4-18-2017

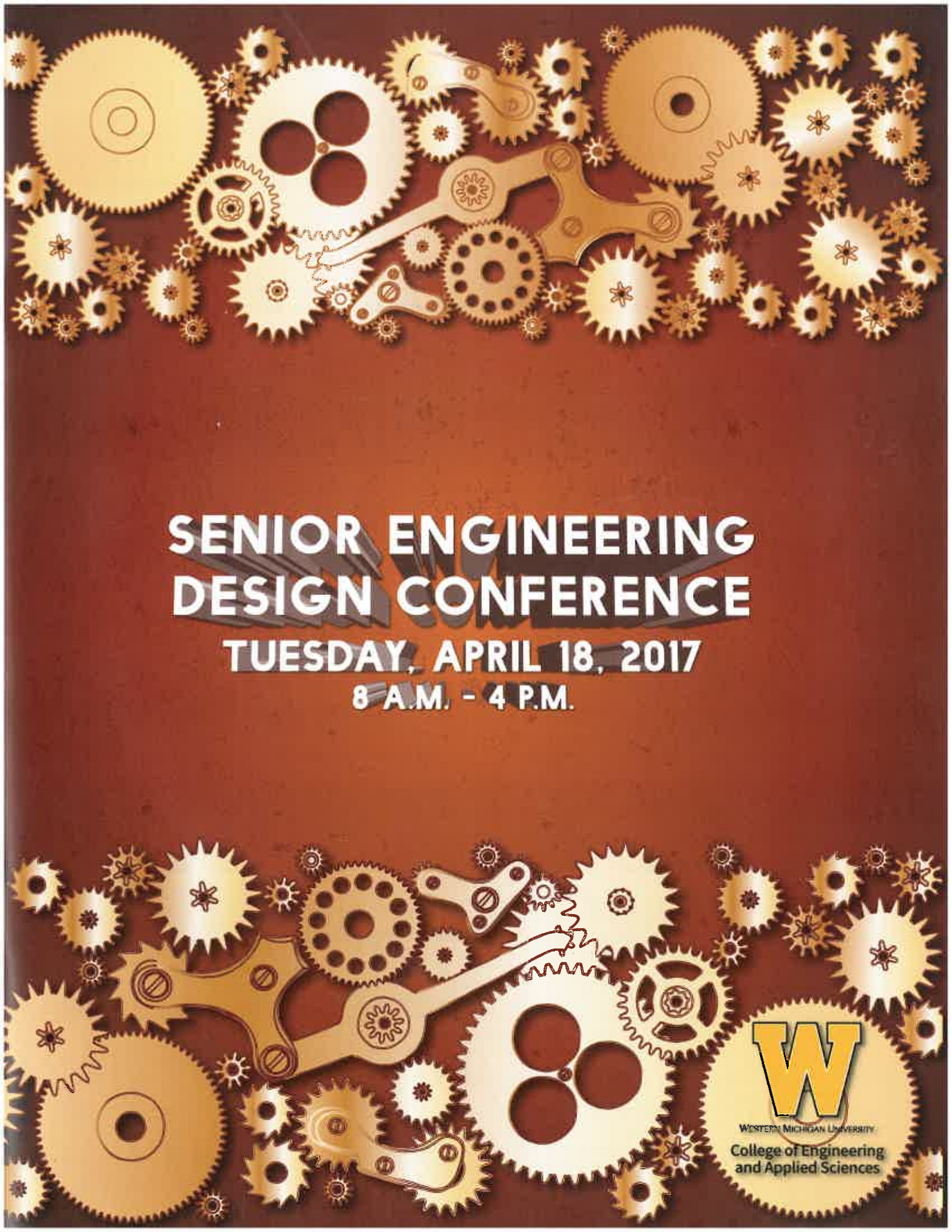
# 60th Conference on Senior Engineering Design

College of Engineering and Applied Sciences

# SENIOR ENGINEERING DESIGN CONFERENCE

## TUESDAY, APRIL 18, 2017

8 A.M. - 4 P.M.



Western Michigan University
College of Engineering and Applied Sciences

# Conference on Engineering Design Projects

You are invited to attend the sixtieth Conference on Senior Engineering Design Projects. The conference will be held from **8:00 a.m**. to **4:30 p.m., Tuesday, April 18, 2017** at the College of Engineering and Applied Sciences on the Parkview Campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry. The conference is free and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the College Circle in front of the building and then park in lot P-2.

**Parking** is available in the ramps behind the College of Engineering and Applied Sciences. There is no charge for parking for those attending the Conference.

**Presentations begin on the hour and half hour.** Please do not enter a room after a presentation has begun.

## Session locations, times, and page number for project descriptions:

| | | | |
|---|---|---|---|
| Chemical and Paper Engineering | D-208 | 8:00 a.m. – 4:30 p.m. | pg. **5** |
| Civil and Construction Engineering | D-115 | 9:00 a.m. – 11:30 a.m. | pg. 10 |
| Computer Science | D-202 | 8:30 a.m. – 11:30 a.m. | pg. 12 |
| Electrical and Computer Engineering | D-204 | 9:00 a.m. – 4:00 p.m. | pg. 15 |
| Engineering Design, Manufacturing, and Management Systems | D-201 | 8:00 a.m. – 12:00 p.m. | pg. 20 |
| Industrial and Entrepreneurial Engineering & Engineering Management | D-212 | 10:00 a.m. – 12:00 p.m. | pg. 23 |
| Mechanical and Aerospace Engineering A | D-109 | 8:30 a.m. – 4:30 p.m. | pg. 25 |
| Mechanical and Aerospace Engineering B | D-210 | 8:30 a.m. – 4:00 p.m. | pg. 30 |

A lunch break is scheduled from 12 p.m. to 1 p.m. There is a café available on site.

**For more information about the conference**, call Tamara Bergman at (269) 276-3248.

Brochure available electronically at:
**wmich.edu/engineer/news/seniors**

| TIME | ROOM/DEPARTMENT | | TOPIC |
|---|---|---|---|
| 8:00 | D-208 | ChP | STATISTICAL ANALYSIS OF PAPER MACHINE PRODUCTIVITY |
| | D-201 | EDMMS | MOLDFLOW INTEGRATION FOR AUTOMOTIVE DESIGN |
| 8:30 | D-208 | ChP | MICRO PARTICLE RETENTION AID IN DRAINAGE OF SLUDGE |
| | D-202 | CS | C'S PERFECT TIE SALES WEBSITE SERVICES |
| | D-201 | EDMMS | AUTOMATED 7MM BALL PLUG STAKING STATION FOR ABS BRAKE VALVE |
| | D-109 | MAE A | LETHAL REAGENT VIAL OPENING SYSTEM |
| | D-210 | MAE B | FATIGUE TESTING OF MATERIALS |
| 9:00 | D-115 | CCE | CEAS STUDENT CENTER EXPANSION |
| | D-208 | ChP | PAPER EXPANSION QUALITY TEST |
| | D-202 | CS | ROOM FINDER APPLICATION |
| | D-204/205 | ECE | AUTOMATED PANCAKE MAKER USING DIGITAL IMAGES |
| | D-201 | EDMMS | CARBON FIBER COMPOSITE JET SKI PARTS |
| | D-109 | MAE A | THE USE OF FIXED WINGED PROPELLER DRIVEN AIRCRAFT ON MARS |
| | D-210 | MAE B | 3D MODELING, PROTOTYPING, AND STRUCTURAL ANALYSIS OF AN AUTOMOTIVE INFERIOR FRAME STRUCTURE<br>PRESENTATION CLOSED TO THE PUBLIC |
| 9:30 | D-115 | CCE | STORY POINT SENIOR LIVING FACILITY SITE DEVELOPMENT |
| | D-208 | ChP | ANALYSIS OF A WATER RESERVOIR HEAT EXCHANGER |
| | D-202 | CS | WMU SOLAR CAR PERFORMANCE SIMULATOR |
| | D-204/205 | ECE | VERTICAL TAKEOFF AND LANDING FOR FIXED-WING UAV |
| | D-201 | EDMMS | RESEARCH AND DEVELOPMENT OF A SYNTHETIC MUSCLE |
| | D-109 | MAE A | BIOGAS SEPARATOR AND STORAGE TANK |
| | D-210 | MAE B | ORBITAL SEPARATION AND PROPAGATION SIMULATION |
| 10:00 | D-115 | CCE | SWARTZ CREEK GENERAL RETAIL STORE |
| | D-208 | ChP | REPLACEMENT OF MANUAL NUTSCHES WITH A SELF-CONTAINED DRYING SYSTEM |
| | D-202 | CS | WEBSITE DEVELOPMENT WITH GSA 508 COMPLIANCE |
| | D-204/205 | ECE | SOLAR ENERGY GENERATION AND CONVERSION LAB STATIONS |
| | D-201 | EDMMS | SOPS AND WORK CENTER PROCESS IMPROVEMENTS OF SPRINKLER ASSEMBLY LINES |
| | D-212 | IEE | INTERNATIONAL STUDENT APPLICATION PROCESS IMPROVEMENT |
| | D-109 | MAE A | COMPRESSOR FOR BIOGAS PURIFICATION SYSTEM |
| | D-210 | MAE B | IMPROVEMENT OF RECIPROCATING AIR COMPRESSOR VALVE DESIGN |
| 10:30 | D-115 | CCE | TEXAS TOWNSHIP NON-MOTORIZED TRAIL IMPROVEMENTS<br>NEW WORK CENTER OPTIMIZATION |
| | D-208 | ChP | PALERMO PIZZA POINT OF SALE |
| | D-202 | CS | PAPER-BASED OPTICAL GLUCOSE METER |
| | D-204/205 | ECE | TOOL SELECTION PROGRAM FOR ASSEMBLY OPERATIONS |
| | D-201 | EDMMS | IMPLEMENTATION OF AN IMPROVED INVENTORY CONTROL SYSTEM |
| | D-212 | IEE | 3-AXIS MAGNETORQUER FOR CUBSAT |
| | D-109 | MAE A | POWERED WHEELCHAIR OPERATION FIXTURE FOR A VIRTUAL |
| | D-210 | MAE B | REALITY TESTING ENVIRONMENT |
| 11:00 | D-115 | CCE | WMU FLOYD HALL UNDERGRADUATE LAB |
| | D-208 | ChP | OPTIMIZATION OF POP-TART PRODUCTION |
| | D-202 | CS | SITE ACCESS CHECKPOINT APPLICATION |
| | D-204/205 | ECE | FULLY AUTONOMOUS ROOMBA WASTE COLLECTION ADD-ON |
| | D-201 | EDMMS | HIGH PRECISION 3D PRINTER |
| | D-212 | IEE | PARAPLEGIC TRANSFER AND INDEPENDENT MOBILITY |
| | D-109 | MAE A | DESIGN OF A CUBESAT SEPARATION MECHANISM |
| | D-210 | MAE B | ASEPTIC FREEZE DRY SHELF REMOVAL DEVICE |
| 11:30 | D-208 | ChP | ENERGY MODELING OF PRODUCTION LINE TO PRODUCE A BAKED SNACK |
| | D-202 | CS | VEHICLE NAVIGATION USING A MICROSOFT KINECT |
| | D-204/205 | ECE | SUNSEEKER DISPLAY MODIFICATION |
| | D-201 | EDMMS | HUMAN-POWERED HYDRAULIC VEHICLE |
| | D-212 | IEE | DECANT WORKSTATION STANDARDIZATION |
| | D-109 | MAE A | YEAST HARVESTING AND STORAGE SYSTEM FOR COMMERCIAL BREWING |
| | D-210 | MAE B | INSTRUMENTED ENDURANCE TEST STAND FOR A PNEUMATIC ACTUATOR |
| 1:00 | D-208 | ChP | ENZYME ENHANCED REFINING OF FIBERS |
| | D-204/205 | ECE | NFPA FPV CHALLENGE ELECTRICAL CONTROL SYSTEM |
| | D-109 | MAE A | DESIGN AND DEVELOPMENT OF A FORMULA SAE POWERTRAIN |

| | | | |
|---|---|---|---|
| | **D-210** | **MAE B** | **PREVENTING CONCUSSION WITH INNOVATIVE SMART HELMET** |
| **1:30** | **D-208** | **ChP** | **OPTIMIZATION OF A SOLVENT RECOVERY PROCESS BY THEORETICAL MODELING** |
| | **D-204/205** | **ECE** | **DATA ANALYSIS & FEEDBACK SYSTEM FOR WMU SOLAR GARDENS** |
| | **D-109** | **MAE A** | **CRIMP DESIGN FOR NEW HUMPHREY PRODUCTS VALVE** |
| | **D-210** | **MAE B** | **VALIDATION OF THE MK6 AEROSHIP THROUGH FLIGHT TESTING** |
| **2:00** | **D-208** | **ChP** | **HIGH Ph WASTEWATER MITIGATION** |
| | **D-204/205** | **ECE** | **BRAIN-COMPUTER INTERFACE** |
| | **D-109** | **MAE A** | **ENERGY HARVESTING FOR THE WHITE CANE** |
| | **D-210** | **MAE B** | **AERODYNAMIC DRAG REDUCTION FOR TRACTOR-TRAILERS** |
| **2:30** | **D-208** | **ChP** | **DESIGN ANALYSIS OF AN ENERGY EFFICIENT POWER PLANT** |
| | **D-204/205** | **ECE** | **SENSOR INTERFACES: INTELLIGENT SURGICAL BOX TRAINER** |
| | **D-109** | **MAE A** | **LASS UNMANNED AERIAL SYSTEM** |
| | **D-210** | **MAE B** | **DESIGN OF AN ASME SECTION VIII PRESSURE VESSEL** |
| **3:00** | **D-208** | **ChP** | **COMPARISON OF BIO-MASS TO BIO-OILS REACTOR SYSTEMS** |
| | **D-204/205** | **ECE** | **TORSION ELEMENT TEST BENCH** |
| | **D-109** | **MAE A** | **REPRINTER** |
| | **D-210** | **MAE B** | **PROPELLANT TANK AND FEED SYSTEM FOR WESTERN AEROSPACE LAUNCH INITIATIVE** |
| **3:30** | **D-208** | **ChP** | **REACTOR DESIGN FOR POLYETHER SYNTHESIS** |
| | **D-204/205** | **ECE** | **LEAPDUINO CHECKERS** |
| | **D-109** | **MAE A** | **PHOTOVOLTAIC POWERED UNMANNED AERIAL SYSTEM** |
| | **D-210** | **MAE B** | **PROCESS TO ACHIEVE FAST LOL** |
| **4:00** | **D-208** | **ChP** | **RECYCLING DEINKING SLUDGE WITH THE USE OF ADHESIVES** |
| | **D-109** | **MAE A** | **AIR PRESSURE DECAY TESTER FOR MECHANICAL SEALS** |

**THANK YOU**

The College of Engineering and Applied Sciences is grateful to these sponsors that have provided or cooperated in Senior Engineering Design Projects being presented in April 2017. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

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**CHEMICAL AND PAPER ENGINEERING**
Session Chair – Andrew Kline, Ph.D.
Room D-208

**STATISTICAL ANALYSIS OF PAPER MACHINE PRODUCTIVITY**
by: *Lance McCauley*
Sponsor: None
Faculty Advisor: Raja Aravamuthan, Ph.D.
8:00 a.m. – 8:25 a.m.

Productivity, as measured by uptime percentage and the acceptance rate, of a multi-ply Fourdrinier machine, had decreased over time, indicating that the process had become less efficient. These metrics determine overall machine efficiency, a critical measurement of how the machine is running. Statistically analyzing the trends in the historical data for uptime and acceptance in conjunction with process data including grades produced, machine variables, and reason codes for downtime and rejection allowed for determination of areas that needed corrective actions. Identifying major reason codes and taking corrective actions resulted in higher machine productivity through an increase in uptime and product acceptance.

**MICRO PARTICLE RETENTION AID IN DRAINAGE OF SLUDGE**
by: *Jacob Daniel Marshall*
Sponsor: Kemira: John VanDerkolk
Faculty Advisor: Raja Aravamuthan, Ph.D.
8:30 a.m. – 8:55 a.m.

Waste water sludge retentions were low at a paper mill and adding strain on an undersized waste water facility. In order to improve sludge collection and provide a better end product a dual polymer retention aid was tested. Mediums other than paper sludge were studied for comparison. Different orders of addition and products were tested to determine the optimal program and dosing. A designed set of experiments was then conducted on the machine to see if similar results could be achieved. The end result leads to a higher quality product with lowered transportation and energy costs on the dewatering process.

**PAPER EXPANSION QUALITY TEST**
by: *Paul Spencer Coury, Saurabhi Punhani, Giancarlo Soto, and Andrew James Tilman*
Sponsors: United States Gypsum Corporation Otsego Paper: Erik Bock, Henry Krell, and John McNames
Faculty Advisor: Dania Alsaid, Ph.D.
9:00 a.m. – 9:25 a.m.

Defects that arise in paperboard production, such as warping, impact the quality and appearance of the final product. Previously, paper expansion tests were performed at the beginnings and end of each reel of paper produced. However, the apparatus used in testing was mechanical and had inherent error introduced by the operator and/or the equipment itself. By designing a new method of testing paper expansion that better replicates the conditions that occur during paperboard production more consistent and accurate measurements were obtained. With the results from this test, it was possible to provide better quality control for the end use of the paper.

**ANALYSIS OF A WATER RESERVOIR HEAT EXCHANGER**
by: *Gregory Pelletier*
Sponsor: Graphic Packaging: Manny Garza and Ana Perez
Faculty Advisor: Andrew Kline, Ph.D.
9:30 a.m. – 9:55 a.m.

Process water temperature control in a machine reservoir is crucial to maintain speed in the paper making process. Process upsets can result in freshwater make-up which causes the water temperature to drop. The feasibility of a heat exchanger to control water temperature of the paper machine reservoir during upset conditions was evaluated. To reduce process water temperature variability a heat exchanger was sized and the effects of its implementation analyzed to determine the economic costs and benefits associated with its addition.

**REPLACEMENT OF MANUAL NUTSCHES WITH A SELF-CONTAINED DRYING SYSTEM**
by: *Brookelyn Cosner, Jason Meichtry, Muhammad Siddiqui, and Paulina Yu*
Sponsor: Pfizer Inc., Nick Muller, Eric Smith, and Zach Wolf
Faculty Advisor: Dania Alsaid, Ph.D.
10:00 a.m. – 10:25 a.m.

Manual nutsche filters offer filtration to a large variation of isolation needs. Their drawbacks include variations in drying times and operator and product exposure. A self-contained drying system was evaluated to eliminate operator's exposure to the product as well as the products exposure to the environment. Operator's safety is the principal objective of this process improvement. Our recommendation includes a comprehensive economic evaluation of each incremental investment objective.

**NEW WORK CENTER OPTIMIZATION**
by: *Chris Gilbert, Myriah Kahlmorgan, Dylan Porter, and Clarissa Stanton*
Sponsor: Amway: Nancy Beard, Mark Carlson, Bret Nordland
Faculty Advisor: Andrew Kline, Ph.D.
10:30 a.m. – 10:55 a.m.

Within the cosmetics division of Amway, two new production lines have been designed, installed, and are operational, producing 7 different products. These lines combine both new and repurposed equipment from a previous production facility, with a total investment of $4.5MM. Operational data has suggested that there are process optimization opportunities to increase throughout and efficiency. By identifying various losses and incorporating analyzation techniques such as time studies the team will report on the optimal system changes and upgrades.

**OPTIMIZATION OF POP-TART PRODUCTION**
by: *Trent Emlaw, Kanwinder Gill, Brian Puckett, and Matthew Toney*
Sponsor: Kellogg Company
Faculty Advisor: Andrew Kline, Ph.D.
11:00 a.m. – 11:25 a.m.

The use of outdated equipment for pastry production is a common issue in the food industry which offers many options for potential improvements. Changes to the system for pastry production were done by analyzing the line's equipment data. This helped locate the best places for improvements. These modifications involved reducing the line's downtime, wasted product, operating costs, and maintenance costs. Several improved systems were developed after the mass and energy balances were calculated for the existing system. A cost analysis was developed from these balances for the systems based on the available options found through discussions with vendors.

**ENERGY MODELING OF PRODUCTION LINE TO PRODUCE A BAKED SNACK**
by: *Ibrahim Alnaghmoush, Derek Childers, Dylan Davis, and Adam Fritz*
Sponsor: Kellogg Company
Faculty Advisor: Andrew Kline, Ph.D.
11:30 a.m. – 11:55 a.m.

Sustainability is an important area of engineering for both environmental considerations and increasing profitability. An energy map of an industrial process was created to determine the energy use per pound of finished product. Using this map cost savings and energy reduction opportunities were identified. An economic analysis was performed in order to determine which opportunities were the highest worth to the company. No negative impacts to product safety, people safety, or product quality were allowed from these opportunities. These opportunities could help improve sustainability of the production process and increase productivity.

**ENZYME ENHANCED REFINING OF FIBERS**
by: *David Thoms*
Sponsor: None
Faculty Advisor: Dewei Qi, Ph.D.
1:00 p.m. – 1:25 p.m.

In the production of paper, retaining fiber fines in the sheet is something that is desired in order to improve machine run ability by reducing the amount of fines that accumulate in the white water. Pulp was treated using a combination of enzymes, mechanical refining, and retention aids in order to determine the effect that enzymes have on the retention and drain ability of the sheet. This was accomplished using a Brit jar to simulate drainage on a paper machine, followed by measuring the turbidity of water that drained through the screen.

**OPTIMIZATION OF A SOLVENT RECOVERY PROCESS BY THEORETICAL MODELING**
by: *Emerson Denny, Shannon O'Dell, Matthew Van Ness, and Ryan Winkels*
Sponsor: Kalsec® Inc.; David Gordon and Mark Nelson
Faculty Advisor: Dania Alsaid, Ph.D.
1:30 p.m. – 1:55 p.m.

Various Solvents are used in the production of spice extracts. These solvents can be recovered and reused, which reduces the need to continuously purchase solvent. An existing solvent separation column will be upgraded and its operating conditions modified in order to optimize solvent recovery for seven different feed stream compositions. Column upgrades were modeled, and the process was simulated using Aspen Plus® software to find optimum column conditions in order to maximize solvent recovery for each feed composition.

**HIGH Ph WASTEWATER MITIGATION**
by: *Cody Fridley, Andrew House, William Morrow, and Emily Wenson*
Sponsor: Kalsec® Inc.; Steve Kuhnert and Sarah Davis
Faculty Advisor: Dania Alsaid, Ph.D.
2:00 p.m. – 2:25 p.m.

Waste water sent from a dynamic processing facility to Kalamazoo Water Reclamation Plant must meet a pH pre-treatment regulation of 12.5 S.U. or below. Data from the effluent were collected by Plant operations and the City of Kalamazoo, which show a historical tendency to exceed this regulation standard. Although the specific cause of these occurrences remains unknown, the company's commitment to the city and our community's environment makes it a priority for this facility to implement a change to decrease future occurrences of waste water effluent of high pH. Through historical analysis of pH-altering materials, standard operating procedures, and process economics the most environmentally conscientious, cost effective, and technically feasible pH mitigation was proposed.

**DESIGN ANALYSIS OF AN ENERGY EFFICIENT POWER PLANT**
by: *Edwina Dennis and Joel Freimark*
Sponsor: None
Faculty Advisor: Andrew Kline, Ph.D.
2:30 p.m. – 2:55 p.m.

The AIChE National Student Design Competition problem is a chemical engineering design problem developed by a team of chemical engineers from industry and academic. It is available to chemical engineering departments as one means of testing chemical engineering design skills. This presentation will focus on optimizing flow rates to improve overall energy performance for a coal generated power plant.

**COMPARISON OF BIO-MASS TO BIO-OILS REACTOR SYSTEMS**
by: *Brett Keizer and Jessica McGowen*
Sponsor: None
Faculty Advisor: Andrew Kline, Ph.D.
3:00 p.m. – 3:25 p.m.

The AIChE National Student Design Competition problem is a chemical engineering design problem developed by a team of chemical engineers from industry and academia. It is available to chemical engineering departments as one means of testing chemical engineering design skills. This presentation will focus on the solution for a design problem in topic area of interest to the student design team.

**REACTOR DESIGN FOR POLYETHER SYNTHESIS**
by: *Ziad Ibrahim and Stephen Norton*
Sponsor: None
Faculty Advisor: Andrew Kline, Ph.D.
3:30 p.m. – 3:55 p.m.

The AIChE National Student Design Competition problem is a chemical engineering design problem developed by a team of chemical engineers from industry and academic. It is available to chemical engineering departments as one means of testing chemical engineering design skills. The team will present their solution focusing on safety through process control.

**RECYCLING DEINKING SLUDGE WITH THE USE OF ADHESIVES**
by: *Anthony Monterusso*
Sponsor: None
Faculty Advisor: Andro Mondala, Ph.D.
4:00 p.m. – 4:25 p.m.

Commonly sludge from the deinking process of paper production is being landfilled. A more sustainable use for the sludge is to recycle it back into the papermaking process. This would be done by mixing the sludge with an adhesive while maintaining the strength properties in order to maximize the sludge's content in the paper. Fiberboard production is the optimal field for recycled deinking sludge due to a lack of need of bleaching done to the fibers. The completed design will provide a method for the reduction of landfilled deinking sludge.


**CIVIL AND CONSTRUCTION ENGINEERING**
Session Chair – Decker Hains, Ph.D.
Room D-115

**CEAS STUDENT CENTER EXPANSION**
by: *Sean Hazen, Kyle Smith, and Turner Solterman*
Sponsor: Houssam Toutanji, Ph.D.
Faculty Advisor: Decker Hains, P.E., Ph.D., PMP
9:00 a.m. – 9:25 a.m.

The newest trend in higher education and the professional world is interdisciplinary collaboration. An addition to Floyd Hall is necessary to serve as this space for the different engineering registered student organizations. A full structural and architectural design was created using Autodesk Revit and Risa3D, along with a detailed cost estimate and construction schedule. Using input from the different engineering registered student organizations, we have made a space for everyone to come together and work with each other in the pursuit of a better engineering experience.

**STORY POINT SENIOR LIVING FACILITY SITE DEVELOPMENT**
by: *Odai M. Alhouz, Fesal F. Alsherthri, Ryan J. Anderson, and Aaron D. Spence*
Sponsor: Prein & Newhof, Michael Schwartz, P.E.
Faculty Advisor: Decker Hains P.E., Ph.D., PMP
9:30 a.m. – 9:55 a.m.

Adventures such as Story Point Senior Living Facility thrive on their care, functionality, and looks. To complement the facility, a parking lot, water management system, walking path, shelter, and alternate access road were built. The parking lot, water management system, and road will increase the function and they were designed in compliance with local and federal guidelines to encourage longevity, safety, and environmental protection. A walking path and shelter have been built to encourage resident's health and happiness. The development will continue to be a pillar of Portage where people in need will find comfort.

**SWARTZ CREEK GENERAL RETAIL STORE**
by: *Jacob Rilett, Julie Warner, and Bradley Wright*
Sponsor: AR engineering: Andrew Rossell, Spencer Odell, and Whitney Briggs
Faculty Advisor: Decker Haines, P.E., Ph.D., PMP
10:00 a.m. – 10:25 a.m.

Site development is an important part of the design process for any new construction project. A new retail facility was constructed on an undeveloped site in Swartz Creek Michigan. Local zoning laws along with existing wetlands and utility lines on site required extensive interaction with the local governing bodies. The completed site plan required considerations for grading, sustainability, storm water management, parking lot design, utility plans, and building location, along with traffic impact study requirements necessitated by the fire station located on the opposite corner of the intersection. AutoCAD software was used to create plans for the site and provide a visual for all possible design solutions. The completed design allowed for the new structure to be constructed to benefit the area without negative impact on traffic flow or the existing environment.

**TEXAS TOWNSHIP NON-MOTORIZED TRAIL IMPROVEMENTS**
by: *Patrick Ezeani, Chris Liebert, Johanes Perwata, and Jeff Rickfelder*
Sponsor: Charter Township of Texas, Doug Plachcinski
Faculty Advisor: Decker Hains, P.E., Ph.D., PMP
10:30 a.m. – 10:55 a.m.

A newly opened non-motorized trail way in Texas Township has quickly become a very popular spot for local residents looking to enjoy activities outside. Solutions for many of the trail's issues have been solved using survey equipment, AutoCAD, Civil 3D software, soil testing equipment along with additional resources. Two new parking lot designs, crosswalk improvement recommendations, and plans to add a restroom facility will help make this trail safer and more enjoyable for all users.

**WMU FLOYD HALL UNDERGRADUATE LAB**
by: *Alec Ingram, Ryan Mazurek, and Bryan McDowell*
Sponsor: Houssam Toutanji, Ph.D.
Faculty Advisor: Yufeng Hu, Ph.D.
11:00 a.m. – 11:30 a.m.

Floyd Hall is home to many engineering project teams; however, some find their current accommodations inadequate to successfully run their projects. To satisfy their needs, an extension on to Floyd Hall was designed to house these teams and offer areas for leisure, meetings, and studies. The 15,000 SFT two story addition has been created with Risa 3D and Revit software. Design deliverables include foundation design, proposed site layout, parking lot reconfiguration, structural design, and floorplan layout. The design is intended to maximize floor space efficiency while giving students the necessary tools and accommodations to be successful.

**COMPUTER SCIENCE**
Session Chair – John Kapenga
Room – D-202

**C'S PERFECT TIE SALES WEBSITE SERVICES**
by: *Stephen Betcher, Sean Hulway, Joe Mangas, and Matt Mazzarella*
Sponsor: None
Faculty Advisor: John Kapenga, Ph.D.
8:30 a.m. – 8:55 a.m.

For a local small business, competing against larger competitors can be a large challenge in today's economy. With a versatile sales website C's Perfect Tie will be able to reach new customers and create ease for existing customers. Through the use of Amazon Web Services and website design with Ruby on Rails, C's Perfect Tie Sales Website services will be able to expand its business beyond its current capabilities.

**ROOM FINDER APPLICATION**
by: *Skylar Freeman, Brandon Kelly, and Nicholas Pignone*
Sponsor: Stryker: Alex Petrov, Jame Laymon, and Gary Millikin
Faculty Advisor: John Kapenga, Ph.D.
9:00 a.m. – 9:25 a.m.

For a global corporation with buildings in locations all over the world, it can be challenging for users to navigate from building to building and be able to locate and book rooms. Conference room data was gathered and an interactive web application was developed using a C# net framework with an SQL Oracle database. An application that contains a complete list of buildings and rooms and allows users to navigate through them in a simple and interactive way that is very effective.

**WMU SOLAR CAR PERFORMANCE SIMULATOR**
by: *Aaron Brainard, Adam Hubbell, and Broderick Hyman*
Sponsor: WMU Sunseeker Solar Car Project
Faculty Advisor: John Kapenga, Ph.D.
9:30 a.m. – 9:55 a.m.

Speed and power management are crucial during a multi-day solar car race. A combined simulation of environmental and vehicular models allows the solar car team to optimize these parameters. A Java-based performance modeling application was created to determine optimal driving speed during the race. The application has the ability to adapt to solar car configurations, in order to assist the design process. This provides several tools that can help the team develop a winning race strategy, both before and during the race.

**WEBSITE DEVELOPMENT WITH GSA 508 COMPLIANCE**
by: *Benjamin Masters and Mark Stark*
Sponsor: Pennfield Public Schools
Faculty Advisor: John Kapenga, Ph.D.
10:00 a.m. – 10:25 a.m.

The ability to keep up within the digital landscape of today's internet is a challenging process. Pennfield Public Schools needed an update to their current web structure to ensure that not only GSA 508 Compliance Standards are met, but giving them the ability to integrate their numerous web applications into one location. By designing a web template standard, this allows educators with different degrees of proficiency to easily develop and maintain their department's domain. These standards and platform integration will help aid their future needs to their students moving forward.

**PALERMO PIZZA POINT OF SALE**
by: *Bradley Clark, Nathan LaVire, and Joseph Owens*
Sponsor: Palermo Pizza: Renee Mead
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. – 10:55 a.m.

Nearly all modern restaurants and stores use computerized point of sale programs to process transactions, track employee time clocks, and manage other day to day needs. Palermo Pizza's point of sale used a very out of date piece of software from a related business with buggy behaviors and a poorly designed interface. This system has been replaced with a fast, modern interface in the form of a webapp designed in Ruby on Rails with a modern database running on MYSQL.

**SITE ACCESS CHECKPOINT APPLICATION**
by: *Jay Jatin, Cameron Simon, and Nisha Verma*
Sponsor: CSM Group: Noah Schneider
Faculty Advisor: John Kapenga, Ph.D.
11:00 a.m. – 11:25 a.m.

Keeping a consistent way of supervising contractors at a busy worksite can be incredibly confusing and hectic, especially when using a paper system. To combat this, the Site Access Checkpoint Application was created to manage these chaotic situations. The application keeps track of contractors signing in and out of the jobsite and allows for safety training if needed, notifying the contractor and admin by email. The infrastructure of the web application utilizes Angular JavaScript to create more organized and accessible code and the Google Application Engine for security. The application was developed for future use.

**VEHICLE NAVIGATION USING A MICROSOFT KINECT**
by: *Aleksandr Dobrev, Andrew Gifford, and James Jenkins*
Sponsor: Spencer Watza
Faculty Advisor: John Kapenga, Ph.D.
11:30 a.m. – 11:55 a.m.

GPS is insufficient for many precise, small-scale, navigation tasks. Making use of a small ground vehicle, the goal is to use a Microsoft Kinect and work towards an implementation of an Autonomous Proximity Operations Demonstration System. This system will serve as a base for experimentation with simultaneous location and mapping (SLAM) and provide a platform for extension to a large aerial vehicle. In solving such a problem, a 3D map is constructed while traversing a previously unknown environment using an iterative refinement filter. The generated map is then used to perform navigation and complete a given mission.

**ELECTRICAL AND COMPUTER ENGINEERING**
Session Chair – Massood Atashbar, Ph.D.
Room D-204/205

**AUTOMATED PANCAKE MAKER USING DIGITAL IMAGES**
by: *Lujain Abukabbos, Brandon Kail, and Ubaldo Pablo-Mendoza*
Sponsor: Steve Durbin, Ph.D.
Faculty Advisor: Steve Durbin, Ph.D.
9:00 a.m. – 9:25 a.m.

Combining automation and creativity, this pancake maker was designed to enable users to incorporate digital images into pancakes. This system includes a Raspberry Pi that transforms the image of choice into 4-shades of grayscale to generate motor movements. The microcontroller's movements are sent as commands to an Arduino which is used to move the motors and dispense the batter onto the griddle. Using this development will make the process of designing custom made pancakes easier and much more efficient.

**VERTICAL TAKEOFF AND LANDING FOR FIXED-WING UAV**
by: *Nathan Bowen, Michael Daniel, and Isaac Frank*
Sponsor: I-TEC
Advisor: Dean Johnson, Ph.D.
9:30 a.m. – 9:55 a.m.

I-TEC uses a slingshot launch method for the fixed-wing, unmanned aerial vehicles in its fleet. While effective, this requires the launch site to have adequate runway space and equipment. To eliminate these needs, a vertical takeoff and landing system was developed and built for a fixed-wing unmanned aerial vehicle. Vertical lift propellers were designed into the body of the airframe to accomplish vertical flight. These additional propellers are covered during horizontal flight to reduce drag. The complete system was designed and simulated using PTC Creo and MathWorks Simulink software and developed for the Pixhawk autopilot system.

**SOLAR ENERGY GENERATION AND CONVERSION LAB STATIONS**
by: *Bradley Beerman, Jonathan Kellogg, and Caleb Martin*
Sponsor: None
Faculty Advisor: Bradley Bazuin, Ph.D.
10:00 a.m. – 10:25 a.m.

This project has provided educational materials and hands-on laboratory stations for solar energy and solar energy powered electronics. With a focus on high school education and community demonstrations, the laboratory stations combine light sources, solar panels, and a range of electronic modules to demonstrate basic concepts in electronics, energy generation, energy conversion, and the solar powering of small consumer devices and products. Each station includes a custom solar panel constructed of solar cells similar to those found in larger commercial solar panels. Electronic modules include a cell phone charger, fan, and LED light displays. For an instructor's station, a slot car race track.

**PAPER-BASED OPTICAL GLUCOSE METER**
by: *Garrett Gloceri, Leigh Kapnick, and Jade Wolfe*
Sponsor: None
Faculty Advisor: Massood Atashbar, Ph.D.
10:30 a.m. – 10:55 a.m.

Accurate blood sugar monitoring is necessary for various medical reasons. Using efficient, compact microfluidic paper-based analytical devices (uPADS), a blood sample can be filtered onto four micro-zones. One of these will immobilize the glucose oxidase in the sample to allow for blood sugar monitoring. Colorimetric changes will be interpreted using an optical detection circuit including light emitting diodes (LED's) and photodiodes. Data will then be sent via Bluetooth transmissions to an Android based smartphone application developed to analyze the intensity changes. The resulting glucose levels will be displayed in the custom app to be monitored and reviewed by the user.

**FULLY AUTONOMOUS ROOMBA WASTE COLLECTION ADD-ON**
by: *Drew Baetens, Joshua McCoy, and Zach Urban*
Sponsor: Ralph Tanner, Ph.D.
Faculty Advisor: Ralph Tanner, Ph.D.
11:00 a.m. – 11:25 a.m.

The Roomba, produced by iRobot, is a popular autonomous vacuum cleaner. However, a common complaint is that this robotic cleaner has a very small waste collection bin. This presentation introduces a docking station add-on device that will automatically empty the Roomba's waste bin every time it returns to the station. This device, through both electrical and mechanical components, will remove, empty, and return an iRobot Roomba's waste bin without the need for human interaction. By doing so, a customer can enjoy a fully autonomous Roomba without the concern for frequently emptying its small waste bin.

**SUNSEEKER DISPLAY MODIFICATION**
by: *Zachary LaPointe, Guerin Rowland, and Anas Ahmed Algethmi*
Sponsor: None
Faculty Advisor: Bradley Bazuin, Ph.D.
11:30 a.m. – 11:55 a.m.

The new Sunseeker 2016 was in desperate need of new driver displays and driver control module. The new electronic systems developed provide readily reproducible display modules that have improved interfacing, visibility, and mounting. It can also be used for a wide range of embedded microcontroller applications. The new driver control module uses an embedded TI MSP430 microcontroller to provide all the previous functionality along with additional interfaces and features that should support current and future Sunseeker solar cars.

**NFPA FPV CHALLENGE ELECTRICAL CONTROL SYSTEM**
by: *Charles Mizikar IV, Patrick Pottorff, and Rachel Person*
Sponsor: National Fluid Power Association
Faculty Advisor: Dean Johnson, Ph.D.
1:00 p.m. – 1:30 p.m.

The Fluid Powered Vehicle (FPV) is a human-powered vehicle that uses fluid dynamics for its operation. An electronic control system will be designed, implemented and tested for the FPV to operate the various hydraulic components in either an automated or some semi-autonomous modes. It will be a microcontroller-based system having the flexibility to be adjusted on the fly. The competition, sponsored by the National Fluid Power Association, will take place on April 20$^{th}$ and 21$^{st}$.

**DATA ANALYSIS & FEEDBACK SYSTEM FOR WMU SOLAR GARDENS**
by: *Bryan Birchmeier, Diana Kangogo, and Kevin Watson*
Sponsor: Bradley Bazuin, Ph.D.
Faculty Advisor: Bradley Bazuin, Ph.D.
1:30 p.m. – 1:55 p.m.

The installation of the WMU Educational Solar Garden not only provides power to Floyd Hall but also allows student access to a wide range of information and data on daily solar power collection and the operation and efficiency of installed system components. The data analysis and feedback system is an automated computer server designed to continuous collect available weather and solar operational data and provide long term data storage in a database management system. From the collected data, the system also provides regularly updated charts and graphs showing power generated, cost savings, and return on investment for WMU website displays. Finally, the historical database collected will be a resource for future solar energy research and development at WMU.

**BRAIN-COMPUTER INTERFACE**
by: *Bishop, Justin Byrd, and Katie Eluskie*
Sponsor: None
Faculty Advisor: Damon Miller, Ph.D.
2:00 p.m. – 2:25 p.m.

Brain-computer interfaces use signals from the brain to control physical devices. These interfaces can be costly and/or invasive. A low-cost, non-invasive, brain computer interface was designed to use signals from the brain obtained using surface electrodes to control a set of LED lights. The brain-computer interface relies on a Neurosky® Mindwave headset, Rasberry Pi®, and digital signal processing techniques. This system could be expanded to accomplish more complex tasks.

**SENSOR INTERFACES: INTELLIGENT SURGICAL BOX TRAINER**
by: *Joshua Clemens, Sarah Seng, and Krystal York*
Sponsor: Janos Grantner, Ph.D.
Faculty Advisor: Janos Grantner, Ph.D.
2:30 p.m. – 2:55 p.m.

The FLS Trainer system allows medical students to practice laparoscopic surgery techniques safely and cost-effectively. However, the system is not currently equipped to test certain key elements of laparoscopic surgery. A sensor interface for monitoring students' wrist movements, grip strength, and test duration was created using a STM32F3 Discovery Board microcontroller and three electromechanical sensors. The microcontroller was programmed to log and store this information to allow students to study their movements in greater detail. This additional feedback will allow student to fine tune their skills and better equip themselves for the care of future patients.

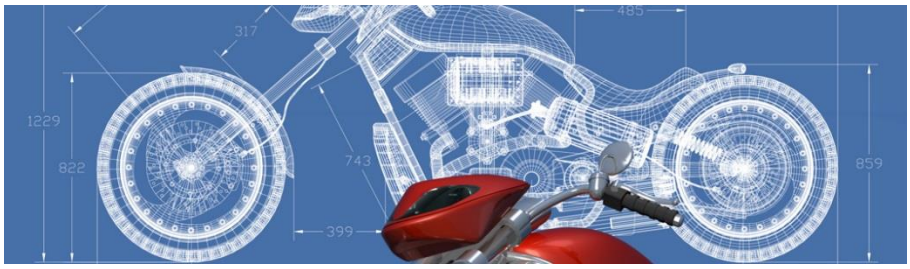
**TORSION ELEMENT TEST BENCH**
by: *Richard Blischke, Trevor Gick, and Steve Johnson*
Sponsor: ROSTA USA, Ian Osborn
Faculty Advisor: Johnson Asumadu, Ph.D.
3:00 p.m. – 3:25 p.m.

A local manufacturing company required an apparatus to test several different products used in industrial applications. This apparatus was required to test existing designs and qualify new designs and materials. The products include elements used for industrial suspension systems, vibration dampers, and other industrial machines. This design automates the test, applying necessary torque for a specified 30° rotations while measuring applied torque and rotation angle. The measured data is tabulated and presented graphically to the user operating Lab View software.

**LEAPDUINO CHECKERS**

by: *Adam Sweeris, Eric Pietrowicz, and Travis Wilson*
Sponsor: Robert Makin
Faculty Advisor: Steve Durbin, Ph.D.
3:30 p.m. – 3:55 p.m.

Gadgets are outgrowing the traditional touchscreen interface. Companies are racing to adapt to this new landscape of user interaction. Leapduino Checkers conceptualizes the intuitive gesture based control of a 4-axis robotic arm capable of playing a game of checkers. The user may challenge his or her opponent to a game of checkers without ever coming in physical contact with the game board. Using an infrared sensing unit, the movement of the user's hand is mirrored by the robotic arm in this real-time system, illustrating a new form of interfacing with the gadgets of the future.




**ENGINEERING DESIGN, MANUFACTURING, AND MANAGEMENT SYSTEMS**

Session Chair – Betsy Aller, Ph.D.

Room D-201

**MOLDFLOW INTEGRATION FOR AUTOMOTIVE DESIGN**

by: *Vincent Kucway, Emanuel Magallon, and Sonnet Woolf*

Sponsor: Autodesk

Faculty Advisor: Jay Shoemaker

8:00 a.m. – 8:25 a.m.

Autodesk Moldflow Advisor is a software that simulates the flow of injected molded plastic through a part that has been modeled in a 3D space. The Moldflow Integration training course was developed to rapidly familiarize automotive designers with the most relevant feature of this software pertaining to their job scope. The designer's consideration of plastic flow improves the part's manufacturability and reduces expenses associated with design changes that would have arisen later on. Designers having taken this course will now be able to employ Moldflow as a tool to efficiently transition conceptualized vehicle components through manufacturing and onto the road.

**AUTOMATED 7MM BALL PLUG STAKING STATION FOR ABS BRAKE VALVE**

by: *Tyler Allen and Beau Rundell*

Sponsor: ZF TRW: Mike Jones

Faculty Advisor: Kevin Barnes

8:30 a.m. – 8:55 a.m.

Companies continuously strive to improve processes for higher efficiency and lower production costs. The original method used to close a drilled passageway was a diametral interference fit between the parent material and a 7mm ball. The fit was formerly accomplished by a swedging process. Upgrading to a staking press provides a much more consistent depth capability of the ball, maintains the spot face of the parent material (required to measure the depth), and reduces cycle time and operator interference. A pneumatic press was set up, a new PLC program installed, and specially designed tooling was created. The new work station implements poka-yoke as a measure to reduce error and scrap. Project results add efficiency, consistency, and satisfaction from the customer.

**CARBON FIBER COMPOSITE JET SKI PARTS**
by: *John Gawrys, Tyler Lysne, Ryan McDonald, and Dan Thomas*
Sponsor: Lightning Skis: Jim McQueen
Faculty Advisor: Mitchel Keil, Ph.D.
9:00 a.m. – 9:25 a.m.

Composite performance materials are the future of today's aftermarket industry. Jet ski components were reverse engineered and designed in CAD software to take advantage of specific composite properties. After identifying desired properties, a combination of materials was selected to achieve the desired performance. Molds and manufacturing processes were then developed to efficiently make these parts. To validate the strength of these composite parts, standardized tests were performed. The final product gives the sponsor cost-effective parts with added strength, lighter weight, and performance-enhancing characteristics.

**RESEARCH AND DEVELOPMENT OF A SYNTHETIC MUSCLE**
by: *Benjamen Archer, Delano Carson, Alexander Dean, Geordie Ebright, and Jeff Hensler*
Sponsor: None
Faculty Advisor: David Middleton
9:30 a.m. – 9:55 a.m.

The modern medical field uses a variety of mechanisms and materials to create viable substitutes for human muscle fibers. After researching current methods and materials, several viable substitutes or replacements for human muscle were discovered. Computer aided design (CAD) software was utilized in the development of the initial parameters, along with a weight test to insure the material can expand and contract with a load applied. This synthetic muscle concept can lead industry to a breakthrough in technology for biomechanics of the muscle as well as aid in future research on the subject.

**SOPS AND WORK CENTER PROCESS IMPROVEMENTS OF SPRINKLER ASSEMBLY LINES**
by: *Diego Jazwinski, Carl McAllister, Marley McVey, Derek Pomaville, and Shelby Rhein*
Sponsor: The Viking Corporation: Sandi Lester and Renee Stirrett
Faculty Advisor: Larry Mallak, Ph.D.
10:00 a.m. – 10:25 a.m.

Rising global demand for emergency sprinkler systems calls for accurate labor standards and standard operating procedures (SOPs). The Early Suppression Fast Response and Commercial Concealed assembly lines were evaluated using time studies, left-hand right-hand charts, and video analysis. These tools were used to identify labor standards and to create new SOPs. The new labor standards will help identify inefficiencies and support process improvements. Recommendations concerning continuous improvement actions and their expected performance outcomes were identified.

**TOOL SELECTION PROGRAM FOR ASSEMBLY OPERATIONS**
by: *Regan Elzerman, Alan Meinecke, Sullivan O'Connor, and Dominic Oo*
Sponsor: Stryker Medical Division: Michael Kobrehel
Faculty Advisor: David Lyth, Ph.D.
10:30 a.m. – 10:55 a.m.

Effective decision making is driven by data. Manufacturing companies require a reliable decision-making tool to allocate funds and reduce costs when assessing alternatives. Using historical data and manufacturer performance specifications, a computerized decision-making program was created to verify the selection of battery-operated, hand-held tools and their application to assembly operations. The program was designed to mimic the logic of the current system, which relies heavily on individual evaluation. The program was developed to create a visual and data-driven representation of the decision-making process for optimized tool selection and to communicate this process to other stakeholders affected by the selection.

**HIGH PRECISION 3D PRINTER**
by: *Joe Caruso, Eric Cook, Cole Miller, and Wilson Pines*
Sponsor: None
Faculty Advisor: Pavel Ikonomov, Ph.D.
11:00 a.m. - 11:25 a.m.

3D printers are a promising technology for the manufacturing industry. Current 3D printers are either too costly or cannot meet a high precision. In stereolithography (SLA) 3D printers, a laser moves on predefined paths on x- and y-axes to cure a resin, layer by layer, and then moves on the z-axis for each subsequent layer until the part is produced. This SLA 3D printer has been designed, built, and tested to perform at a micro-level of precision at an affordable cost. The 3D printer will serve as a foundation for future students to print high precision parts such as biocompatible bone structures.

**HUMAN-POWERED HYDRAULIC VEHICLE**
by: *Adam Cwynar, Andrew Klug, Luis Morales, and Matthew Williams*
Sponsors: The National Fluid Power Association Education and Technology Foundation
Parker Hannifin
Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriguez, Ph.D.
11:30 a.m. – 11:55 a.m.

The Fluid Power Vehicle Challenge gives students the opportunity to build and develop a human-powered chainless bicycle with hydraulic systems and motion controls. Previous cycle designs were tested and evaluated to determine optimal solutions and results. Hydraulic diagrams and calculations were created to select components deemed best for the application. The vehicle was modeled and simulated using CREO Parametric 3.0 and then assembled with both selected components and custom-made parts fabricated by the team. The final design was tested and modified to achieve maximum performance. The efficient and environmentally-friendly vehicle will be scored on sprint, efficiency, and durability performance in a national design competition between university student teams in April 2017.


**INDUSTRIAL AND ENTREPRENEURIAL ENGINEERING & ENGINEERING MANAGEMENT**

Session Chair – Azim Houshyar, Ph.D.

Room D-212

**INTERNATIONAL STUDENT APPLICATION PROCESS IMPROVEMENT**

by: *Nathan Crites, Cole Kapovich, and Jack Newa*

Sponsor: Western Michigan University- Faunce Student Services

Faculty Advisor: Dana Hammond

10:00 a.m. – 10:25 a.m.

The International program at Western Michigan University continues to grow. However, to maintain and attract more student interest in the program, the university must utilize a more efficient and organized application and enrollment process. The complete process of an international student's application was studied, observed, and analyzed in an attempt to eliminate waste within the program. From-to charts, Pareto charts, time and motion studies as well as simulation were utilized to streamline the international program processes. Reducing the lead time for application and enrollment processes will help the international program continue to grow, attracting students from all over, and supporting diversity at the university.

**IMPLEMENTATION OF AN IMPROVED INVENTORY CONTROL SYSTEM**

by: *Adam Jorgensen, Julio Mangandi, and Dennis Schneider*

Sponsor: Burr Oak Tool, Inc., Tim Trine

Faculty Advisors: Dana Hammond, Azim Houshyar, Ph.D., and Bob White, Ph.D.

10:30 a.m. – 10:55 a.m.

Effective management of inventory levels can reduce costs and provide appropriate levels of customer service. Analysis of an inventory control system at a local company found that inventory levels did not meet customer service level requirements. Analyzing lead times, demand, setup and holding costs resulted in revised order quantities, safety stock, and reorder points that reduced inventory expenses and improved customer service levels.

**INNOVATIVE DEVICE DESIGN FOR THE DISABLED**

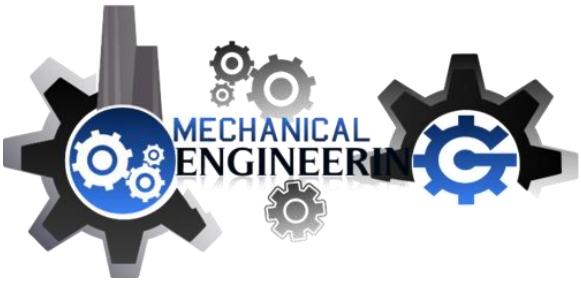
by: *Laura Fett, Mackenzie Sievers, and Michelle Valente*
Sponsor: Western Michigan University – Department Head of Occupational Therapy, Dr. Atchinson
Faculty Advisor: Tycho Fredericks, Ph.D.
11:00 a.m. – 11:25 a.m.

Students with disabilities face daily struggles to adapt to common tasks and devices. Although largely researched, difficulty in the educational system stems from the variety of disorders. There is a defined need for individualized aids for specific disabilities. Using skills developed in the areas of ergonomics, design, and research, adaptive equipment and useful tools were created for these students. Each design took into account the safety, adaptability, and well-being of the user. In the end, several designs were generated, tested, and evaluated in hopes of bettering students' lives, educational experience, and development.

**DECANT WORKSTATION STANDARDIZATION**

by: *Matthew Haan and Bradley Short*
Sponsor: Dematic, John Crimmins, and Kevin Heath
Faculty Advisor: Tycho Fredericks, Ph.D.
11:30 a.m. – 11:55 a.m.

Decant workstations, which sort receiving boxes into storage totes, are currently re-engineered every time a new customer buys a material handling system. This wastes company time and other resources. To develop a new, standardized design, past models were evaluated both quantitatively and qualitatively based on numerical data and company feedback. New concepts were created and prototypes were tested to measure performance. Adjustments were made in the design to accommodate worker health and safety as well as affordability of the workstation. The final decant workstation design combines different elements to provide a standard solution to be offered to customers.




**MECHANICAL AND AEROSPACE ENGINEERING A**

Session Chair – Bade Shrestha, Ph.D. and Christopher Cho, Ph.D.

Room D-109

**LETHAL REAGENT VIAL OPENING SYSTEM**

by: *Hugh Swager and Clark Walsh*

Sponsor: Thomas Adkins

Faculty Advisor: Judah Ari-Gur, Ph.D.

8:30 a.m. – 8:55 a.m.

In one chemical conversion step in the production of a pharmaceutical drug, chemical operators open sealed glass vials of a highly hazardous solid reagent and charge that material into a vessel. A system of encompassing and opening these vials was designed and fabricated using AutoCAD software and machining tools. The system minimized personal contact with broken glass as well as the potentially lethal reagent. It also standardized the charging process for operators of varying strengths without sacrificing dexterity, achieving the goal of improved safety.

**THE USE OF FIXED WINGED PROPELLER DRIVEN AIRCRAFT ON MARS**

by: *Devin Anderson, Martin-Jericho Jaramillo, Sean Wagner*

Sponsor: None

Faculty Advisor: William Liou, Ph.D.

9:00 a.m. – 9:25 a.m.

There are a lot of challenges in exploring other worlds in our solar system. Mars in particular has many of technical challenges resulting in slow collection of data. The development of unmanned aerial systems for use on Mars is vital for the future of mar exploration. To this end an in depth analysis of the use of electric propeller driven fixed winged aircraft, using atmospheric scaling techniques, and wind tunnel testing of both propulsion systems, and lifting surfaces in the Martian environment is needed for future development of Martian UAV's.

**BIOGAS SEPARATOR AND STORAGE TANK**
by: *Brandon Nimtz, Trevor Richardson, and Kenton Vogel*
Sponsor: None
Faculty Advisor: Bade Shrestha, Ph.D. and Muralidhar Ghantasala, Ph.D.
9:30 a.m. – 9:55 a.m.

Biogas is a renewable fuel source produced by the breakdown of organic matter in the absence of oxygen. A system was designed using CAD software and analyzed with ANSYS that would separate biogas into its two major components, Methane ($CH_4$) and Carbon Dioxide ($CO_2$), using each component's thermodynamic properties. Once separated, each component was then stored in separate storage tanks in order to be later used for its respective application. This system consists of many different components including: heat exchangers, pipes, valves, liquid-gas separator, pumps, and pressure vessels.

**COMPRESSOR FOR BIOGAS PURIFICAITON SYSTEM**
by: *Ian Cole and Robin Kurth*
Sponsor: None
Faculty Advisor: Bade Shrestha, Ph.D. and Muralidhar Ghantasala, Ph.D.
10:00 a.m. – 10:25 a.m.

Biogas is one of the most exciting potential sources of renewable energy. Small rural farms may harvest biogas from fermented organic waste. This gas contains flammable methane as well as inert carbon dioxide. Removing a portion of the carbon dioxide allows the gas to be of high quality and used for at-home applications such as cooking or heating water, or even sold to others as a source of additional income. A compressor system was utilized in conjunction with the gas liquid separator and heat exchangers and a prototype for a portable device that can purify raw biogas to high quality gas was designed.

**3-AXIS MAGNETORQUER FOR CUBSAT**
by: *Kevin Lerner, Ali Mohsini, Roberto Molina, and Silmang Sene*
Sponsor: Western Aerospace Launch Initiative, Jennifer Hudson, Ph.D.
Faculty Advisor: Jennifer Hudson, Ph.D.
10:30 a.m. – 10:55 a.m.

There are a handful of different attitude control methods used by satellites. Many modern CubeSat's, a type of small satellite, commonly use a 3-axis magnetic field generator, or magnetorquer, as a means of attitude control. The magnetorquer is composed of three coils o wire that generate a magnetic field when current is run through them. This magnetic field generates a torque to line up with the Earth's magnetic field, like a compass needle, and it will allow the CubeSat to reorient itself. A magnetorquer was designed as an attitude control actuator for a CubeSat. The software GMAT (General Mission Analysis Tool) and Matlab were used in order to conduct the various simulations.

**DESIGN OF A CUBESAT SEPARATION MECHANISM**
by: *Gregory Bosma, Andrew Drummond, and Ross Hiller*
Sponsor: Western Aerospace Launch Initiative, Nagual Simmons and Kristina Lemmer, Ph.D.
Faculty Advisor: Koorosh Naghshineh
11:00 a.m. – 11:25 a.m.

CubeSats are compact, relatively inexpensive satellites that are often used for space research. In order to perform research related to electric propulsion devices, the Western Aerospace Launch Initiative (WALI) requires a medium-sized CubeSat capable of separating into two bodies while in orbit. Intentional separation is not common in CubeSats, so a unique mechanism was designed and simulated using the 3D CAD software Solidworks. A prototype was constructed and evaluated through pendulum and vibration testing to verify separation velocity and structural integrity. The design is a less expensive, custom alternative to commercial off-the-shelf devices for release of space components.

**YEAST HARVESTING AND STORAGE SYSTEM FOR COMMERICAL BREWING**
by: *Austin Hood, Winston Jones, and Clint Parker*
Sponsor: Arcadia Ales, Dave Sippel
Faculty Advisor: Parviz Merati
11:30 a.m. – 11:55 a.m.

A semi-automated yeast harvesting and storage system was designed for installation inside of Arcadia Ales, an established Kalamazoo brewery. Yeast is harvested from beer batches after fermentation for use in future batches, keeping the brewing process consistent and sustainable. The new system provides Arcadia Ales with a stainless steel plumbing system connecting all of its open fermentation tanks to a central tank for yeast storage. The revised process increases batch sanitation and reduces the time required for an associate to complete this process. A control system was implemented with a human-machine interface to control the plumbing circuit components and storage tank.

**DESIGN AND DEVELOPMENT OF A FORMULA SAE POWERTRAIN**
by: *Jason Malphrus, Ramin Mirshab, and Evan Weese*
Sponsor: Western Michigan University
Faculty Advisor: Richard Hathaway, Ph.D.
1:00 p.m. – 1:25 p.m.

Formula SAE challenges students to design and manufacture a formula one style car for an international competition. In order to stay competitive, a well-developed powertrain unit is vital to on track performance. The development of the induction and exhaust systems, engine internals, gearing, and differential were explored to create a reliable system with manageable power delivery. The use of simulation software, rapid prototyping, and high precision machining led to a seamless integration of each subsystem. The vehicle was validated using both a dynamometer and in-vehicle testing to measure the powertrain improvements from previous years.

**CRIMP DESIGN FOR NEW HUMPHREY PRODUCTS VALVE**
by: *Muhammad Arif, Joshua Feddema, and Lian Peng*
Sponsor: Humphrey Products, David Phaneuf
Faculty Advisor: Christopher Cho, Ph.D.
1:30 p.m. – 1:55 p.m.

Pneumatic valves have existed for a long period of time with a large variety of applications. Constant attempts have been made to perfect the efficiency of the manufacturing of these devices. One way to increase accuracy is by way of designing robust fixtures. Ideal building conditions for a fixture were determined through both computers aided simulation and physical testing. During the design process, these results were used as benchmarks to be replicated by way of a hands-free fixture, eliminating chances of human error during assembly. Perfecting this step in the assembly process was critical in ensuring that the overall efficiency of this product will meet or exceed the standards seen in the pneumatic world. The finished design has improved efficiency, accuracy, and operator safety of this process ensuring a top quality product.

**ENERGY HARVESTING FOR THE WHITE CANE**
by: *Dustin DeRuiter and Vincent Pokorzynski*
Sponsor: None
Faculty Advisor: Pnina Ari-Gur, Ph.D.
2:00 p.m. – 2:25 p.m.

Persons with low vision use a white cane to safely navigate their environment. These canes have limited detection range, resulting in numerous improvements to this basic tool. The Smart Cane™ is such a device which uses optical sensors to detect obstacles above the user's waist. An alternative power supply for this device was built using piezoelectric elements to convert energy into a useful form.

**LASS UNMANNED AERIAL SYSTEM**
by: *Samuel Hiltner and Michael Pool*
Sponsor: None
Faculty Advisor: William Liou, Ph.D.
2:30 p.m. – 2:55 p.m.

Unmanned aerial systems (UAS) are becoming increasingly common, and yet no single UAS is capable of operating on land, in air, on water, and beneath the surface of water. LASS is the first UAS to encompass all of these capabilities. Using a quadcopter setup, a powered tricycle undercarriage, and a ducted fan, LASS is able to seamlessly operate and transition between each of its four distinct modes. Being fully waterproofed, LASS is capable of traveling at a depth of greater than one foot. These capabilities provide improved functionality for search and rescue missions, disaster mitigation, and more.

**REPRINTER**
by: *Andrew Aurand, Christian Brower, and Mackenzie Preston*
Sponsor: None
Faculty Advisor: Lee Wells, Ph.D.
3:00 p.m. – 3:25 p.m.

Additive manufacturing (3D printing) is a rapidly growing technology, though, expensive printing filament and wasted material make it less affordable and an unsustainable process. The RePrinter combats these issues by recycling scrap 3D printed plastic parts and household plastics, such as pop bottles, and creates filament for fused deposition modeling (FDM). This product is a fully automated system which grinds, extrudes, and spools the filament for immediate use in FDM. The RePrinter works to control the extrusion speeds and tensions to optimize precise filament dimensions for quality 3D printing, while delivering the product in a timely cost effective matter.

**PHOTOVOLTAIC POWERED UNMANNED AERIAL SYSTEM**
by: *Jeffrey Demers, Matthew Jacobs, and Joshua Simmons*
Sponsor: None
Faculty Advisor: Kapseong Ro, Ph.D.
3:30 p.m. – 3:55 p.m.

Within the last decade, urgency for a more sustainable means of flight has emerged in the aeronautical industry. As a result, alternative energy capabilities have become a major study for engineers in the field. This project aims to design, build, and fly an Unmanned Aerial System (UAS) that achieves dramatically improved flight time, compared to its traditional counterpart, by the integration of photovoltaic power generation. As an additional focus, the team hopes to educate the community of the advantage and capabilities of using alternative energy sources in flight systems.

**AIR PRESSURE DECAY TESTER FOR MECHANICAL SEALS**
by: *Stephan Claxton, Logeswary Sastry, and Zichen Zhao*
Sponsor: Flowserve Corporation, Joseph Allen
Facutly Advisor: Peter Gustafson, Ph.D.
4:00 p.m. – 4:25 p.m.

Mechanical seals undergo static pressure decay testing to assess the static sealing. Currently, a mechanical seal tester is built based on each individual seal's shaft, bore, and operating length specificaitons. A general mechancial seal air pressure decay tester useful for multiple seal design will reduce turnover time in assessing the static condition of seals. It will also reduce material waste and will provide an ergonomical product for company engineers.


**MECHANICAL AND AEROSPACE ENGINEERING B**
Session Chair – Ho Sung Lee, Ph.D. and Claudia Fajardo-Hansford, Ph.D.
Room D-210

**FATIGUE TESTING OF MATERIALS**
by: *Andrew Melton, Jacob Miller, and Benjamin Post*
Sponsor: None
Faculty Advisor: Daniel Kujawski, Ph.D.
8:30 a.m. – 8:55 a.m.

Fatigue in materials change the strength of a part and should be accounted for in an engineering design. The lifespan of a part exposed to cyclic loadings can differ drastically from non cyclic loadings. Material test specimens of 2024-T4 aluminum, 7075-T6 aluminum, and 1045 steel were manufactured, and tested to produce data that can be incorporated into the design of parts to help account for the change in material properties. Results generated from testing will give further insight into proper design for components that undergo cyclic loading.

**3D MODELING, PROTOTYPING, AND STRUCTURAL ANALYSIS OF AN AUTOMOTIVE INFERIOR FRAME STRUCTURE**
by: *Alexander Bertoia, Chloe Lawrie, and Drake McArthur*
Sponsor: Bosch, Jeffrey Roder
Faculty Advisor: Muralidhar Ghantasala, Ph.D.
9:00 a.m. – 9:25 a.m.
PRESENTATION CLOSED TO PUBLIC

Automobile technology is continually advancing and improving. This project is a joint innovation project with a non-disclosure agreement between the University and Robert Bosch LLC. The mechanical model – together with electronic features from Bosch which were outside of our mechanical components design scope – is a new invention in the field of automotive engineering that can be included in any passenger vehicle to noticeably enhance the driveer's visibility and thereby enhance overall safety while driving. The mechanical models designed include all necessary mechanical and user interface component designs satisfying requirements from Bosch. SOLIDWORKs was used to design the mechanical and user interface components. Rapid prototyping as well as assembly of the mechanical and user interface components was performed including integration of the components into a Bosch provided driving simulator cockpit for testing and display.

**ORBITAL SEPARATION AND PROPAGATION SIMULATION**
by: *Vincent Frank and Matthew Griffith*
Sponsor: None
Facutly Advisor: Jennifer Hudson
9:30 a.m. – 9:55 a.m.

Western Aerospace Launch Initiative (WALI) is planning to launch a CubeSat into space which will then separate into two smaller CubeSats. However, before the launch of the satellites they need to know in which direction would give them the best results for one satellite to observe the other. GMAT and MATLAB software have been used to create multiple simulations of various possible separation orientations, as well as, used to analyze and visualize the data that is generated. The simulations have major impact on the design requirements for their control systems and separation mechanism for the satellites.

**IMPROVEMENT OF RECIPROCATING AIR COMPRESSOR VALVE DESIGN**
by: *Tyler Maisonneuve and Luis Silva*
Sponsors: Gast Manufacturing, Travis Boerema and Sean Hubbard
Faculty Advisor: Richard Meyer, Ph.D.
10:00 a.m. – 10:25 a.m.

Design factors to improve the efficiency, flow, and pressure of a reciprocating air compressor were investigated. Initially, output flows and pressures for different port designs were evaluated using compuational fluid dynamics. These results were used to identify factors for inclusion in a Design of Experiments study. The completion of this study led to the production of several valve plates to test the experimental performance of a compressor. The valve plate port design that resulted in the highest increase of performance will be used as an optimization model for current and future reciprocating air compressors.

**POWERED WHEELCHAIR OPERATION FIXTURE FOR A VIRTUAL REALITY TESTING ENVIRONMENT**
by: *Murtadha Aljaffar, Nate Pierson, and Derek Scheffers*
Sponsor: None
Faculty Advisor: Richard Meyer, Ph.D.
10:30 a.m. – 10:55 a.m.

Powered wheelchair testing is unsafe for bystanders and normally requires large open testing grounds. A 3D rendered model for a testing support frame was created using SOLIDWORKS software. The model as a conceptual aid allowed for design improvements through iterations. A goal for the design was portability for testing at different sites. The final design was an aluminum structure with sliding ramps that achieved portability through folding. The constructed final design was tested and demonstrated for the capabilites of safe powered wheelchair testing and ease of portability.

**ASEPTIC FREEZE DRY SHELF REMOVAL DEVICE**
by: *Travis Bush, Cory Fritz, and Louis Piccione*
Sponsor: Pfizer Inc., Dave Lambers, Robert Pfeiffer, and Eric Henson
Faculty Advisor: Javier Montefort, Ph.D.
11:00 a.m. – 11:25 a.m.

Freeze Dryer shelves can be damaged during normal operations and must be removed from the facility for rework or repair. The process of removing shelves was time consuming and a potential hazard to workers. Using Autodesk CAD, a device has been designed to safely and efficiently remove these shelves from the aseptic area. The device minimizes production downtime, while meeting all industry and facility standards. This design can be used in future and current Pfizer plants around the world.

**INSTRUMENTED ENDURANCE TEST STAND FOR A PNEUMATIC ACTUATOR**
by: *Eric Eldred and Ramy Rezkalla*
Sponsor: Parker Hannifin Corporation
Faculty Advisor: Javier Montefort, Ph.D.
11:30 a.m. – 11:55 a.m.

Parker's pneumatic division currently sells several products within the agriculture industry. Parker is in the midst of developing a pneumatic cylinder which will control downforce of the row closing wheels of a planter produced by a large agriculture OEM. The team has proposed a modular design which will adequately meet all of Parker's needs for the array of tests that needs to be applied on this text fixture. The team designed the prototype using Inventor for 3D-Modeling and Ansys for Finite Element Analysis. The team also developed a LabVIEW program which is customizable by the Parker engineering team to automatically cycle the prototype cylinders on a specified profile.

**PREVENTING CONCUSSION WITH INNOVATIVE SMART HELMET**
by: *Adam Anderson, Joshua Bakker, and Matthew Rosso*
Sponsor: None
Faculty Advisor: Pnina Ari-Gur, Ph.D.
1:00 p.m. – 1:25 p.m.

The issue and awareness of concussions in football have risen significantly in recent years. Reducing the forces experienced by the head inside the helmet is a critical step towards concussion prevention. A prototype of a football helmet incorporating a smart material called nitinol was developed and tested against an identical helmet without nitinol. The data collected from the impact testing conducted gives evidence to whether or not helmets utilizing nitinol can improve the head safety of football players.

**VALIDATION OF THE MK6 AEROSHIP THROUGH FLIGHT TESTING**
by: *Mohamed Nooh Hussain, Manish Raj Wengda Selvam, Lun Jie Yaap, and Zi Hao Yap*
Sponsor: None
Facutly Advisor: Tianshu Liu, Ph.D.
1:30 p.m. – 1:55 p.m.

A hybrid airship is an air vehicle designed with a combination of an airship and a conventional wing. The combination of both aerostatic and aerodynamic lift allows the hybrid airship to travel for high altitude at low speed as well as short take-off characteristics. This provides solutions to problems regarding personal, high altitude and planetary flights. The main objectives of this project is to get the airship airbone and to optimize for a more stable and sustainable flight. Computer Aided Design (CAD) software of AutoCAD© and Solidworks© are both used for the design of the main wing, tail wing, and wing boxes as the previous design suffered an irreparable damage during flight testing.

**AERODYNAMIC DRAG REDUCTION FOR TRACTOR-TRAILERS**
by: *David Moussa and Gaganpreet Singh*
Sponsor: None
Faculty Advisor: Tianshu Liu, Ph.D.
2:00 p.m. – 2:25 p.m.

Tractor-trailers are the backbone of most logistical operations around the world, and according to statistics as of the year 2016 there are 2.2 million registered trucks in the United States alone, with an average fuel consumption of 26 billion gallons of diesel fuel each year. The problem is that at highway cruising speeds, 65% of the energy generated is used to overcome aerodynamic drag. In order to solve this problem a simple aerodynamic device called a tail plate mounted on the aft section of an idealized tractor-trailer model was designed and tested to show its drag reduction capability.

**DESIGN OF AN ASME SECTION VIII PRESSURE VESSEL**
by: *Justin Hoikka, Scott Jarvis, and Chris Woloszyk*
Sponsor: None
Faculty Advisor: Parviz Merati, Ph.D.
2:30 p.m. – 2:55 p.m.

In order to prevent failure, pressure vessels are designed and built to a very strict code dictated by the American Society of Mechanical Engineers (ASME). An ASME Section VIII pressure vessel was designed, built, and tested to meet temperature and pressure requirements. An Excel program was made to perform all necessary calculations which can be used in the future to verify design of other pressure vessels. The vessel design was confirmed using a Finite Element Analysis software.

**PROPELLANT TANK AND FEED SYSTEM FOR WESTERN AEROSPACE LAUNCH INITIATIVE**
by: *Gregory Izaguirre and Carlos Soto*
Sponsor: None
Faculty Advisor: Kristina Lemmer, Ph.D.
3:00 p.m. – 3:25 p.m.

A prototype of a propellant tank-feed system was designed, built, and tested. The tank and adjoining components for the storage and flow of xenon gas is designed for a CubeSat. The system may be implemented for use of the Western Aerospace Launch Initiative's CubeSat project. This storage tank in conjunction with a pressure regulator, feed line valve system, and a portotype microcontroller board to control valves and make sensor measurements was designed with the possibility of future applications on a univerity CubeSat. The design will satisfy the need for a stable and reliable propellant feed system on launchable research unit.

**PROCESS TO ACHIEVE FAST LOI**
by: *Bryan Garland, Jason Kohnert, and TJ Strock*
Sponsor: None
Faculty Advisor: Sam Ramrattan, Ph.D.
3:30 p.m. – 3:55 p.m.

It is crucial in manufacturing to have correct sand-chemical mixtures when making molds or risk producing defect casts. Therefore, testing of samples to insure the right composite is necessary. The new process utilizes infrared radiation heating to 'cook' the samples within a few minutes, vastly improving on the hours it currently takes. The sample is heated to three benchmark temperatures, where the changes in mass for moisture, volatile and inorganic chemicals are measured, and the percentages of the composite are calculated. The quicker test time will save time and energy, and reduce the likelihood poor casts are being made.

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CEAS Mission

To educate our learning community for life-long excellence in responsible professional leadership. To increase knowledge through collaborative discovery, integration, application, and teaching. To serve as a resource and partner to our constituents. To prepare job-ready graduates for the global market.

CEAS Vision

A scholarly community dedicated to excellence through student-centered education and research emphasizing professional practices in engineering and applied sciences.

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- Engagement: Produce job- ready graduates with the ability to grow in their profession and who are lifelong learners
- Innovation: Move the profession and society forward by providing engineers, scientists, and technologists with new capabilities
- Leadership: To graduate engineers, technologists, and applied scientists who are and will continue to be leaders in their profession and community
- Globalization: Our graduates must be prepared to work in a global engineering and applied sciences industry

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