Capstone Design CONFERENCE 2024

JUNE 3–5, 2024 ▶ KNOXVILLE, TENNESSEE

Workshop Information

Workshop 2A: Tuesday, June 4, 8:30-10 am

Engineering Unleashed: It Tolls for Thee — Enhancing Student Meaning in Senior Design

Facilitator:

A. L. Ranen McLanahan (The Kern Family Foundation)

When a student team understands the potential meaning, impact, and value created by their senior design project, it fundamentally changes their approach. In this workshop, we will explore the importance of helping students define their own sense of relevance, significance, and value. Drawing on lessons from so-called entrepreneurially minded learning (EML), we will delve into these intrinsic elements of attention and motivation.

Outcomes for Participants:

- Experience Elements of Student Attention: Engage in hands-on activities that demonstrate effective methods of capturing and maintaining student attention throughout the project cycle. These experiential components will provide you with practical tools to apply in your own teaching.
- Understand the Role of EML in Enhancing Motivation: Discover how Entrepreneurially Minded Learning (EML) can boost students' intrinsic motivation by connecting the dots between academic projects and real-world implications.
- Foster Ownership and Autonomy: Explore methods to empower students to take ownership of their projects. This segment will focus on methods to help students define where and how they can influence project outcomes, increasing their commitment and satisfaction with their work.

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Workshop 3A: Tuesday, June 4, 10:30 am-12 pm

Systems Engineering Research Center (SERC) and the Acquisition Innovation Research Center (AIRC) -- Two Sources for Capstone Design Projects with US Government Customers

Facilitators:
CAPT William Shepherd (USN ret) (SERC/Stevens Institute of Technology)
Michael DeLorme (SERC/Stevens Institute of Technology)
Col. Ken Cameron (USMC ret) (SERC/Stevens Institute of Technology)

SERC's Capstone Marketplace connects capstone design students with DoD customers to engineer new hardware and software prototypes. The Marketplace has had 10 years of successful collaboration with military units and DOD organizations to provide innovative capabilities for its customers.

- Student teams create working hardware and software prototypes in a multi-discipline development effort.
- Military personnel and government officials serve as Subject Matter Experts and evaluators for student teams.
- System Engineering processes and "system" thinking are emphasized in student teams' developments.

AIRC's Innovation Capstones are new initiatives sponsored by DOD to broaden project approaches developed by the Capstone Marketplace. Innovation Capstone projects address both technical and non-technical activities needed to introduce new capabilities to government organizations. Projects are open to students in business, law, and other non-technical degree tracks. Students working in Innovation Capstone teams will pursue "Whole of Business" and "Whole of Government" aspects in their project research.

- Multi-discipline student teams, in technical and non-technical tracks of study
- Undergraduate, graduate, and mixed student teams (grad and undergrad)
- Project objectives identified by government customers and Innovation Capstone managers
- Business operations are emphasized. Student teams address organization, financing, management, contracting, production, regulatory, environmental, and other aspects of new capability developments

The session will include Capstone project perspectives, outcomes, and feedback from SERC and AIRC managers. Current Capstone faculty, students, and government customers will participate as available. Discussions on Capstone objectives, content, and processes are anticipated with the Capstone Design community.

Workshop 3B: Tuesday, June 4, 10:30 am-12 pm

Enhancing University Capstone Projects through Model-Based Design with MATLAB & Simulink

Facilitator: Ahmed Mekky (MathWorks)

Model-Based Design (MBD) enables educators to transform capstone design projects by leveraging virtual prototyping and rapid iteration. With MATLAB and Simulink, educators can guide students towards a more integrated, efficient, and collaborative development process, mirroring industry's multidisciplinary collaboration and rapid prototyping. MBD enables virtual concept validation, streamlined design, and faster, more accurate iteration before physical implementation, with:

- Faster Design Cycles: Simulink allows virtual prototyping for rapid testing and modification, reducing hardware iterations and prototyping costs.
- Improved Learning: Visual models enhance understanding of system dynamics, multi-domain interactions, and holistic system behavior, leading to fewer design flaws and rework.
- Industry-Ready Skills: Students learn industry-standard tools and model-based development workflow, including potentially generating embedded code to control hardware. This fosters skills applicable to project management in engineering environments.
- Better Communication: Models facilitate collaboration and discussion of design ideas, reducing misunderstandings and costly errors.

This workshop demonstrates how MATLAB and Simulink can be utilized for a more efficient and innovative capstone project experience. Participants will gain a foundational understanding of MBD and its importance in engineering and research. The workshop explores how MBD with MATLAB and Simulink fosters multidisciplinary learning by integrating components from multiple domains, including mechanical, electrical, and software, through case studies of successful projects.

Participants will explore virtual project execution through Simulink simulations and collaborative tools, discovering the advantages of virtual prototyping. The workshop covers the crucial transition from models to real-world applications on supported hardware platforms like Arduino and Raspberry Pi, enabling participants to guide students through the entire capstone project process, from design and simulation to hardware deployment.

Participants will gain a foundational understanding of how to leverage MATLAB and Simulink for efficient, innovative, and multidisciplinary capstone design projects, preparing students with the necessary skills and tools to tackle contemporary engineering problems effectively and innovatively across multiple disciplines. Attendees are welcome to bring their laptops to keep up with the examples being demonstrated.

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Workshop 4A: Tuesday, June 4, 6-7:30 pm

Ethical Review: Incorporating Ethics Toolkits into Computer Science and Software Engineering Capstones

Facilitators:
Matthew Bietz (University of California, Irvine)
Hadar Ziv (UC Irvine - Information & Computer Science School)

Modern society is increasingly concerned with the ethical consequences of information technology. It is incumbent on us as teachers to ensure that students in computer science, software engineering, user experience design, and related disciplines have the knowledge and skills to assess the ethics of the systems and algorithms they create. Ethical concerns are often ignored by professional developers, or treated as an after-thought; students must be engaged in order to encourage consideration of ethical implications. This is especially true in Capstone courses, where project goals and requirements often come from external sources. An innocuous project for course registration or student admission could have FERPA implications or even lead to biased results. A healthcare project could affect medical decisions or patient privacy. And software for self-driving cars can injure or kill pedestrians.

Practices like ethical review, ethical risk sweeping, ethics post-mortems, and ethics impact assessments are becoming common in industry. At UC Irvine, we have been incorporating these tools into capstone courses to help students be confident in the ethical status of their deliverables and to provide experience with assessing, discussing, and mediating ethical concerns.

In this workshop, we will introduce a variety of ethical design toolkits, including the Ethical Explorer Pack, the Values Sensitive Design Envisioning Cards, and the Ethics in Engineering/Design Practice Toolkit. Hands-on activities will give participants the opportunity to explore how these tools work by applying them to case studies from our recent capstone courses. We will discuss the benefits, challenges, and best practices for using these toolkits in capstone courses. Participants will be invited to share their own experiences and tips for incorporating ethical training into Capstones.

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Workshop 4B: Tuesday, June 4, 6-7:30 pm

Using Generative AI to Optimize the Performance Feedback Process and Enhance the Development of Teamwork Behaviors in Capstone Engineering Students

Facilitators:
Susan Sajadi (Virginia Tech)
Mark Huerta (Virginia Tech)
Marie Paretti (Virginia Tech)
Robin Ott (Virginia Tech)

This workshop will share an approach for how generative AI can augment the peer evaluation process in capstone courses by using self-evaluation and peer evaluation comments to produce personalized performance feedback letters for engineering students. The specific goals are:

- Understand the challenges and limitations of commonly used peer evaluation systems, such as CATME, TEAMMATES, etc., in providing students with timely, high-quality feedback on their teamwork behaviors.
- Learn strategies for eliciting effective peer feedback.
- Become aware of a method that helps automate the production of AI performance feedback letters at scale.
- Explore how generative AI augments the original peer feedback using de-identified student examples.
- Consider and discuss recommendations for reflection prompts and preliminary findings of data collected that highlight student perceptions of their personalized feedback, including how it impacts their teamwork behaviors.

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Workshop 4C: Tuesday, June 4, 6-7:30 pm

Agile in the Classroom

Facilitators:
Emily Larsen (Washington State University)
Darin Aaby (Washington State University)

This workshop is designed to provide training on the Agile Scrum framework and how it can be implemented in a variety of capstone design courses. Parts of the workshop are presented as if to a classroom of students, giving attendees an opportunity to practice scrum meetings and backlog management. Workshop attendees are also given a sample project sprint map with opportunity to modify the sprint map to fit different projects and class structures.

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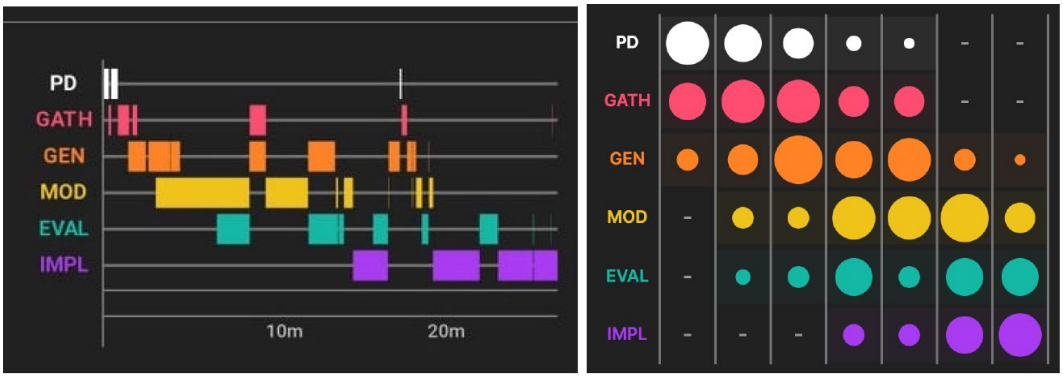
Workshop 4D: Tuesday, June 4, 6-7:30 pm

Design Signatures in the Wild: Making the Invisible Visible

Facilitators:
Susannah Howe (Smith College)
Eli Patten (University of Washington)
Reid Bailey (University of Virginia)
Micah Lande (South Dakota School of Mines & Technology)

In addition to applying an engineering design process, a learning outcome of most capstone design programs is to develop students' awareness of the design process itself. This can be difficult since engineering students often focus on the design deliverables as tasks rather than artifacts of an ongoing process. The intent of this workshop is to teach participants how to build self-awareness for their students and themselves through self-tracked design timelines ("design signatures"). With these design signatures visible in front of them, students and faculty can better reflect on an otherwise invisible design process.



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Workshop 4E: Tuesday, June 4, 6-7:30 pm

Improving Teamwork Skills of Undergraduate Engineering Students

Facilitators:
Carlos Corleto (Texas A&M University)
Joanna Tsenn (Texas A&M University)
Jonathan Weaver-Rosen (Texas A&M University)
Mohammad Waqar Mohiuddin (Texas A&M University)
Shadi Balawi (Texas A&M University)

It is well known that teamwork is one of the critical skills for success in engineering education and beyond. Engineering students' teamwork experiences begin in their first year and culminate in their senior capstone design projects. However, due to the emphasis on technical knowledge and skills demanded by engineering curricula, students often do not receive formal teamwork training. To address this issue, a group of faculty started to develop the "Undergraduates Improving Teamwork Skills" (UNITES) project to help students develop teamwork skills in their undergraduate curricula. The UNITES project consists of three training modules aimed at helping students develop practical teamwork skills in their sophomore, junior, and senior years. The project also involves assessment and student feedback.

This workshop introduces the UNITES project, share its implementation to date, and conducts an active learning demonstration of Module 2. Like the students, workshop participants will complete an individual activity and combine their results into a shared team solution. Next, participants will watch a video with examples of failures and misconceptions that can result from ineffective communication. The video also highlights cross-cultural communication. Participants will then complete a working styles assessment and reflect on how communication and interactions between their working styles may differ and how they can adapt to different situations. Finally, they will connect the information provided in the video to the initial activity, reflecting on their style and that of the other participants in their team, and complete a short reflection activity. The workshop will close with a discussion of the UNITES project to obtain feedback to improve the project and how it may be implemented in the participants' engineering curricula.

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Workshop 4F: Tuesday, June 4, 6-7:30 pm

Using Pro-Forma Financials to Assess Financial Viability of Engineering Design Projects

Facilitators:
Megan Conrad (University of Detroit Mercy)
Nassif Rayess (University of Detroit Mercy)
Molly Laird (University of Detroit Mercy)
Mary McCall (University of Detroit Mercy)

Pro-forma financial statements provide a means for projecting future expenses and revenues for a start-up company. This workshop outlines a method for using pro-forma financials and creating a profit-loss statement for assessing financial viability of a proposed capstone design.

The workshop will provide a framework for accomplishing the following learning outcomes:

1) Develop understanding and ability to accurately predict real-time and future business costs.
2) Provide a process/tools for identifying estimated costs associated with building a business.
3) Yield financial data backed by sources for data-driven decision making.
4) Create graphs/data for compelling pitch to internal and external investors