prepare for college and careers…" http://www.2mminutes.com/pressblog.html

An audience-driven discussion will follow this 54 minute film.

Internet and K-12 Resources

Moderator: John Uhran, University of Notre Dame
Olin Hall O159

Description
Overview and demonstration of two programs featuring web-delivered resources.

Electronic Field Trip
Jeff Mohl, Ball State University

Ball State's award winning program providing a rich set of virtual visits to national parks and museums, augmented by learning and assessment activities.

CITIDOE
Jan Stevens, IUPU-Indianapolis

An educational partnership between the Computer and Information Technology Department at IUPUI and the Indiana Department of Education. Students take online courses in IT for dual high school and college credit.

SATURDAY, APRIL 5 *10:30 a.m. - 12:00 p.m.*

FOCUS ON UNDERGRADUATE STUDENTS

Undergraduate Student Paper Presentations Session I
Moderator: Scott McClellan, Rose-Hulman Institute of Technology
Olin Hall 0167
(See Saturday, April 5 Schedule)

Undergraduate Student Paper Presentations Session II
Moderator: Sue L. Niezgoda, Rose-Hulman Institute of Technology
Olin Hall 0169
(See Saturday, April 5 Schedule)

Undergraduate Student Paper Presentations Session III
Moderator: Glen A. Livesay, Rose-Hulman Institute of Technology
Olin Hall 0257
(See Saturday, April 5 Schedule)

Undergraduate Student Poster Presentations
Moderator: Lorainne Olson, Rose-Hulman Institute of Technology
Hadley Hall 1st Floor Corridor
(See Saturday, April 5 Schedule)

1:15 p.m. - 2:00 p.m. **SATURDAY, APRIL 5**

K-12 SESSION

Tours

For participants who would like to stretch their legs after lunch, we have several options. Several faculty and staff will offer brief presentations and hands-on opportunities for innovative programs here at Rose-Hulman. Maps and additional details will be available after the luncheon on Saturday in the Olin Hall Advanced Lobby.

Client-based Senior Design Projects
James Hanson, Assistant Professor of Civil Engineering
Olin 222

PRISM – Standards Indexed Digital Resources for Middle School STEM
Ryan Smith (Webmaster) and Matt Davidson (Internet Applications Developer)
Dynamics Laboratory, Olin 203

Rose-Hulman Radio Station and K-12 Programming
Pat Ferro, Assistant Professor of Mechanical Engineering
Basement BSB Hall, Radio Studio

Student-Guided Campus Tour
Marsha Krisenko, RHIT Sophomore, Applied Biology
Begin at Olin Hall Advanced Lobby

Tablet PCs in the Classroom – Software and Pedagogies
Julia Williams, Professor and Executive Director of Institutional Research, Planning, and Assessment
Olin 259

Technology-enabled, Student-centered Classrooms
Fred Berry, Department Head and Professor, Electrical and Computer Engineering
Moench C115

SATURDAY, APRIL 5 *2:15 p.m. - 3:45 p.m.*

K-12 SESSION

Moderator: Bruce Black, Rose-Hulman Institute of Technology
Olin Hall 157

A Retrospective Study of Skills, Traits, Influences, and School Experiences of Talented Engineers

Michele L. Strutz, Purdue University

Abstract
By 2012, an estimated 1.6 million engineers will be needed to support the U.S. job market. The prognosis is poor because the engineering field and characteristics of engineers are not well understood by children, teachers, guidance counselors, and parents. This retrospective study will pilot an instrument designed to identify the influences, skills, and traits of talented engineers that drew them to engineering. The survey was developed using Qualtrics© software. Its link was included in an email that invited 7,000 engineering students and faculty and practicing and retired engineers to participate; 1,000 responded. Using the analysis feature of Qualtrics©, the demographics of the participants and the frequency of their responses were tabulated. The primary influencers identified were family, teachers and counselors, and friends. Several stated that they made the decision to pursue engineering themselves without someone's influence. Skills in math, science, thinking, problem solving, and analytic reasoning were listed as most important. Participants stated that being focused, persistent, ambitious, task-oriented, independent, and interested in many things were key traits of an engineer. The results of this survey helped identify the skills and traits of students who would be a good fit for an engineering future; that curriculum modifications are needed to increase student awareness of engineering; and, that parents, teachers, and counselors need a familiarity of degrees and careers in engineering in order to knowledgeably discuss this field with their children and students. Integrating engineering into the mindset of children and adults may be the start of bringing this country back into the position of technological leadership.

Key Words
K-12 Outreach

PRISM -- Teaching New STEM Digital Literacies

Patricia Carlson, Rose-Hulman Institute of Technology

Abstract

This presentation gives an overview of the pedagogy, implementation, and assessment outcomes for PRISM (Portal Resources for Indiana Science and Mathematics). Hosted by Rose-Hulman Institute of Technology, PRISM is Indiana's premier website for standards-based online resources for teachers of middle school science, technology, (pre)-engineering, and mathematics (STEM). The portal (http://www.rose-prism.org) was opened in September, 2003, with the strong financial support of the Lilly Endowment , to address the classic organizational problem of a knowledge gap: what to do when new methods of operating advance more rapidly than members of an organization can meaningfully assimilate and implement.

VERTICAL INTEGRATION BETWEEN PRE-COLLEGIATE AND COLLEGIATE EXPECTATIONS -- From the beginning, the PRISM team has been highly selective in the types of materials we have indexed to academic standards. The bulk of our offerings are non-textual information technology resources that mirror the digital tools used in the modern practice of STEM in the workplace. PRISM currently offers over 2,300 age-appropriate resources, the vast majority of which are carefully designed learning environments for teaching complex skills and sustaining student task engagement.

The majority of our resources are interactive simulations, cognitive skills games, visualizations, cognition mapping applications, modeling packages, virtual laboratories and user-guided, virtual experiments. We also index resource sites providing access to live data and data manipulation tools and to collaborative inquiry activities involving students from many different regions. We look specifically for packages that are designed upon modern instructional theories. These learning activities make visible strategic models for higher-order cognitive activities (such as discerning patterns in bodies of data, decision-making skills, staged problem solving, analysis, synthesis, and drawing inferences).

PRISM's emphasis on new tools for knowledge workers is exemplary because the approach combines promoting STEM career awareness with outstanding resources for creating challenging academic programs. This union of motivation and achievement gives a student not just the **desire** but also the **ability** to pursue postsecondary degrees in STEM.

Key Words

K-12 Outreach

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[1] Lilly Grant #2001-2578-000, *Web-Portal: Integrating the Digital Learning Space for Indiana's Middle School Science, Mathematics, and Technology Teachers*.

Designing an Industrial Automation Lab for K-12 Outreach

Kevin Devine, Illinois State University

Abstract
As a result of a generous donation from the Caterpillar Foundation, the Department of Technology at Illinois State University recently completed the installation of a state-of-the-art industrial automation lab called the Caterpillar Integrated Manufacturing Laboratory (CAT-IML). Although the design of the lab focused primarily on undergraduate education, deliberate steps were taken to ensure the lab could also be used to deliver K-12 outreach activities. The purpose of this paper is three fold. First the paper will describe the development of the CAT-IML, including specific K-12 outreach considerations. Second, the CAT-IML itself will be described with emphasis placed on the safety features that were added in part to accommodate K-12 students. Finally, the K-12 outreach activities conducted in the lab to date will be described including assessment.

Key Words
K-12 Outreach

EXPLORE ENGINEERING: Rose-Hulman's Outreach to Middle and High School Students

Dale Long, Rose-Hulman Institute of Technology
Fred Berry, Rose-Hulman Institute of Technology

Abstract
ARose-Hulman Institute of Technology (RHIT) places a high priority on reaching out to the local community. This is part of the formula for its success. Such outreach fosters service opportunities so students can discover engineering, mathematics, and science careers are about more than calculations, theories and books. Service is a fundamental aspect of being a professional and thus fundamental to our students' education. Pedagogically, learning in the affective and social domains is enhanced by such activities, helping improve cognitive learning. Although our emphasis on outreach is a top-down initiative, newcomers to the RHIT community have always been surprised by how unselfishly the staff, students and faculty rally to be a part of community outreach.

Terre Haute, Indiana, the home city of Rose-Hulman, is also a regional center for most of the Wabash River valley in west-central Indiana and east-central Illinois. Much of RHIT's outreach is to Wabash Valley residents. RHIT's EXPLORE ENGINEERING program strives to attract Wabash Valley middle and high school students into the fields of science and engineering. This program is offered every other Tuesday night during the academic year for 1-1/2 hours. Though the program was free for a number of years, a nominal fee of $10 per family is now charged to join for the entire year. Over its nearly 15-year life, hundreds of middle and high school students have explored the exciting world of engineering and science thanks to their participation in EXPLORE ENGINEERING. The program has grown in popularity and stature during the past five years, thanks to the support of the Lilly Endowment Inc. and Indiana Space Grant Consortium. Prior to the recent funding, however, the program was still successful, though operating on little to no budget, other than the commitment of Rose-Hulman's Office of Communications & Marketing staff to organize and moderate the meetings every other week, publish a newsletter, maintain membership information and lead the faculty/staff mentoring team administering the program.

Key Words
K-12 Outreach

2:15 p.m. - 3:45 p.m. **SATURDAY, APRIL 5**

K-12 SESSION

Increasing Access to STEM Professions

Moderator: Douglas C. Acheson, IUPU-Indianapolis
Olin Hall O159

I-STEM Resource Network: Promoting STEM Education in Indiana

Brandon Sorge, Director of Operation, I-STEM Resource Network

Description
The Indiana STEM Resources Network (I-STEM) http://www.istem.org supports K–12 education towards STEM literacy for all students. I-STEM focuses on teaching, learning, applied research, community partnerships, and network development. Through these focus areas I-STEM provides teachers with continuing education in content and instructional strategies, disseminates information for students on learning opportunities, shares effective practices for teachers and schools, supports district-level improvements in STEM education, and promotes resource awareness and communication for STEM education. Participants will learn about the development of the I-STEM Resource Network and progress on initial activities.

Pathways to Engineering

Charles Feldhaus, IUPU-Indianapolis

Description
Selections from IUPUI's programs to increase ability and awareness for careers in engineering and technology will be presented.

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