MECHANICAL ENGINEERING
UNIVERSITY OF MICHIGAN

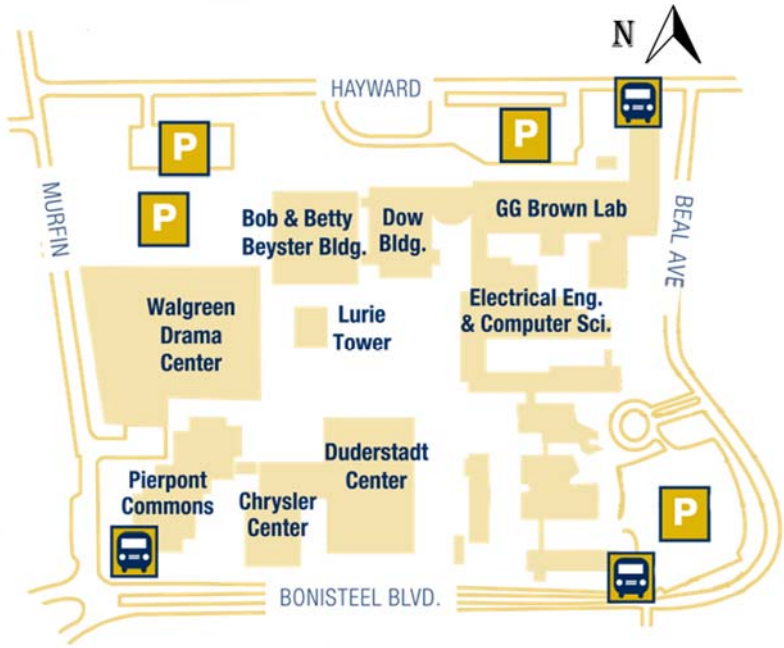
MECHANICAL ENGINEERING UNDERGRADUATE SYMPOSIUM

APRIL 14, 2016

COLLEGE OF ENGINEERING
MECHANICAL ENGINEERING
UNIVERSITY OF MICHIGAN

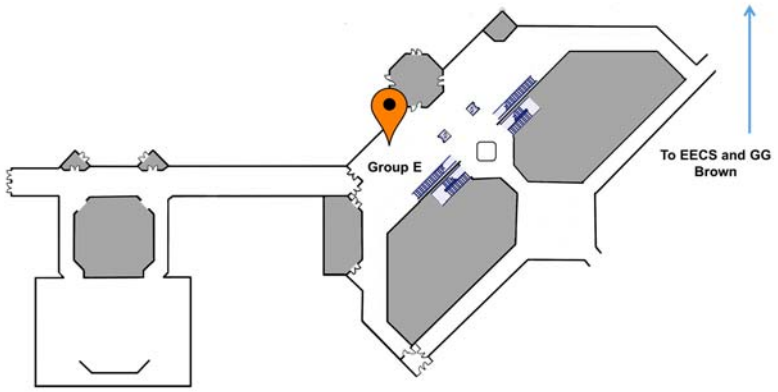
GG Brown BorgWarner Galleria

U of M North Campus



Maps

Duderstadt Center - ME 450 Projects



Group E ME450/ ENG490 Projects in Duderstadt Atrium

Waterwheel for use in Rural Gabon	REFRESCH
ADI Castings for Weight and Cost Reduction	Joyworks/Applied Process
Strain-sensitive Coatings	Prof. Shtein
Plastics Recycling Machine	Prof. Kamatey-Asibu
Mobility Aid for Children	Gandee Family
Tethered "Pico" Satellite	MiTEE
Deployable Solar Photovoltaic Array for Satellite Applications	Prof. Gilchrist
Improved Hearing Aids for Children	Prof. Shtein
Automating Skin Biopsy Specimen Preparation	Dr. Fisher/ Ken Calderone
3D Haptic Feedback "Smart Cane"	Dr. Lee/ Dr. Ojeda
One Way Lacrimal Bypass Tube	Kellogg Eye Center
Wheelchair Kinematic Design Concept	Dr. Dwamena

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Welcome

On behalf of the Mechanical Engineering Department at the University of Michigan, we would like to welcome you to the Winter 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 courses.

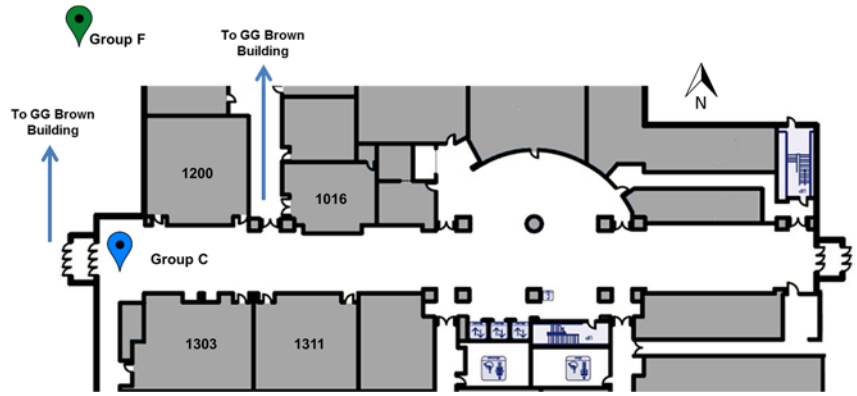
In RISE, our undergraduate students leverage our state-of-the-art facilities working side-by-side with internationally-renowned faculty to tackle cutting edge projects that impact our society. Projects range from medical device development to manufacturing processes, advanced structures, connected design, mechanics, Formula SAE Car, medical device design, automotive analysis and testing, and manufacturing systems!

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 mirror to reflect several laser beams onto a target, and engage with our seniors as they display their ME 450 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 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

EECS Building - ME 450 Projects



Group F	Outside- Between EECS and GG Brown	
ME450/ ENG490	Lacrosse Project	U-M Athletic Department

Group C	Electrical Engineering and Computer Science (EECS)	EECS Atrium
ME 450 Team 1	Glow Plug Manufacturing Device	Nanosystems
ME 450 Team 5	Training Wheel Disconnect Mechanism	FatWheels
ME 450 Team 12	Development of Inflatable Structures	Toyota
ME 450 Team 13	Light-weighting of Sledge Hockey Sled	ADAPT
ME 450 Team 14	Upper Extremity Terminal Device	VA Hospital
ME 450 Team 18	Clothing Storage for Child's Room	KID
ME 450 Team 22	Rehabilitation Balance Device	Harbor Rehabilitation
ME 450 Team 23	Glow Plug Manufacturing Device	Nanosystems
ME 450 Team 24	Lower Extremity Terminal Device	VA Hospital
ME 450 Team 27	Rehabilitation Balance Device	Harbor Rehabilitation
ME 450 Team 28	Passive Dynamic Walkers	Prof. Remy
ME450/ ENG490	Design of Automated Slicer	ICG

Maps

GG Brown Building - ME 450 Projects

Group A	Assembly Room	1510 GG Brown
ME 450 Team 2	Armrest Positioning Mechanism	JCI
ME 450 Team 3	Automated Flap Closing Mechanism	Packsize
ME 450 Team 6	Improvements to In-process Shipping Containers	Alcoa
ME 450 Team 9	Energy-Efficient Road Speed Fan Operation	EPA
ME 450 Team 10	Design of Small Scale Aquaculture System	REFRESCH
ME 450 Team 11	Use of Waste Heat for Longer Growing in Greenhouse	White Lotus Farms
ME 450 Team 25	Racing Transmission Temperature Regulation	Baja Racing SAE

Group B	Mechatronics Lab	1345 GG Brown
ME 450 Team 4	Development of Snow Making Nozzle	SMI/Boyne Mountain
ME 450 Team 7	Wire Tension Measurement Device	AMI/ Ultra Electronics
ME 450 Team 8	Improved Electrospinning Apparatus	Lahann Lab
ME 450 Team 15	Minimally Invasive Surgery Exhibit for Hands-On Museum	FlexDex Surgical
ME 450 Team 17	Capillary Break-up Rheometry (CBR) Device	Schultz Lab
ME 450 Team 19	Breast Pump for Low-resource Settings	Global Health
ME 450 Team 20	Subcutaneous Contraception Insertion Device	Global Health
ME 450 Team 21	Subcutaneous Contraceptive Removal Device	Global Health

Group D	IP Room	1531A GG Brown
ME 450 Team 26	CAC Condensation	
ME 450 Team 16	Single Port Minimally Invasive Surgery	

MEUS Planning Committee

MEUS Technical Planning Committee

Diann Brei	MEUS Chair / Poster Judge
Claus Borgnakke	Poster Judge
David Dowling	Session Chair
Amy Hortop	ME 450 Course Coordinator
Jonathan Luntz	Session Chair
Chinedum Okwudire	Session Chair
Kenn Oldham	Session Chair
Gabor Orosz	Session Chair
C. David Remy	Session Chair
Alan Wineman	Session Chair
Mike Umbriac	ME 250 Course Coordinator / ME 350 Course Coordinator

MEUS / RISE Organizers

Ken Arbogast-Wilson	Tim Moore
Kristel Briney	Katie Morningstar
Rachel Casanova	Nikki Taylor-Vargo
Jacob Hayward	Angela Wegrecki
Linh Huynh	Michele Wong

Graduate Student Judges

Ali Attari	Keval Ramani
Shantonio Birch	Amirreza Rastegari
Jintao Chen	Asma Sharafi
Yeonjoon Cheong	Mohsen Taheri
Tyler Dillstrom	Rutvik Topkar
Molong Duan	Emma Treadway
Alison Hake	Shinuo Weng
Saeed Kazemiabnav	Brian Worthmann
Ahmet Mazacioglu	Yevgeniy Yesilevskiy
Payam Mirshams	Deokkyun Yoon
Amir Nankali	

Schedule at a Glance

1. Medical Device Development
Session Chair: Jon Luntz
Room: 2636 GGB
9:20am-10:20am

2. Manufacturing Processes
Session Chair: Gabor Orosz
Room: 2540 GGB
10:20am-11:20am

4. Connected Design
Session Chair: Chinedum Okwudire
Room: 2636 GGB
11:20am-12:20pm

6. Formula SAE Car
Session Chair: Gabor Orosz
Room: 2540 GGB
12:00pm-1:20pm

8. Automotive Analysis and Testing
Session Chair: David Dowling
Room: 2636 GGB
3:00pm-4:00pm

Poster Session
BorgWarner Galleria
4:00pm-5:30pm

ME Project Sponsors

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

ME 250
Shell

ME 450

Ms. Lynn Bashore
Mr. Brad Bowden
Mr. Steven Donoghue
Dr. Ben Dwamena
Prof. Galen Fisher
Gandee Family
Mr. John Hoard
Mr. Ibrahim Mohedas
Coach John Paul
Ms. Stacy Ramcharan
Prof. David Remy
Prof. Bill Schultz
Prof. Steve Skerlos
Prof. Joe Trumpey
Ms. Brenda Vyletel
Ms. Maria Young

U-M Laboratory for Innovation in Global Health Technology

April 14, 2016

ME 450 Design and Manufacturing III
GG Brown Building/EECS Building/Duderstadt Ctr

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 4-5 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 GG Brown Building, EECS Building, and the Duderstadt Center as part of Design Expo from 12:00 pm -4:00 pm.

3. Advanced Structures
Session Chair: C. David Remy
Room: 1642 GGB
10:20am-11:20am

5. Mechanics
Session Chair: Kenn Oldham
Room: 3350 GGB
11:20am-12:20pm

7. Medical Device Design
Session Chair: Alan Wineman
Room: 2636 GGB
1:40pm-2:40pm

9. Manufacturing Systems
Session Chair: Chinedum Okwudire
Room: 2540 GGB
3:00pm-4:20pm

ME Reception
BorgWarner Galleria
4:00pm-5:30pm
Open to ME students participating in Design Expo or MEUS

RISE: Research, Innovation, Service, 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!

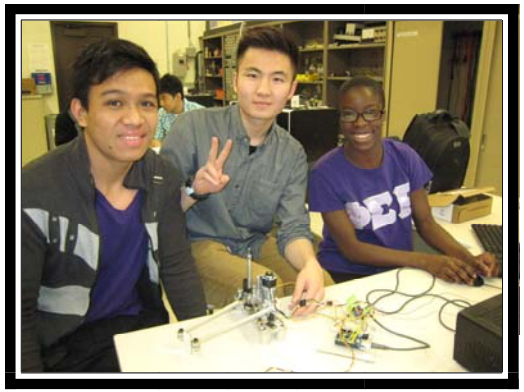
Sophomores and juniors conclude their projects with a poster session during the evening reception, where students will be available to discuss their projects in detail. The posters will also be on display during the day, if you are unable to attend the reception.

The public is invited to peruse the posters, attend presentations, and interact with the students throughout the day.

ME 350 Design and Manufacturing II
BorgWarner Galleria
1:00 PM - 3:00 PM

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 mirror to reflect several laser beams onto a target. The students use a motor and transmission to move the linkage, an infrared sensor to stop the motion if an object is in the way, 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 mirror for each firing of the lasers.



ME 250 Design and Manufacturing I
BorgWarner Galleria
1:00 PM - 3:00 PM

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.

RISE Sessions

Session 1. Medical Device Development
Session Chair: Jon Luntz
Room: 2636 GGBA

9:20 AM **Heat Generation in Schanz Pin Insertion**
STUDENT: Taylor Zdanowski
INSTRUCTOR: Albert Shih

9:40 AM **Hip Exoskeleton Design and Development for Better Control Methods and Assistive Walking**
STUDENT: Shaun Marshall
INSTRUCTOR: C. David Remy

10:00 AM **Structure and Corrosion Behavior of a Magnesium Alloy for Bio-Implants**
STUDENT: Lindsay Purvis
INSTRUCTOR: Alan Wineman

ME X50 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, and 450), will present their projects for the Design Expo during the ME Undergraduate Symposium.

RISE Awards

We are pleased to hold three competitions for this year's 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 MEUS 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.

Session 2. Manufacturing Processes

Session Chair: Gabor Orosz

Room: 2540 GGB

10:20 AM **Effects of Chip Morphology in High-Throughput Drilling of Compacted Graphite Iron**
STUDENT: Wei Yau Tee
INSTRUCTOR: Albert Shih

10:40 AM **Reducing Settling Time of Nanopositioning State in Point-to-Point Motion by a Novel Bearing**
STUDENT: Xingjian Liu
INSTRUCTOR: Chinedum Okwudire

11:00 AM **3D Printing for Prototypes of Thin-Film PZT/ Polymer Microrobots**
STUDENT: Clark Teeple
INSTRUCTOR: Kenn Oldham

Session 3. Advanced Structures

Session Chair: C. David Remy

Room: 1642 GGBA

10:20 AM **Multi-Stable Cellular Origami Structures**
STUDENT: Kevin Eckstein
INSTRUCTOR: Kon-Well Wang

10:40 AM **DE Actuated Automotive HVAC Louvers**
STUDENT: Nicholas Manzek
INSTRUCTOR: Diann Brei
CO-INSTRUCTOR: Jon Luntz

11:00 AM **Mathematical and Numerical Modeling of Advanced Tent Fabrics**
STUDENT: Erica Dombro
INSTRUCTOR: Greg Hulbert

Participating ME Student Organizations and Programs

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 academic activities such as student-led seminars, social activities such as coffee hours, technical workshops, professional development events, outreach, and mentorship activities. Additionally MEGC aids the department in activities such as recruiting weekends, new student orientation, etc.

College of Engineering Honors Program

The College of Engineering Honors Program at the University of Michigan 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 April 2016. Visit our website at http://honors.engin.umich.edu/.

Participating ME Student Organizations and Programs

We are very grateful for the assistance of our 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 fun Star Wars reception theme and entertaining activities. Please make sure to stop by during the reception to play an “out-of-this-world” round of ME Jeopardy!

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 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/.

Session 4. Connected Design

Session Chair: Chinedum Okwudire
Room: 2636 GGB

11:20 AM **System Design for Connected Vehicle System with Non-Linearity and Time Delay**
STUDENT: Jiexin Chen
INSTRUCTOR: Gabor Orosz

11:40 AM **Device Motion Design for Consumer Experience in Automotive Applications**
STUDENT: Yifan Ding
INSTRUCTOR: Diann Brei
CO-INSTRUCTOR: Jon Luntz

12:00 PM **Data Analysis for Human Subject Study on Interest Level**
STUDENT: Dazhi Wang
INSTRUCTOR: Dawn Tilbury
CO-INSTRUCTOR: Emily Provost

Session 5. Mechanics

Session Chair: Kenn Oldham

Room: 3350 GGBA

11:20 AM **Feature Evaluation for EMG Based Load Classification**
STUDENT: Anne Gu
INSTRUCTOR: Kira Barton

11:40 AM **Microstructure-Deformation Relationships in AM Ti Alloys**
STUDENT: Jason Krystek
INSTRUCTOR: Samantha Daly

12:00 PM **High-Resolution 3D Optical Microscopy Using Structured Illumination**
STUDENT: Yang Zhang
INSTRUCTOR: Wei Lu

Poster Session and ME Reception

BorgWarner Galleria

4:00 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

Supplementing LED Grow Lighting with Reflected Sunlight
STUDENT: Lauren Sklarsky INSTRUCTOR: Jesse Austin-Breneman

Spatial Atomic Layer Deposition
STUDENT: Andre Brooks INSTRUCTOR: Neil Dasgupta

Heat and Vibration Reduction of a Planar Scanning Stage During Step Motion
STUDENT: Bowen Zeng INSTRUCTOR: Chinedum Okwudire

Spray Imaging Analysis of Cetane Reference Fuels
STUDENT: Archit Gupta INSTRUCTOR: Andre Boehman

Device Motion Design for Consumers in Automotive Applications
STUDENT: Brian Kalinowski INSTRUCTOR: Diann Brei
CO-INSTRUCTOR: Jon Luntz

Category Coding and Paradigm Relatedness in Engineering Design
STUDENT: Jennifer Wenger INSTRUCTOR: Shanna Daly

Session 9. Manufacturing Systems

Session Chair: Chinedum Okwudire

Room: 2540 GGB

3:00 PM **A Continuous Model for a Serial Line in Manufacturing System**
STUDENT: Yuxin Chen
INSTRUCTOR: Jun Ni

3:20 PM **Design and Construction of an Atomic Layer Deposition Reactor**
STUDENT: Daniel Cruz
INSTRUCTOR: Neil Dasgupta

3:40 PM **Two-Axis Servo-System Hardware Upgrade and Manufacture of Interfacing Circuits and Data Converter Board**
STUDENT: Heath Ahlers
INSTRUCTOR: Galip Ulsoy
CO-INSTRUCTOR: Dr. Azad Ghaffari

4:00 PM **Conversion of Commercial 3D Printer to E-Jet Printer**
STUDENT: Ryan Tepper
INSTRUCTOR: Kira Barton

Session 6. Formula SAE Car

Session Chair: Gabor Orosz

Room: 2540 GGB

12:00 PM **Aerodynamic Parameter Analysis for a Formula SAE Vehicle**
STUDENT: Tristan Mackethan
INSTRUCTOR: Jesse Austin-Breneman

12:20 PM **Handling Characteristics Correlation of a Formula SAE Vehicle Model**
STUDENT: Jason Ye
INSTRUCTOR: Jesse Austin-Breneman

12:40 PM **Sensitivity Studies for Track Testing of a Formula SAE Car**
STUDENT: Peter Karkos
INSTRUCTOR: Jesse Austin-Breneman

1:00 PM **Analysis of Critical Chassis Parameters for a Formula SAE Car**
STUDENT: Christopher Fowler
INSTRUCTOR: Jason Austin-Breneman

Session 7. Medical Device Design

Session Chair: Alan Wineman

Room: 2636 GGBA

1:40 PM **Cell Phone Based Miniaturized Coagulation Monitoring Platform for Point-of-Care Diagnosis**
STUDENT: David Peyer
INSTRUCTOR: Jianping Fu

2:00 PM **Bamboo Crutch Design for Developing Communities in Zambia**
STUDENT: Neil Syal
INSTRUCTOR: Panos Papalambros

2:20 PM **Bamboo Crutch Design for Developing Communities in Zambia**
STUDENT: Eamon Whalen
INSTRUCTOR: Panos Papalambros

Session 8. Automotive Analysis and Testing

Session Chair: David Dowling

Room: 2636 GGB

3:00 PM **Simulation Based Study of Size and Positioning for Novel Exhaust Catalyst System**
STUDENT: Sriram Sivakumar
INSTRUCTOR: Andre Boehman
CO-INSTRUCTOR: John Hoard

3:20 PM **Multi-Cylinder Engine Ethanol Blend Knock Limit Testing**
STUDENT: Brady Worden
INSTRUCTOR: Margaret Wooldridge

3:40 PM **Chassis Rigidity Analysis for a Formula SAE Racecar**
STUDENT: Hubbard Velie
INSTRUCTOR: Jesse Austin-Breneman