Welcome

On behalf of the Mechanical Engineering Department at the University of Michigan, we would like to welcome you to the Fall 2016 Mechanical Engineering Undergraduate Symposium (MEUS).

MEUS provides a venue for our exceptional undergraduate students to showcase their projects from RISE (Research, Innovation, Service and Entrepreneurship) as well as their Design and Manufacturing X50 and X55 courses.

In RISE, our undergraduate students leverage our state-of-the-art facilities working side-by-side with internationally-renowned faculty to tackle cutting edge projects that impact our society. Projects range from transportation systems to mechanical system design and manufacturing, robotic systems, biological and fluidic systems, manufacturing processes and systems, and mechanical art!

Running concurrent to the MEUS poster and presentation sessions is Design Expo. Have an exciting day cheering for the ME 250 teams in their project competition, view the ME 350 four-bar linkage that automatically positions a cup to catch falling balls, and engage with our seniors as they display their ME 450 / ME 455 capstone design projects.

The goal of MEUS is to provide an intimate forum for a vibrant exchange of ideas and results within our University of Michigan ME Community. We are thrilled with the exceptional response. Our sincere appreciation goes to all the students and their RISE/X50/X55 mentors for choosing to share their very best work at MEUS. The planning of MEUS has been a significant team effort of faculty, staff and students. Our thanks go to them for assembling such an outstanding event.

Kon-Well Wang, PhD
Tim Manganello/BorgWarner Department Chair and
Stephen P. Timoshenko Collegiate Professor of Mechanical Engineering
MEUS Planning Committee

MEUS Technical Planning Committee

Diann Brei
Claus Borngnokke
David Dowling
Amy Hortop
Chinedum Okwudire
Kenn Oldham
Gabor Orosz
Jwo Pan
Noel Perkins
Mike Umbriac
Alan Wineman

MEUS Co-Chair
Poster Judge
Session Chair
ME 450 Course Coordinator
MEUS Co-Chair / Session Chair / Poster Judge
Session Chair
Session Chair
Poster Judge
Session Chair
ME 250 Course Coordinator / ME 350 Course Coordinator
Poster Judge

MEUS / RISE Organizers

Ken Arbogast-Wilson
Kristel Briney
Rachel Casanova
Grey Cichy
Michele Goci
Jacob Hayward
Tim Moore
Katie Morningstar
Lisa Rogers
Nikki Taylor-Vargo
Angela Wegrecki

RISE: Research, Innovation, Service, and Entrepreneurship

Through the RISE program, mechanical engineering undergraduate students leverage our state-of-the-art facilities working alongside internationally-renowned faculty to tackle cutting edge projects that impact our society. The Mechanical Engineering Undergraduate Symposium (MEUS) is the accumulation of the students’ work.

During the day, seniors in ME 490 will present their RISE projects in 20 minute presentations. Everyone is welcome to attend these sessions and ask probing questions!

Sophomores and juniors conclude their projects with a poster session during the evening reception, where students will be available to discuss their projects in detail. The posters will also be on display during the day, if you are unable to attend the reception.

The public is invited to peruse the posters, attend presentations, and interact with the students throughout the day.
# Schedule at a Glance

**December 8, 2016**

## Session 1: Transportation Systems
- **Room:** 1642 GGB
- **Time:** 9:20am-10:20am

## Session 2: Mechanical System Design and Manufacturing
- **Room:** 2636 GGB
- **Time:** 10:20am-11:40am

## Session 3: Robotic Systems
- **Room:** 2540 GGB
- **Time:** 10:40am-12:00pm

## Session 4: Biological and Fluidic Systems
- **Room:** 2636 GGB
- **Time:** 12:20pm-1:20pm

## Session 5: Manufacturing Processes and Systems
- **Room:** 2636 GGB
- **Time:** 1:40pm-3:20pm

## Session 6: Mechanical Art: Giant Rubik’s Cube
- **Room:** 2540 GGB
- **Time:** 3:20pm-4:20pm

## Poster Session and ME Reception
- **Location:** BorgWarner Galleria
- **Time:** 4:30pm-5:30pm
  - Reception open to ME students participating in Design Expo or MEUS.

---

**Session 1: Transportation Systems**  
**Session Chair:** Gabor Orosz  
**Room:** 1642 GGB

- **9:20 AM**  
  - Optimization for Maintenance of High-Speed Trains  
  - **Student:** Zhiyi Chen  
  - **Instructor:** Jun Ni

- **9:40 AM**  
  - Tip In Water Injection for Diesel NOx Reduction  
  - **Student:** Matthew McNamara  
  - **Instructor:** Andre Boehman

- **10:00 AM**  
  - Explore Knitting of Smart Materials to Create Changeable and Interactive Product Surfaces  
  - **Student:** Lucy Zhuang  
  - **Instructor:** Diann Brei  
  - Co-Instructor: Jonathan Luntz
### Session 2: Mechanical System Design & Manufacturing

**Session Chair:** David Dowling  
**Location:** 2636 GGB

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Student</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:20 AM</td>
<td>Secure Cloud Manufacturing</td>
<td>Dan Xu</td>
<td>Kira Barton</td>
</tr>
<tr>
<td>10:40 AM</td>
<td>ElectriFit</td>
<td>Brandon Hazelton</td>
<td>Michael Thouless</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>Scent Release Mechanism</td>
<td>Arianna Carley</td>
<td>Karl Grosh</td>
</tr>
<tr>
<td>11:20 AM</td>
<td>Utility of Design Heuristics in Novice Designer Idea Generation</td>
<td>Laura Murphy</td>
<td>Shanna Daly</td>
</tr>
</tbody>
</table>

### Session 3: Robotic Systems

**Session Chair:** Kenn Oldham  
**Location:** 2540 GGB

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Student</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:40 AM</td>
<td>Improving the Functionality of the E-Nable Raptor Reloaded Hand Through Redesign and Validation</td>
<td>Jane Modes</td>
<td>C. David Remy</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>Effect of an Articulated Spinal Joint on the Gait Dynamics of Quadrupeds</td>
<td>William Yang</td>
<td>C. David Remy</td>
</tr>
<tr>
<td>11:20 AM</td>
<td>Design and Modeling of a Highly-Compliant Micro-Robot</td>
<td>Yudong Chen</td>
<td>Kenn Oldham</td>
</tr>
<tr>
<td>11:40 AM</td>
<td>A Scaled Connected Vehicle Experiment Using Ground Robots</td>
<td>Weilun Peng</td>
<td>Gabor Orosz</td>
</tr>
<tr>
<td>Time</td>
<td>Session Title</td>
<td>Student</td>
<td>Instructor</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>12:20 PM</td>
<td>Stress/Strain Testing on Patient Ovarian Cancer Cells</td>
<td>John Bohenick</td>
<td>Krishna Garikipati</td>
</tr>
<tr>
<td>12:40 PM</td>
<td>Microfluidic Mechanical Cell Lysis</td>
<td>Joshua LeVay</td>
<td>Katsuo Kurabayashi</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>Sake Bomb Entry Fluid Dynamics</td>
<td>Alexander Coryell</td>
<td>Eric Johnsen</td>
</tr>
<tr>
<td>1:40 PM</td>
<td>Design and Fabrication of a Step Stage for Wafer Scanners</td>
<td>Bowen Zeng</td>
<td>Chinedum Okwudire</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Nano-Fabrication of MoS2 Biosensor with Cycle-Wise Examination</td>
<td>Joseph Oh</td>
<td>Xiaogan Liang</td>
</tr>
<tr>
<td>2:20 PM</td>
<td>Spatial Atomic Layer Deposition Station</td>
<td>Andre Brooks</td>
<td>Neil Dasgupta</td>
</tr>
<tr>
<td>2:40 PM</td>
<td>Design of a Gas Delivery System for a Spatial Atomic Layer Deposition Station</td>
<td>Ezinwo Weli</td>
<td>Neil Dasgupta</td>
</tr>
<tr>
<td>3:00 PM</td>
<td>Ball Milling Then Hot Pressing as a Candidate Synthesis Method for Chalcogenide Perovskites</td>
<td>Christopher Bauer</td>
<td>Jeff Sakamoto</td>
</tr>
</tbody>
</table>
### Session 6: Mechanical Art: Giant Rubik’s Cube

**Session Chair:** Noel Perkins  
**Meeting Room:** 2540 GGB

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Student</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:20 PM</td>
<td><strong>Mechanical Art: Giant Rubik’s Cube</strong></td>
<td>Ryan Kuhn</td>
<td>Noel Perkins</td>
</tr>
<tr>
<td>3:40 PM</td>
<td><strong>Mechanical Art: Giant Rubik’s Cube</strong></td>
<td>Douglas Nordman</td>
<td>Noel Perkins</td>
</tr>
<tr>
<td>4:00 PM</td>
<td><strong>Mechanical Art: Giant Rubik’s Cube</strong></td>
<td>Jason Hoving</td>
<td>Noel Perkins</td>
</tr>
</tbody>
</table>

### Poster Session and ME Reception

**Location:** BorgWarner Galleria  
**Time:** 4:30 PM - 5:30 PM

Mechanical Engineering is pleased to conclude the day’s activities with a reception to celebrate a successful semester for the ME Community and to announce the RISE and X50 Award winners.

**ME 390 Posters**

**Redesign of Compliant Joint for Improved Precision and Speed in Nanopositioning Stages**  
Student: Xingjian Liu  
Instructor: Chinedum Okwudire

**Inflatable Devices for Automotive Applications**  
Student: Xiangyi Ye  
Instructor: Diann Brei  
Co-Instructor: Jonathan Luntz

**Properties of the E-Jet Process at Various Environmental Conditions**  
Student: Ryan Tepper  
Instructor: Kira Barton

**Pneumatically Controlled Digital Microfluidics**  
Student: Parker Haffey  
Instructor: Jianping Fu

**Solar-Powered Electric Bicycle Trailer**  
Student: Maria Roma  
Instructor: Kazu Saitou

**Splint Design for a Piezoelectric Cardiovascular Sensor for Detecting Intradialytic Hypotension**  
Student: Danielle Park  
Instructor: Kenn Oldham

**Inflatable Devices for Automotive Applications**  
Student: Varghese Vadakumcherry  
Instructor: Diann Brei  
Co-Instructor: Jonathan Luntz
RISE Awards

We are pleased to hold three competitions for the Mechanical Engineering Undergraduate Symposium: Best Poster, Best Session, and Best Paper.

Best Poster Award
All RISE ME 290 and ME 390 students will automatically be entered to compete for the Best Poster Award. The best poster will be judged by faculty and graduate students based upon quality of the project work, the poster, and the presentation of the work.

Winners of the award will be honored at the reception with a certificate and monetary award.

Best Session Award
All RISE ME 490 students that present at MEUS will be automatically entered to compete for the Best Session Award. Judges will attend the presentations and will select the best of each session based upon the quality of the presentation and the project work.

Winners of each award will be honored with a certificate.

Best Paper Award
The top RISE award is the Best Paper Award. The judges will review the final papers from the winners of the Best Session Award to select the best overall project based upon the quality of the project work and the presentation in both oral and written forms.

The winner of the Best Paper Award will be honored with a certificate and monetary award.

Collaborating Programs and Student Organizations

We are very grateful for the assistance of our collaborating programs and student organizations in promoting RISE and helping to plan and execute MEUS.

The ME Graduate Council (MEGC) contributed as judges for our RISE awards. ASME and PTS were instrumental in the "retro video game" reception theme and activities. Please make sure to stop by during the reception to play a variety of retro video games.

ASME (American Society of Mechanical Engineers)
ASME is an organization devoted to the enrichment of the UM Mechanical Engineering experience. Through seminars with professors, corporate information sessions, and visits to companies, ASME allows students to see the applications of classroom learning in the real world. Additionally, ASME works to create a community within the Mechanical Engineering Department by helping with events such as the ME Pancake Breakfast, Halloween Bash, and the ME T-shirt Contest. ASME provides an opportunity for students to meet and network through various social events, intramural sports, and community service. To learn more about our chapter, visit our website at http://www.umich.edu/~asme/.

PTS (Pi Tau Sigma)
Pi Tau Sigma is the international mechanical engineering honor society. Juniors and seniors are invited to join based on their academic achievements, and are initiated after showing desired involvement with the society, department, and college. You can see PTS members around campus grilling brats in the warm weather, tutoring in the FLC, hosting corporate info sessions, volunteering at department events such as the Halloween Bash and Pancake Breakfast, and on the ice for IM broomball. To learn more about our chapter, visit our website at http://www.umich.edu/~ptsme/.
Collaborating Programs and Student Organizations

MEGC (ME Graduate Council)
MEGC serves as a liaison to voice the opinions, problems and issues of the graduate students in the Department of Mechanical Engineering. The council engages in organizing student-led research seminars, technical workshops, professional development events, outreach, mentorship, and social activities. Additionally, MEGC aids the department in activities such as recruiting weekends, new student orientation, etc. Visit our website at http://me.engin.umich.edu/Gradcncl/index.html.

College of Engineering Honors Program
The College of Engineering Honors Program provides a unique opportunity for highly-motivated students to reach their full potential, both inside and outside of the classroom. Specialized academic requirements create an enriched learning environment that caters to the various disciplines of the College of Engineering. Honors students work closely with faculty and student mentors, facilitating strong intellectual bonds and personal growth, culminating in the creation of an Honors Capstone project. Students from Engineering Honors will be presenting their Honors Capstone project at the MEUS in December 2016. Visit our website at http://honors.engin.umich.edu/.

Multidisciplinary Design Program (MDP)
The College of Engineering MDP offers students a wide variety of long-term, team-based experiential learning opportunities. We partner with research faculty and industry leaders to bridge the gap between the classroom and professional experience. Additionally, MDP pilots new models for experiential learning and conducts educational methods research to improve the quality of the experiential learning opportunities we offer. Students participate in MDP by joining a Faculty Research or externally-sponsored project, earning academic credit through a student competition team, or attending a technical workshop. The program is focused on engineering projects but is open to students from over eleven different schools and colleges across campus. To learn more about our program and academic minor, visit our website at http://mdp.engin.umich.edu.

ME X50 and X55 Projects
The Michigan Engineering Design Expo is held concurrently with the Mechanical Engineering Undergraduate Symposium (MEUS).

The Design Expo showcases the achievements of our students in engineering design and prototyping, and demonstrates applications of their studies that solve real-world problems.

Students in mechanical engineering design and manufacturing courses (ME 250, 350, 450, and 455), will present their projects for the Design Expo during the ME Undergraduate Symposium.
In ME 250, the students learn engineering drawing; CAD and solid modeling; use of mechanical elements such as bearings, gears, and springs; engineering analysis; and manufacturing processes. They get hands-on experience using machine tools such as a milling machine, lathe, laser cutter, and water jet cutting machine, as well as a 3D printer.

In the course project, the students put their knowledge to use. They work in teams of four to design and build a remote-controlled machine that must compete to move objects in an arena. The students learn to choose a strategy, generate concepts for the design, perform analysis on their concept, and then design the individual components. They are given a kit of materials which they can use to manufacture the components using the student machine shop. They test and validate their designs before the competition, which is held during the MEUS.

In ME 350, the emphasis is on the model-based design of mechanical and mechatronic systems. The students learn the design of mechanisms, the design of mechanical elements for strength, and mechatronics. Mechatronics is the synergistic integration of mechanics, electronics, control theory, and computer science within product design and manufacturing, in order to improve and/or optimize its functionality.

In the course project, students work in teams of four to design, build, and test a four-bar linkage to automatically position a cup to catch falling balls. The students use a motor and transmission to move the linkage, limit switches to calibrate the linkage position, and an encoder to keep track of the position. The students learn to program an Arduino microcontroller board (running a PID controller) to receive the signals from the sensors and make decisions based on these signals, and send the output to the motor driver to position the cup to catch the balls. The Arduino also reads a color sensor to decide where to put each ball after it is caught.
ME 450 Design and Manufacturing III
Mechatronics Lab/Blue Lounge/EECS Building
12:00 PM - 4:00 PM

ME 450 is the capstone in our unique design and manufacturing sequence. Students are taught to approach open-ended design challenges through processes, to manage and work in collaborative teams, and to synthesize and apply diverse engineering knowledge to the design and manufacturing of real mechanical systems. Teams of 3-5 students work together on a semester-long design problem, typically from industry, or faculty research, and present a working prototype at Design Expo. Students are exposed to the design process from eliciting user needs and generating concepts through to prototype validation.

ME 450 projects can be viewed in the Mechatronics Lab, the Blue Lounge, and the EECS Building as part of the Design Expo from 12:00 pm - 4:00 pm.

ME 455 / DESC1 501 Analytical Product Design
ME Assembly Room
12:00 PM - 4:00 PM

In this intense immersive class, students are taught design of technical products from a multidisciplinary perspective that includes engineering, art, psychology, marketing, and economics. Using a decision-making framework, emphasis is placed on quantitative methods through building mathematical models and accounting for interdisciplinary interactions. Students work in teams of 4-6 students to elicit product specification through consumer and market research, generate concepts and engineer a detailed design to meet the product specifications, build and validate a proof-of-concept prototype and develop a business plan with financial analysis. Students reveal their product designs at Design Expo.
ME Project Sponsors

The Mechanical Engineering Department would like to thank our Fall 2016 ME 250 and 450 project sponsors:

**ME 250**
- Shell

**ME 450**
- Professor Mihaela Banu
- Professor Neil Dasgupta
- Mr. Garrick Hu
- Dr. Jacob Joseph
- Professor Kannatey-Asibu
- Dr. Thomas Konney
- Dr. Grant Kruger
- Dr. Ibrahim Mohedas
- Dr. Virginia Nelson

- Dr. Samuel Obed
- Professor Johannes Schwank
- Professor Joe Trumpay
- Dr. Cornelius Turpin
- Dr. Benjamin Viglianti
- Ms. Brenda Vyletel
- Ms. Maria Young
- Mr. Robert Weinstein

**U-M Orthotics and Prosthetics Center**
**U-M Global Health Design Initiative**
**U-M Laboratory for Innovation in Global Health Technology**

Maps

GG Brown Building - ME 450 Projects
Maps

EECS Building - ME 450 Projects

Maps

GG Brown Building - ME 455 Projects

<table>
<thead>
<tr>
<th>ME 450 Team</th>
<th>Project Title</th>
<th>Project Sponsor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team 1</td>
<td>Automotive Seating</td>
<td>Adient</td>
</tr>
<tr>
<td>Team 3</td>
<td>Development of Micro-PCM for Automotive Interiors</td>
<td>Toyota</td>
</tr>
<tr>
<td>Team 5</td>
<td>Conjugate Laser Cutting and Creasing</td>
<td>Packsize</td>
</tr>
<tr>
<td>Team 6</td>
<td>Packaging Distribution</td>
<td>Packsize</td>
</tr>
<tr>
<td>Team 8</td>
<td>Carbon Capture Canister</td>
<td>EPA</td>
</tr>
<tr>
<td>Team 12</td>
<td>Oil Lubrication System</td>
<td>Roush Industries Inc.</td>
</tr>
<tr>
<td>Team 13</td>
<td>Breil Systems</td>
<td>Whirlpool</td>
</tr>
<tr>
<td>Team 14</td>
<td>Selection and Testing of a Bearing Material for a Throttle Body Butterfly Valve</td>
<td>GW Link</td>
</tr>
<tr>
<td>Team 15</td>
<td>Development of System to Monitor, Record, and Display Load and Torsional Windup</td>
<td>Farmespag Clutch</td>
</tr>
<tr>
<td>Team 16</td>
<td>Performance Improvement Development</td>
<td>U.M Baja Team</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ME 455 Team</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>dTravel Studio</td>
<td>cubo</td>
</tr>
<tr>
<td>Team M4U</td>
<td>IndiGO Brake</td>
</tr>
<tr>
<td>KIT 101</td>
<td>PetFree</td>
</tr>
<tr>
<td>Team Get on Up</td>
<td>Get on' Up</td>
</tr>
<tr>
<td>Team Funshades</td>
<td>Skyleaf</td>
</tr>
<tr>
<td>Team Design Kitchen</td>
<td>Innobrewer</td>
</tr>
<tr>
<td>Team Grocery Techs</td>
<td>QuickLift</td>
</tr>
<tr>
<td>Team Earbuddies</td>
<td>The Earbuddy</td>
</tr>
<tr>
<td>R3</td>
<td>All-in-One Home Waste Disposal System</td>
</tr>
<tr>
<td>Team Awesome</td>
<td>The Trash Buggy</td>
</tr>
</tbody>
</table>
Maps
Borg Warner Galleria

U of M North Campus