AE3 ACADEMY FOR EXCELLENCE IN ENGINEERING EDUCATION

Celebration of Teaching

APRIL 16, 2021 · ZOOM · 1:00-3:00PM

Program

WELCOME & INTRODUCTION OF DEAN RASHID BASHIR

Jay Mann, Director of AE3

REMARKS

Rashid Bashir, Dean

KEYNOTE ADDRESS

Dr. Gilda Barabino

President, Olin College of Engineering

COLLINS SCHOLAR REFLECTION AND RECOGNITION

Chris Migotsky, Faculty Teaching Programs Coordinator & Jay Mann

Eleftharia Kontou (2019-2020) & Brad Solomon (2020-2021)

CELEBRATING EXCELLENCE IN ENGINEERING EDUCATION

Jonathan Makela, Associate Dean & Jay Mann

SIIP POSTER SESSION

Rashid Bashir

Dean, Grainger College of Engineering

Rashid Bashir is Dean of The Grainger College of Engineering, the Grainger Distinguished Chair in Engineering and Professor of Bioengineering at the University of Illinois at Urbana-Champaign (UIUC). He received the NSF Faculty Early Career Award, the 2012 IEEE EMBS Technical Achievement Award, the Pritzker Distinguished Lectureship Award from BMES in 2018, and the 2021 American Institute for Medical and Biological Engineering Professional Impact Award. He has been involved in 3 startups that have licensed his technologies. He was part of the core founding team and co-chair of the curriculum committee for the Carle Illinois College of Medicine. His research group is interested in developing new technologies for precision and personalized medicine, and 3D bio-fabrication of cellular systems. Using bionanotechnology, BioMEMS, and lab on chip, he is working at the interface of biology and engineering from the molecular to the tissue scale, and aiming to make an impact on grand challenges in health and medicine.

Dr. Gilda Barabino

President, Olin College of Engineering

Gilda A. Barabino is President of Olin College of Engineering, and Professor of Biomedical and Chemical Engineering. She previously served as Daniel and Frances Berg Professor and Dean at The City College of New York's (CCNY) Grove School of Engineering. Prior to joining CCNY, she was Associate Chair for Graduate Studies and Professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory. At Georgia Tech she also served as the inaugural Vice Provost for Academic Diversity. Prior to Georgia Tech and Emory, she rose to the rank of Professor of Chemical Engineering and was Vice Provost for Undergraduate Education at Northeastern University. She is a noted investigator in the areas of sickle cell disease, cellular and tissue engineering, and the role of race/ethnicity and gender in science and engineering.

Dr. Barabino is president-elect of the American Association for the Advancement of Science, the world's largest interdisciplinary scientific society. She is also an active member of the National Academy of Engineering and the National Academy of Medicine and serves on numerous committees of the National Academies of Science, Engineering and Medicine, including the Roundtable on Black Men and Black Women in Science, Engineering and Medicine; the Health and Medicine Division Committee; and the Committee on Women in Science Engineering and Medicine which she chairs. Dr. Barabino also serves as a member of the National Institutes of Health's National Advisory Council for Biomedical Imaging and Bioengineering; National Science Foundation's Advisory Committee for Engineering; the congressionally mandated Committee on Equal Opportunities in Science and Engineering; and the American Association for the Advancement of Science Committee on Science, Engineering and Public Policy. Dr. Barabino also serves on the Scientific Advisory Board of the Chan Zuckerberg Biohub. She consults nationally and internationally on STEM education and research, diversity in higher education, policy, and faculty and workforce development.

She received a B.S. from Xavier University of Louisiana and a Ph.D. from Rice University.

Collins Scholars Graduates

2019-2020

Nikhil Chandra Admal · MechSE

Tugce Baser · CEE

Ujjal Bhowmik · ECE

Barry Bradlyn · Phys

Lili Cai · MechSE

Roy Dong · ECE

Katherine Driggs-Campbell · ECE

Jie Feng · MechSE

Holly Golecki · BioE

Andres Goza · AeroE

Jiajun He · MechSE

Axel Hoffmann · MatSE

Dakshita Khurana · CS

Eleftheria Kontou · CEE

Jason Merret · AeroE

Radhika Mittal · ECE

Jacquelyn Noronha-Hostler · Phys

Melkior Ornik · AeroE

João Ramos · MechSE

Theresa Saxton-Fox · AeroE

Pengfei Song · ECE

Xiao Su · ChBE

Hanghang Tong · CS

Richard Zhang · ECE

Collins Scholars Graduates

2020-2021

Benjamin Cosman · CS

Yael Gertner · CS

Elizabeth Goldschmidt · Phys

Saurabh Gupta · ECE

Ramez Hajj · CEE

Jacob Henschen · CEE

Salah Issa · ABE

Nickvash Kani ·ECE

Lewis Lehe · CEE

Colleen Lewis · CS

Hongye Liu · CS

Fahad Mahmood · Phys

Maggie Mahmood · Phys

Olga Mironenko · ECE

Uzoma Monye · ChBE

Francesco Panerai · AeroE

Rebecca Reck · BioE

Ling Ren · CS

Jonathan Schuh · ECE

Brad Solomon · CS

Andrew Stillwell · ECE

Ann Sychterz · CEE

Christopher Tessum · CEE

Joe Tom · CEE

Laura Villafañe Roca · AeroE

Chrysafis Vogiatzis · ISE

Gang Wang · CS

Yuxiong Wang · CS

Education Innovation Fellows (EIFs)

Yuting Chen · ECE

Jeff Erickson · CS

Molly Goldstein · ISE

Marcia Pool · BioE

John Popovics · CEE

Chris Schmitz · ECE

Tim Stelzer · Phys

Matt West · MechSE

Craig Zilles · CS

Student Consultants on Teaching (SCOTs)

Andrew Conwell · CEE

Robin De Lara · MatSE

Mina Makhaeel · MechSE

Eugenia Maldonado · MechSE

Joe Mirabelli · EDUC

Teaching Professionals Program (TPro2)

Co-facilitators

Geoffrey Herman · CS

Karin Jensen · BioE

Event Presenters

Lawrence Angrave · CS

Molly Goldstein · ISE

Paul Jensen · BioE

Rebecca Reck · BioE

Devin Dionne · Gies College of Business

Keith Hays · Office of Access & Equity

Dr. Kacey Beddoes · San Jose State University

Dr. Cheryl Bodnar · Rowan University

Dr. Krista Kecskemety · The Ohio State University

Dr. Ryan Meuth · Arizona State University

Dr. Andrew Danowitz · California Polytechnic State University

Caitlin Lantz · Housing & Residential Life Embedded Clinical Counselor

Juvenal George · Grainger Embedded Clinical Counselor

Brian Siemann · DRES

Paul Jensen · BioE

Mariana Silva · CS

Tim Yang · CS

Ananya Cleetus · CS

Melissa Chen · CS

Ali Nunes · MatSE

Neha Prabhu · CS

Lightning Symposia Presenters

Abdu Alawini · CS

Katie Ansell · Phys

Wayne Chang · MechSE

Kerrie Douglas · Purdue University

Theresa Saxton-Fox · AeroE

Holly Golecki · BioE

Geoffrey Herman · CS

Blake Johnson · MechSE

Amanda Johnston · Purdue University

Cecilia Leal · MatSE

Negar Mehr · AeroE

Michael Nowak · CS

Andre Schleife · MatSE

Mariana Silva · CS

Tim Stelzer · Phys

Chrysafis Vogiatzis · ISE

Brian Woodard· AeroE

Abby Wooldridge · ISE

Student Panel on Instruction During COVID-19

Alycia Bhargava · CS

Robin De Lara · MatsE

Eugenia Maldonado · SED

Ifeloluwa Ositaja · AeroE

Collins Scholar Seminar Presenters

Student Kick-Off Panel

Andrew Conwell · ECE

Eugenia Maldonado · SED

Ian Ludden · CS

Faculty and Staff

Nancy Amato · CS

Jenny Amos · BioE and Illinois Carle College of Medicine

Lucas Anderson · CITL

Rohit Bhargava · BioE

Cheelan Bo-Linn · CITL

Tim Bretl · AeroE

Wayne Chang · MechSE

Jess Dalhaus · Engr Office of Research

John Gallagher · English

Philippe Geubelle · AeroE and College Admin

Faculty and Staff cont.

Lynford Goddard · ECE and IDEA

Mark Hart · Engr IT

Bobbi Hardy · Engr IT

Geoffrey Herman · CS

Keilin Jahnke · TEC

Emad Jassim · UPO

Michael Loui · Emeritus, ECE (Illinois and Purdue)

Dave Mussulman · Engr IT

Marci Pool · BioE and the Illinois Cancer Institute

John Popovics · CEE

Tim Stelzer · Phys

Shelly Schmidt · FSHN

Chris Schmitz · ECE

Mariana Silva · CS

Don Takehara · Engr Office of Research

Ross Wantland · Office of the Vice Chancellor for Diversity

Campus, College & National Awards & Recognition

--- CAMPUS ---

Paris Smaragdis · CS – 2020 Excellence in Graduate & Professional Teaching

Wade Fagen-Ulmschneider · CS – 2020 Excellence in Undergraduate Teaching—Instructional Staff

Jenny Amos · BioE – 2021 Excellence in Undergraduate Teaching

Paul Davidson · ABE – 2021 Excellence in Undergraduate Teaching

John Hart · CS –2021 Excellence in Online & Distance Teaching

--- COLLEGE ---

Arijit Banerjee · ECE – 2020 Everitt Teaching Award for Teaching Excellence

Brian Cunningham · ECE – 2021 Everitt Teaching Award for Teaching Excellence

Rizwan Uddin · NPRE – 2020 Grainger College of Engineering Teaching Excellence Award

Pinshane Huang · MatSE – 2021 Grainger College of Engineering Teaching Excellence Award

Ranjitha Kumar · CS – 2020 Rose Award for Teaching Excellence

Mats Selen · Phys – 2020 Rose Award for Teaching Excellence

Leon Liebenberg · MechSE – 2021 Rose Award for Teaching Excellence

Chandra Radhakrishnan · ECE – 2021 Rose Award for Teaching Excellence

Dallas Trinkle · MatSE – 2020 Collins Award for Innovative Teaching

Raluca Ilie · ECE – 2021 Collins Award for Innovative Teaching

--- NATIONAL ---

Geoffrey Herman · CS – IEEE Van Valkenburg Early Career Teaching Award

--- INNAUGURAL COLLEGE AWARDS---

Jenny Amos · BioE – Hahn Faculty Scholar

Karin Jensen · BioE – Hahn Faculty Fellow

Tim Bretl · AeroE – Severns Faculty Scholar

Matt West · MechSE – Severns Faculty Scholar

Craig Zilles · CS – Severns Faculty Scholar

Strategic Instructional Innovations Program (SIIP)

PrairieLearn and Course Redesign for Core CEE Intro Sequence

CEE201 and CEE202, as foundational required courses, were chosen to lead the CEE curriculum update and innovation, with a view to scaffolding to upper level courses. CEE201 is about systems engineering and economics.CEE202 is introduction to engineering risk and uncertainty through introductory probability and statistics. One of the target outcomes of the curriculum update and innovation is strengthening of computational thinking and coding skills among CEE undergraduates. Key goals of this SIIP project are to (i) support the department-wide objective of introducing coding/computational skills throughout the CEE curriculum and (ii)enable over time sustainability of implementation of course updates through simplification of class management with use of available and well-supported campus educational platforms and tools.

Teaching of coding has been integrated within the substantive material for each course, after a set of introductory practice coding sessions and assignments in the first 2-3 weeks of instruction. To support mastery and be able to test students the same way we teach them, we re-developed our course materials on the PrairieLearn (PL) platform. Currently PL hosts pre-lecture videos and quizzes, in-class worksheets, homeworks and exams. The two courses have also adopted student centered learning, within the scope of the relevant Grainger College of Engineering initiative, in summer 2020. Students watch one or two lecture videos with 5-12 min duration and answer simple quiz questions, before they go to class. During class, student teams work on worksheet problems for a deeper level of understanding of the concepts introduced in the videos, while teaching personnel are available to provide clarifications and prompts for deeper thinking. Our assessment results support an overall upward trend

regarding cognitive outcomes. In the affective domain, about half of the students report difficulty with coding throughout the three surveys they take during the semester (early-, mid-and end-of-semester). Student responses for the student-centered learning model are mixed, with some students wishing for more in class lecture time, while at the same time, a majority of students agree that working on their own enhances their learning. It is notable that students consistently assign high value to team work for their learning, since we adopted student-centered learning. Students often display confusion regarding materials residing on multiple platforms, a sentiment likely related to currently having to manage many online classes. Our future efforts need to concentrate on improved streamlining of course materials and workflows that can better accommodate both in class and online students. With a view to sustainability of course updates, instructor and teaching assistant (TA) training presents challenges of similar nature, especially for new TAs with no long-term commitments to the courses. Consideration of course design modifications for enhanced user experience needs to extend to instructing teams, as well.

Sotiria Koloutsou-Vakakis (CEE), Hadi Meidani (CEE), Eleftheria Kontou (CEE), Lei Zhao (CEE), Chris Tessum (CEE)

Facilitating Adoption of Collaborative Activities using Computer-Based Tools

The main goal of this project was the development and improvement of existing computer-based tools to facilitate collaborative and active learning activities inside and outside of the classroom. In the first year of this project we were able to: (1) implement shared assessments and group submissions in PrairieLearn; (2) develop, test and improve weekly group activities for three different courses; (3) assist other faculty outside of this research group creating group activities for their classes; (4) implement strategies to improve collaborations during these activities based on POGIL pedagogies; (5) start the implementation of POGIL roles in PrairieLearn and (6) collect a substantial amount of data (log files from PrairieLearn,

recording and observations from classroom interactions, and students' surveys) for analysis during the upcoming Summer. Initial survey results indicate that over 95% of students agree that the group activities provide a valuable learning experience, enjoy working with their groups, and are able to effectively collaborate.

Mariana Silva (CS), Abdussalam Alawini (CS), Mattox Beckman (CS), David Mussulman (EngIT), Jenny Amos (BioE), Geoffrey Herman (CS), Karin Jensen (BioE), Eric Shaffer (CS), Andre Schleife (MatSE)

Cross-Engineering Course Assessment Model for Engineering Mechanics Courses

The objective of this project is to develop a concept inventory assessment to be administered in multiple courses in the same engineering degree program. The goal of the study is to use the results of the assessment to qualify student retention of fundamental engineering concepts over several semesters, and help identify challenging concepts in the curriculum where more emphasis and repetition may be needed. A standardized assessment for multiple courses will also bring continuity and foster a sense of consistency between courses for students. The engineering courses identified for this study are TAM 251: Introductory Solid Mechanics, ME 330: Engineering Materials, and ME 371: Mechanical Design II, where TAM 251 is a pre-requisite for ME 330 and ME 371. Key course outcomes of TAM 251 that directly correlate with ME 330 and ME 371 course learning objectives were first identified, then corresponding conceptual questions were created. The assessment was implemented in the online assessment platform PrairieLearn. Students in all three courses were asked to take the concept inventory at the beginning and the end of the semester to determine the extent current TAM 251 students comprehend TAM 251 key concepts, and how well these concepts are retained in ME 330 and ME 371.The analysis of preliminary data collected showed varying degrees of consistency between student performance on specific questions against their performance on the overall assessment, which points to the need for question validation and redesign in some

cases. Future data collection and analysis will explore the validity of the concept inventory itself, and correlations between assessment performance and student grades in the three identified courses.

Wayne Chang (MechSE), Randy Ewoldt (MechSE), Brian Mercer (MechSE)

Revising the CS Introductory Programming Sequence

Introduction to Computer Science II (CS-128) uses a daily lesson pedagogy to disseminate new material to our students every day through a combination of text, video, and programming walkthroughs. Online "playgrounds" for interactive coding exercises are interspersed throughout these lessons and allow our students to actively engage presented material. These "playgrounds" provide our students with in-browser compilation, execution, and grading of code. As a result, CS-128 students are not only exposed to new material each day but have an opportunity to practice what they've learned in "playgrounds" situated directly adjacent to that material. The design and implementation of the services supporting these activities are one of the primary outcomes of our SIIP initiative. We look forward to sharing our SIIP supported work with you.

Geoffrey Challen (CS), G. Carl Evans (CS), Margaret Fleck (CS), Michael Nowak (CS), Michael Woodley (CS), Craig Zilles (CS)

ENgaGement In eNgineering Education (ENGINE)

ENGINEis a multidisciplinary community of practice dedicated to investigating pedagogies of engagement. Our goal is to move beyond traditional content delivery methods by exploring diverse teaching strategies that foster student mastery of course concepts while enhancing their emotional and cognitive engagement. Via discussions and collaborations with undergraduate and graduate students, faculty peers, learning center staff, and regular guest presenters, we strive to develop, test, and promote the relationships between engagement, cognition, and emotion and to better understand how they may inform our teaching and learning practices. Recent efforts suggest that pedagogies of engagement.

Via discussions and collaborations with undergraduate and graduate students, faculty peers, learning center staff, and regular guest presenters, we strive to develop, test, and promote the relationships between engagement, cognition, and emotion and to better understand how they may inform our teaching and learning practices. Recent efforts suggest that pedagogies of engagement can make teaching more enjoyable and learning more powerful, especially during these critical days of online delivery.

Leon Liebenberg (MechSE), Cheelan Bo-Linn (CITL), Justin Aronoff (Speech & Hearing Sci), Robert Baird (CITL), Tim Hale (Kinesiology & Community Health), Katherine LaBare (Library), H. Chad Lane (Educational Psych), Brian Mercer (MechSE), Alex Pagano (MechSE), Shelly J. Schmidt (FSHN), Saad Shehab (ScD), Ava Wolf (CITL), Taylor Tucker

Peer Mentorship via Undergraduate Learning Assistants in PHYS100 Discussion Sections

Recently, research around STEM success and retention has attended to the roles of social and motivational factors, such as feelings of belonging in a discipline, self-efficacy, and interpretations of struggle. Our project investigates ways that PHYS100 can support student development along these social and motivational factors through (i) belonging interventions, (ii) collaborative learning, and (iii) the introduction of undergraduate learning assistants in the course. To assess the impacts of these efforts, we administered pre-and post-surveys on belonging, self-efficiancy, and interpretations of struggle in Phys100 and a comparison course (Phys211), (zoom) Phys100 duscussion sections. We will share preliminary survey results and an example of how collaborative group work environments can results and an example of how collaborative group work environments can normalize academic struggle in engineering.

Eric Kuo (Phys), Gary Gladding (Phys), Morten Lundsgaard (Phys)

Early Instruction in Linear Algebra and Computational Tools in the Curricula of CS, MechSE, and the College of Engineering

The Linear Algebra SIIP project's task has been to innovate and improve instruction in concepts of linear algebra and linear structures, with the two main goals being (i) to provide substantive linear algebra instruction early on in the curriculum, and (ii) to incorporate a computational lab component, emphasizing practical applications. Now in its second year, the project has successfully implemented a new class, Math 257, now taught in parallel to Math 415 and set to replace it in the near future. This new course for sophomores offers computational lab exercises every week and makes use of modern techniques of active and collaborative learning. It also spearheads the use of PrarieLearn and collaborative learning in the larger context of mathematics classes for our student population. Initial survey data show enthusiastic student support and improved student confidence in their abilities regarding not only linear algebra, but computational tools in general.

Sascha Hilgenfeldt (MechSE), Philipp Hieronymi (Mathematics), Luke Olson (CS), Mariana Silva (CS), Matthew West (MechSE)

Excellence in Computer Engineering Education (EXCEED): Incorporating Parallel Programming Thinking in ECE Curriculum

In response to the paradigm shift in computing capabilities (especially with multicore, many core, and GPU computing capabilities), the EXCEED SIIP team has been integrating the concepts of parallel and distributive computing (PDC) into a series of existing courses (ECE 120, ECE 220, and ECE 385) following the NSF/IEEE-TCPP Curriculum Initiative on Parallel and Distributed Computing -Core Topics for Undergraduates" guideline. Giving emphasis on "early and often" is the key to success. Our goals is to introduce the concepts of PDCas small modules, programming assignments and advanced timing analysis labs as extra credits along with the existing materials in ECE 120, ECE 220, and ECE 385, before students get in to the specialized parallel computing course, ECE 408, designed for seniors. In our

presentation, we will talk about the PDC modules we developed and launched, students' participation and their performance, and the impacts these modules had on students' overall performance in the courses.

Yuting Chen (ECE), Zuofu Cheng (ECE), Kirill Levchenko (ECE), Ujjal Bhowmik (ECE)

Remote testing with PrairieLearn

PrairieLearn is an online platform for homeworks, exams, and computational exercises. It focuses on automatically creating randomized assessments and auto-grading them, so that students can repeatedly practice skills to mastery and then take secure exams on the same topics. This year the SIIP team worked on adding features and security for remote online exams, and added support for interactive coding in Jupyter Notebooks, VS Code, and similar platforms.

Tim Bretl (AE), Geoffrey Herman (CS), Craig Zilles (CS), Mariana Silva (CS), Dave Mussulman (Eng IT), Matt West (MechSE)

Interdisciplinary Methods for Research Computing: A Course for New Researchers

We developed a course for any major on campus (undergraduate and graduate) to learn how to take advantage of modern computing resources and "soft skills" in conducting their research and managing collaborators. We focus on teaching student show to reason critically using data, automate what can be automated, develop rigor and confidence in results through testing and V&V, compose a functional workflow in the context of a research application, and collaborate effectively using modern tools and project management. In our pilot run in Sp21, we had students from more than nine departments across campus participate.

Neal Davis (CS), Jake Bowers (PS/Statistics), André Schleife (MatSE), Rich Sowers (ISE), Elizabeth Wickes (Information Sciences)

Understanding the Needs and Learning Pathways of Students with Disabilities

Among all college students, students with disabilities are particularly at risk due to a high percentage of under-reporting. We conducted a survey across several large engineering and computing courses at an anonymous university to identify course components that engage students with and without disabilities. We were motivated to find opportunities for future course improvements for all students and greater equity for students with disabilities. Therefore, in the survey, we asked for both students' disability and demographics info and their usability and satisfaction with more than ten types of course modalities, including live Zoom lectures, recordings of lectures, small group discussions, instructor notes, transcripts of lectures, discussion boards, etc. The study spanned 7 different departments with a total enrollment of 1800 students and was composed of queries of early and end time points during Fall 2020. Preliminary results from 220 responses from 13 different courses showed that students with disabilities prefer recorded lecture videos with transcripts, course textbooks, and instructor notes/slides that they can engage with offline, while students without disabilities were more satisfied with office hours and lecture notes/videos. Besides, female students appeared to be less satisfied with instructor PowerPoint slides, live Zoom lectures, and discussion/lab sessions than non-female students. These results demonstrated the importance of multiple resources and supported Universal Design Principles.

Hongye Liu (CS), Jenny Amos (BioE), Lawrence Angrave (CS)

Improving Undergraduate Writing Instruction and Feedback through Professional Development of STEM Graduate-Student Teaching Assistants

Our team has been fostering a campus-wide community of practice around writing in STEM curricula. We apply a transdisciplinary action research approach, integrating interventions and research with the aims of i) adapting and developing effective pedagogies, ii) identifying effective

support structures, and iii) advancing understanding of development of STEM students' writing skills. In response to faculty requests for more support preparing teaching assistants to teach, respond to, and evaluate writing, this year we developed a new graduate-level course (ENG598 WTG). The course introduces pedagogical tools for teaching writing in STEM and assists graduate students in understanding STEM writing and improving as writers themselves. Our presentation will describe the course and introduce our methods for assessing its impacts. It will also include an overview of our full Writing Across Engineering and Science project and resources available to faculty.

S. Lance Cooper (Phys), Celia Elliott (Phys), John Gallagher (English), Blake Johnson (MechSE), John Popovics CEE), Paul Prior (English), Julie Zilles (Crop

Developing Intervention Methods that Improve Visuospatial Skills of Engineering Students

Decades of research involving many thousands of participants has consistently shown that spatial skills are one of the strongest predictors of future success in STEM coursework and STEM careers. Additionally, spatial visualization skills, especially mental rotation skills, of female students are well documented to lag behind those of their male counterparts. Fortunately, research also shows that visuospatial skills are malleable, and individuals may need different methods to practice and improve their skills. This SIIP team has developed a computer-based training platform for spatial visualization skills consisting of diverse types of multiple-choice questions and sketching exercises. We offered this training as part of a GFX course for students during their first semester on campus. Students enrolled in the course improved their scores on a standardized visualization assessment by approximately 40% from the beginning of the course compared to the end. We also included this standard visualization assessment with the other placement tests for all new students to take

assessment with the other placement tests for all new students to take before entering Grainger Engineering.

Brian Woodard (AE), Gretchen Forman (GFX), Molly Goldstein (ISE), Julia Laystrom-Woodard (AE), Tiffany Li (CS), Michael Philpott (MechSE), Angie Wolters (WIE), Ziang Xiao (CS)

Learning by Immersion: Creating Virtual Reality Labs for Electromagnetism Courses

This project involves the development of 3D visualizations of abstract concepts E&M, Vector Calculus, and Coordinate Transformations, using Virtual Reality (VR) technology in an immersive, exploratory, and engaging environment. Virtual Reality provides the means of exploration, to construct visuals and manipulable objects to represent knowledge, which in turns leads to a constructivist way of learning, in the sensethat students are allowed to build their own knowledge from meaningful experiences. In addition, using VR as a teaching tool has the potential of addressing many challenges traditional teaching usually faces, and can lead to increased student engagement while removing some of the anxiety student experience while in active learning environments.

The VR experiences are generated by Electrical Engineering and Computer Science at University of Illinois at Urbana-Champaign, which reflects the strong educational impact of this project, as it allows students to contribute to the educational experiences of their peers. Student competencies around conceptual understanding of electromagnetism topics, as well as their understanding of mathematical concepts, are measured via formative and summative assessments. To evaluate the effectiveness of VR learning, each VR experience encompasses build-in evaluation tools, such as short conceptual questions, designed to primarily measure conceptual understanding of the various topics, rather than measuring the ability to simply manipulate equations. These quizzes are part of the VR experiences, as students are allowed to access and engage in the experiment as needed in order to appropriately answer the posed questions. The assessment is set in a playful setting that acts as training

game that not only provides the context for discovery, but also reinforces the learning experience.

Here we discuss the implementation and the pedagogy of the Virtual Reality experiences to visualize concepts in E&M, Vector Calculus and Coordinate Transformations, with examples for a specific lab and student feedback with the new approach.

Raluca Ilie (ECE), Eric Shaffer (CS), Erhan Kudeki (ECE), Cynthia D'Angelo (Educational Psychology)

ILLINOIS
Grainger College of Engineering

SIIP Poster Session Schedule

SIIP Team	Poster Session 1 2:05-2:20	Poster Session 2 2:25-2:40	Poster Session 3 2:45-3:00
CEE 201-202		X	X
Collaborative Learning	X	X	
Cross-Course Assessment	X		X
CS Intro Programming	X	X	
ENGINE	X		X
LAs in Physics		X	X
Linear Algebra	X		X
Parallel Programming		X	X
Remote PrairieLearn	X		X
Research Computing		X	X
Students with Disabilities	X	X	
TA Writing	X	X	
Visuospatial	X	X	
VR		X	X