4-2016

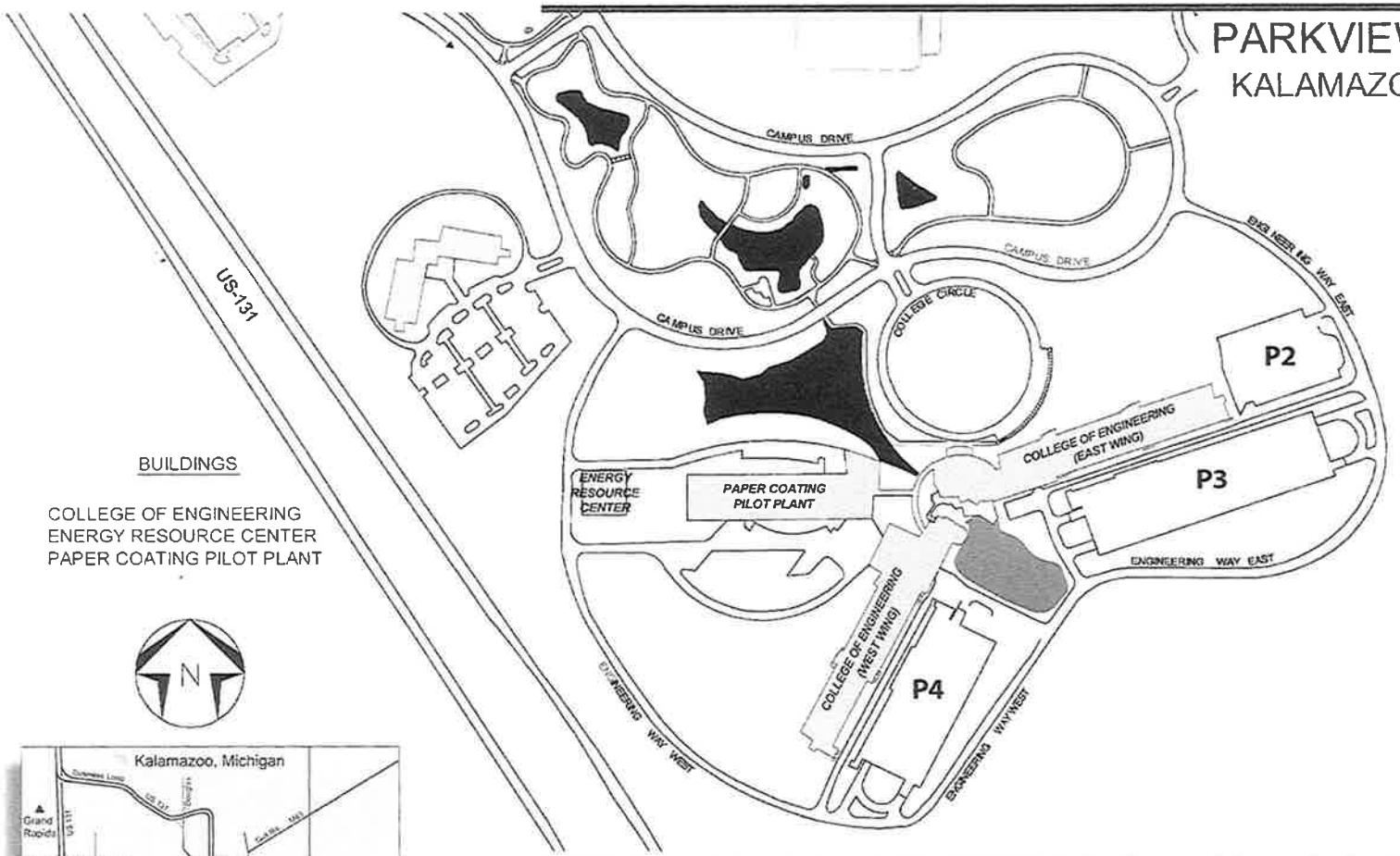
58th Conference on Senior Engineering Design

College of Engineering and Applied Sciences


W
WESTERN MICHIGAN UNIVERSITY
College of Engineering
and Applied Sciences
SENIOR DESIGN ENGINEERING CONFERENCE
Tuesday, April 19, 2016
8 a.m. - 4 p.m.

WESTERN MICHIGAN UNIVERSITY

PARKVIEW CAMPUS
KALAMAZOO, MICHIGAN



BUILDINGS

COLLEGE OF ENGINEERING
ENERGY RESOURCE CENTER
PAPER COATING PILOT PLANT

0 100 300 500

SCALE IN FEET

--Directions--

From I-94
At exit #74, turn north onto U.S. 131, go 2.8 miles, follow the directions listed below for U.S. 131.

From U.S. 131
At exit #36A, turn east onto Stadium Drive. Turn right at first light which is Drake Rd. Continue on Drake Rd. through the next light (at Parkview Ave.) into the WMU Parkview Campus. You will now be on Campus Drive.

From WMU Main Campus
From the corner of Stadium Dr. and Howard, go west on Stadium Dr. until you come to Drake Rd. Turn left onto Drake and continue south through the next light (at Parkview Ave.) and into the WMU Parkview Campus. You will now be on Campus Drive.

WMU PHYSICAL PLANT
July 2004 by E.Dantes, B.Morris

Conference on Senior Engineering Design Project

You are invited to attend the fifty-eighth Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., **Tuesday, April 19 2016** 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 (See map).

Parking is available in the ramps behind the College of Engineering and Applied Sciences (See: Lots P3 and P4). 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:

Civil and Construction Engineering	D-115	8:30 a.m. to 11:30 a.m.	p.6
Computer Science	D-202	9:00 a.m. to 1:30 p.m.	p.9
Electrical and Computer Engineering	D-204	9:00 a.m. to 2:30 p.m.	p.12
Engineering Design, Manufacturing, and Management Systems	D-201	8:00 a.m. to 12:00 p.m.	p.15
Industrial and Entrepreneurial Engineering & Engineering Management	D-212	9:30 a.m. to 12:00 p.m.	p.18
Mechanical and Aerospace Engineering A	D-109	9:00 a.m. to 3:00 p.m.	p.20
Mechanical and Aerospace Engineering B	D-210	9:00 a.m. to 2:30 p.m.	p.24
Chemical and Paper Engineering	D-208	9:00 a.m. to 3:00 p.m.	p.28

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:
http://www.wmich.edu/engineer/senior-design-conference.html

CCE Civil and Construction Engineering
CS Computer Science
ECE Electrical and Computer Engineering
EDMMS Engineering Design, Manufacturing, and Management Systems
IEE & EM Industrial and Entrepreneurial Engineering & Engineering Management
MAE Mechanical and Aerospace Engineering
ChP Chemical and Paper Engineering

TIME	ROOM/DEPARTMENT	TOPIC
8:00	D-201 EDMMS	RAPID MOLD DEVELOPMENT
8:30	D-115 CCE	FOREST LAKE PRESERVE
	D-201 EDMMS	LEADERSHIP REACTION COURSE PROPOSAL
9:00	D-115 CCE	ZEELAND TRUSS CLAY AVE TORNADO RECONSTRUCTION
	D-208 ChP	RECYCLING OF POLYETHYLENE COATED PAPER
	D-202 CS	FAMILY INTERACTION MAP
	D-204/205 ECE	DEVELOPMENT OF AN INTELLIGENT SURGICAL BOX-TRAINER
	D-201 EDMMS	DEVELOPING A DECISION SUPPORT SYSTEM TO DETERMINE OPTIMAL SAMPLE SIZE FOR A PRODUCT
	D-109 MAE A	STANDARD REGISTER MACHINE DESIGN AND COST ANALYSIS
	D-210 MAE B	FLOW CONTROL AND ELECTRIC ACTUATORS
9:30	D-115 CCE	35TH STREET RESURFACING AND WIDENING
	D-202 CS	NEW ELEARNING PROGRAM SUBMISSION SYSTEM
	D-208 ChP	TESTING OF NANOFIBRILLATED CELLULOSE AS A SURFACE ADDITIVE
	D-204/205 ECE	ROOM MONITOR
	D-201 EDMMS	REVERSE ENGINEERING OF AN ETHMOID BONE MODEL
	D-212 IEE & EM	SCRAP PROCESSING COST ANALYSIS THROUGH STOCHASTIC SIMULATION
	D-109 MAE A	FORMULA SAE PADDLE SHIFT IMPLEMENTATION
	D-210 MAE B	CUBESAT GROUND STATION
10:00	D-115 CCE	33RD STREET WATER MAIN
	D-202 CS	STREETLIGHT & POWER OUTAGE MOBILE APP RELEASE 2
	D-208 ChP	MODIFYING AN OPEN WATER SYSTEM TO A CLOSED SYSTEM
	D-204/205 ECE	DIFFUSED JUNCTION SILICON SOLAR CELL
	D-201 EDMMS	PROCESS IMPROVEMENT BY AUTOMATION
	D-212 IEE & EM	CAPACITY PLANNING AND OPTIMIZATION OF PRODUCTION
	D-109 MAE A	BALLOON ALTITUDE CONTROL MECHANISM
	D-210 MAE B	OPTIMIZATION OF A SUSTAINABLE BICYCLE

		GENERATOR
10:30	**D-115 CCE** **D-202 CS** **D-208 ChP** **D-204/205 ECE** **D-201 EDMMS** **D-212 IEE & EM** **D-109 MAE A** **D-210 MAE B**	**BRIDGE PRESERVATION IMPLEMENTING NDT** **WEB APPLICATION FRAMEWORK FOR STEM SIMULATIONS: FLU** **PAPER MACHINE SPEED VARIATIONS: CAUSES AND SOLUTIONS** **KELLOGGS'S CASE LIFT SYSTEM UPGRADE** **AN EVALUATION AND OPTIMIZATION OF SERVICE CENTERS' ELECTRONIC DOCUMENT MANAGEMENT SYSTEM** **SPACE UTILIZATION AND FLOW ANALYSIS OF MATERIALS IN THE STERILIZATION ROOM AND SURGERY CART PREP AREA OF A HOSPITAL** **REDESIGN OF 125 SERIES PNEUMATIC VALVE** **STEAM TUNNEL FINISHER**
11:00	**D-115 CCE** **D-202 CS** **D-208 ChP** **D-204/205 ECE** **D-201 EDMMS** **D-212 IEE & EM** **D-109 MAE A** **D-210 MAE B**	**JOHN BEERS ROAD RESURFACING PROJECT** **"WMU SAND LAB WEB APPLICATION"** **CLEANING PROCEDURE CONSOLIDATION** **LARGE-SCALE SELF-SYNCHRONIZING CLOCK** **HYBRID 3D METAL PRINTER-ROTATIONAL AXIS TABLE DESIGN** **MATERIAL HANDLING OPTIMIZATION AT STERLING INDUSTRIES** **NEOVENT (LOW-COST DEVICE TO HELP PREMATURE NEONATES BREATHE)** **IMPLEMENTATION OF MAGNETO RHEOLOGICAL (MR) FLUID FOR VARIABLE VALVE**
11:30	**D-202 CS** **D-208 ChP** **D-204/205 ECE** **D-201 EDMMS** **D-212 IEE & EM** **D-109 MAE A** **D-210 MAE B**	**LOAN ANALYSIS FOR CONSUMERS CREDIT UNION** **MODELING OF PRODUCT COOLING FOR BAKED AND SNACK CRACKERS** **SOLAR TRACKING AND LIGHTING DESIGN FOR A MULTIMEDIA SCULPTURE** **HUMAN-ASSISTED FLUID POWER VEHICLE** **THE OPTIMIZATION OF A PAINT LINE MATERIAL HANDLING SYSTEM** **CARBON FIBER WING REDESIGN FOR UNMANNED AIRCRAFT** **A PORTABLE BIOGAS SEPARATOR AND STORING SYSTEM**
1:00	**D-202 CS** **D-109 MAE A** **D-210 MAE B**	**PARLNT 2.0** **VARIABLE VALVE ACTUATION "Session Closed to Public"** **WIND TURBINE GENERATOR, WIND FLOW THROUGH A NARROW CHANNEL**
1:30	**D-204/205 ECE** **D-109 MAE A** **D-210 MAE B**	**CHAINLESS BICYCLE ELECTRONIC CONTROL SYSTEM** **NOISE AND VIBRATION REDUCTION IN A DUAL-CLUTCH TRANSAXLE** **SUNSEEKER 2016 BATTERY THERMAL DESIGN**
2:00	**D-208 ChP** **D-204/205 ECE**	**STEAM CONDENSATE RECOVERY** **PORTABLE, LOW-COST AMBIENT LIGHT SENSOR**

	D-109 MAE A **D-210 MAE B**	**ROTARY BIOREACTOR** **STANDARD REGISTER MACHINE DESIGN AND COST ANALYSIS**
2:30	**D-208 ChP** **D-109 MAE A**	**DESOLVENTIZER TOASTER DESIGN EVALUATION FOR MAINTENANCE RELIABILTY** **DESIGNING AN ACCESSIBLE HALL EFFECT THRUSTER**
3:00	**D-208 ChP**	**NEW MIX TECHNOLOGY OPTIONS APPLIED TO TABLET COMPRESSION FORMULATION**

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 2016. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

AIM Tech Health
Amway
Berrien County Road Commission
City of Kalamazoo
Coloma High School
Consumers Energy
Eaton Corporation
GETRAG Transmissions Corporation
Goodwill Industries of Southwestern Michigan
Graphic Packaging
Humphrey Products
Industrial Firebrick
Kalsec
Kellogg Company
Metro Health Hospital
Michigan Department of Transportation
NASA Glenn Research Center
National Fluid Power Association
Parker Hannifin
Perrigo
Prein & Newhof
Schupan & Sons Inc.
Sigma Machine
Silent Falcon UAS Technologies
Sterling Industries
Summit Polymers, Inc.
Thermal Tech Engineering
thredUP Inc.
USG Otsego Paper
Unitronics
Western Michigan University ROTC
Wightman & Associates Inc.
X-L Machine Co., Inc.
Zeeland Truss and Components

CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – Decker Hains, Ph.D.
Room D-115

FOREST LAKE PRESERVE

by: Nicholas Cadwell, Kory Gainey, Zachary Gorman, and Andrew Mallory
Sponsors: Alan Smaka and Paul Schram, Wightman & Associates, Inc.
Faculty Advisor: Lieutenant Colonel Decker Hains, Ph.D.
8:30 a.m. – 8:55 a.m.

The Forest Lake Preserve project involved the development of a 120-acre parcel into a recreational sports community in Covert Township, Van Buren County, Michigan. The recreational anchor was the design and construction of a 17-acre lake designed specifically for water skiing, as well as the abutting Van Buren State Trail. The site processed significant development challenges due to high water tables, presence of wetlands, heavily wooded nature, and access constraints. Plans for both the lake construction and development layout were completed.

ZEELAND TRUSS CLAY AVE TORNADO RECONSTRUCTION

by: Fawad Akhtar, Travis Hare, Garrett Johnson and Shaun Merrill
Sponsor: Dean DeHoog, Zeeland Truss and Components
Faculty Advisor: Upul Attanayake, Ph.D.
9:00 a.m. – 9:25 a.m.

On July 6, 2014, an EF-1 tornado destroyed the offices and manufacturing facility of Zeeland Truss & Components on Clay Ave in Wyoming, MI. As requested by Zeeland Truss, Blown Away Engineering has provided an alternative design for a green roof on the replacement structure minimizing runoff and increasing sustainability. This option involved selection of a green roof design, structural analysis of the building and foundation, evaluation of geotechnical suitability of the existing subgrade, and investigation of the new drainage characteristics of the building. Further investigation included potential for future LEED certification and parking lot upgrades.

35TH STREET RESURFACING AND WIDENING
by: Tessa Armintrout, Richard Cnossen, and Guanyi Wang
Sponsor: Michael Schwartz, Prein & Newhof
Faculty Advisor: Valerian Kwigizile, Ph.D.
9:30 a.m. – 9:55 a.m.

Roadway design engineering is an important aspect of a fully functional stretch of road. The design for the resurfacing and widening of a three-quarter mile stretch of 35th Street, in Galesburg, Michigan, involved many facets. The primary issue was location topography; the degree of road-side slope required changes to existing grade which would be made outside of the City's right-of-way. Additionally examined were other roadway implications including non-motorized traffic, roadway safety, and storm-water runoff.

33RD STREET WATER MAIN
by: Carlos R. Dominguez De Marchena, Moraima I. Santos Rosario, and Jose E. Vargas Rodriguez
Sponsor: Matt Johnson, City of Kalamazoo
Faculty Advisor: Decker Hains, Ph.D.
10:00 a.m. – 10:25 a.m.

The eastside district of Kalamazoo is being fed by a single water supply (Station 25) and the objective was to create a back-up pipe that can supply clean water from the moment of construction and for 20 years into the future. For this a water main was constructed on 33rd Street in order to provide a secondary source of water to the East Side High district pressure system of Kalamazoo City. This water main was perpendicularly connected with M-96 Avenue and East G Avenue and continues north when it turns into 32nd street.

BRIDGE PRESERVATION IMPLEMENTING NDT
by: Jack Bowton, Cody Cantu, Travis Miller, and Minh Nguyen
Sponsor: Rich Kathrens, Michigan Department of Transportation
Faculty Advisors: Haluk Aktan, Ph.D. and Upul Attanayake, Ph.D.
10:30 a.m. – 10:55 a.m.

The Michigan Department of Transportation (MDOT) owns and maintains over 4,750 bridges throughout the state. In order to adequately allocate financial resources, MDOT has developed an extensive preservation program to ensure continued safety and prolonged life of the inventory of bridges. One of the essential components of bridge preservation is visual inspection. Visual inspection is the process of visually inspecting a bridge for any insufficiencies. The desire to allow a more quantitative approach to visual inspection has led to the decision of using Non-destructive Testing (NDT) techniques. Our team will focus on evaluating the performance of protective coating on steel bridge structures utilizing NDT.

JOHN BEERS ROAD RESURFACING PROJECT

by: Benjamin Esman, Jonathan Greco, and John Tervo
Sponsor: Brian Bernt, Berrien County Road Commission
Faculty Advisor: Decker Hains, Ph.D.
11:00 a.m. – 11:25 a.m.

John Beers Road resurfacing project had an allotted $234,755 budget available. The goal was to resurface as much road as possible and stay within the given budget amount. In resurfacing the maximum amount of road the project must have also included a survey of the site, widening of the shoulder, proper drainage to support the paved shoulders, and satisfactory maintenance of traffic throughout the project in ordinance of MDOT's standard construction specifications.

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

FAMILY INTERACTION MAP
by: Steven Christy, Kyle Infante, and Chad Peterson
Sponsor: Michael Liepman, Ph.D.; Western Michigan University
Faculty Advisor: John Kapenga, Ph.D.
9:00 a.m. – 9:25 a.m.

Family map was a project designed for psychiatrists to visually map out a family's interaction in hopes of better understanding of what's causing negative behavior. Originally created with sticky notes and/or whiteboards, a more convenient and proficient option was needed. A drag-and-drop web application was developed in Ruby on Rails, a popular web application framework. The application offers physicians an easy to use and portable option to create family maps for their patients.

NEW ELEARNING PROGRAM SUBMISSION SYSTEM
by: Cody Beebe, Alec Carpenter, and Joshua Klingler
Sponsor: John Kapenga, Ph.D.; Western Michigan University
Faculty Advisor: John Kapenga, Ph.D.
9:30 a.m. – 9:55 a.m.

The Computer Science department at Western does not have an effective way to have students submit programming assignments. Current options, including ELearning's Dropbox, email, or programs printed on paper, put a heavy burden on graders. A module integrated with ELearning was created that can accept, run, and even grade programs automatically. Now a teacher can create an assignment on ELearning as usual, but instead of grading each program individually, every assignment can be graded automatically judging by what the teacher expects. This new module will provide an effective means of submitting programming assignments in the future.

STREETLIGHT & POWER OUTAGE MOBILE APP RELEASE 2
by: Andrew Burch and Tyler Pease
Sponsor: Christine Shook, Consumer's Energy
Faculty Advisor: John Kapenga, Ph.D.
10:00 a.m. – 10:25 a.m.

Having a presence in the mobile market is increasingly important. Particularly, the need for energy companies to communicate with their customers about power outages. The lonic framework was used on the client side in concert with Cordova, HTML5, CSS and AngularJS to create a hybrid mobile application. The upgraded server uses Python, Flask and a SQLite database. This release includes not only new features, but also improvements to stability, usability, and better support for Android. The application now lends itself to a more complete customer experience, and one that can be easily maintained in the future.

WEB APPLICATION FRAMEWORK FOR STEM SIMULATIONS: FLU
by: Hassan Alshammasy, James Kwapien, Austin Smith, and Caleb Viola
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. – 10:55 a.m.

Interest in STEM education has historically been a challenge for primary and secondary students. A modular web application framework that supports simulations was created using Ruby on Rails, in which the students control the input and measure the output. Statistical analysis of the simulation is available through R. The framework allows for bi-directional feedback between instructor and student. This is illustrated with an agent based flu simulation, which allows students to map an entire flu season and introduces STEM concepts via a real world example.

"WMU SAND LAB WEB APPLICATION"
by: Seth Rachwitz, William Singer, and Christopher Watts
Sponsor: Sam Ramrattan, Ph.D.; Western Michigan University
Faculty advisor: John Kapenga, Ph.D.
11:00 a.m. – 11:25 a.m.

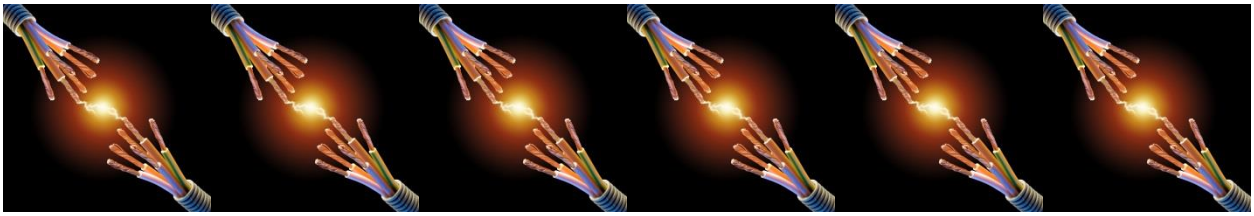
University labs that do testing for outside companies sometimes struggle to send test data a timely, professional fashion. To supplement the current system (e-mail), a web application was designed to allow the lab to create "tests" for any company and upload CSV data files and image containing graphs. Along with this, collaboration tools are built in to allow company employees to discuss each test with lab technicians instead of using e-mail. The goal of the web application is to decrease the time it takes to give companies their test results, and improve the communications companies have with the lab.

LOAN ANALYSIS FOR CONSUMERS CREDIT UNION
by: Aron Lawrence, Renee Shedlock, Moses Troyer, and Nate Vardell
Sponsor: Consumers Credit Union
Faculty Advisor: John Kapenga, Ph.D.
11:30 a.m. – 11:55 a.m.

To be competitive when approving loans, loan auditors must evaluate the loan quickly and accurately. A model was developed to more efficiently approve or deny incoming loans automatically, with less input from loan auditors. Four different methods of statistical classification were researched to analyze the incoming data, and to find the most appropriate and reliable technique at doing so. A decision tree model was decided to be the most helpful for Consumers Credit Union.

PARLNT 2.0
by: Kendrick Cline, Lawrence Cuneaz, Dillon Daudert, and Austin Jones
Sponsors: John Kapenga, Ph.D. and Elise de Doncker, Ph.D.; Western Michigan University
Faculty Advisors: John Kapenga, Ph.D. and Elise de Doncker, Ph.D.
1:00 p.m. – 1:25 p.m.

Parlnt 1.2 has not been updated for over a decade and is outdated, requiring multiple updates. Autoconf is used to configure Parlnt, and is being updated to target modern environments. Parlnt lacks a functional testing suite, which is being implemented to confirm the program runs as expected in different environments. Many legacy systems supported by the Autoconf are binge removed to streamline the application. Updating Parlnt will make the program more accessible for a wide array of modern environments, encouraging the program's use in research.



ELECTRICAL AND COMPUTER ENGINEERING

Session Chairs – Steven M. Durbin, Ph.D. and Ralph Tanner, Ph.D.

Room D-204/205

DEVELOPMENT OF AN INTELLIGENT SURGICAL BOX-TRAINER

by: Shehab Hamadi, Emily Perez, and Joshua Snowden

Sponsor: Janos Grantner, Department of Electrical and Computer Engineering

Faculty Advisor: Janos Grantner, Ph.D.

9:00 a.m. – 9:25 a.m.

There exists a need for more "intelligent" box trainers. This could be achieved by introducing relatively cheap sensor components and utilizing microcontrollers to measure important performance characteristics. The following parameters were measured and recorded: the force applied to the hypothetical tissue surface, the rotational movements of the trainee's hands/wrists, and the time needed to complete the tasks. The results are recorded on an Excel spreadsheet and displayed on a laptop. The new box trainer will help trainees to keep track of their performance and surgical faculty to assess student records, in order to evaluate trainee's performance.

ROOM MONITOR

by: Don Rozsi, Brent Allen, and Mohammed Alzayer

Sponsor: John Kapenga, Department of Computer Science

Faculty Advisor: Ikhlas Abdel-Qader

9:30 a.m. – 9:55 a.m.

The Room Monitor is a device that monitors the temperature, humidity, and the AC wall voltage in a room. The device sends out warning emails and text messages when the room temperature, humidity, or wall power reaches a user-defined threshold, preventing equipment loss due to overheating or condensation.

DIFFUSED JUNCTION SILICON SOLAR CELL
by: Andrew Borkowski Jr., Ahmad Mohammed, and Charlotte Peterson
Sponsor: Steve Durbin, Department of Electrical and Computer Engineering
Faculty Advisor: Steve Durbin, Ph.D.
10:00 a.m. – 10:25 a.m.

The Department of Electrical and Computer Engineering has a number of solar related activities. To bridge and complement these activities, the department would like to be able to instruct undergraduate students in what is involved in the fabrication of a silicon based solar cell. This solar cell was modeled in AutoCAD, Suprem, and Adept to acquire the appropriate characteristics needed to meet specifications. Once modeled the solar cell was created using spin on dopant and screen-printing technology. The creation of this solar cell aids in expanding the knowledge and future studies of those in the electrical engineering community.

KELLOGG'S CASE LIFT SYSTEM UPGRADE
by: Anthony Bradley, Brett Thomas, and Cody Wainer
Sponsor: Kellogg Co.
Faculty Advisor: Ralph Tanner, Ph.D.
10:30 a.m. – 10:55 a.m.

A case lift system in Kellogg's Battle Creek plant will be upgraded to be driven by a servo motor and controlled by a programmable logic controller. This entails investigating and understanding the inner workings of the limit switches, relays, sensors, etc. of the previous process and translating that into ladder logic to drive the system. The system will be integrated into Kellogg's integrated network, allowing access to remotely control and observe the machine from the various human-machine interface displays throughout the plant. Schematics, architectural drawings, and user manuals will be updated to reflect the changes made to the system.

LARGE-SCALE SELF-SYNCHRONIZING CLOCK
by: Rakan Alghufaily, Joseph Onyenwuzor, and Daniel Pouliot
Sponsor: Steve Durbin, Department of Electrical and Computer Engineering
Faculty Advisor: Lina Sawalha, Ph.D.
11:00 a.m. – 11:25 a.m.

The need for accurate, highly visible clocks is apparent whenever one enters an office space to find a nonfunctional battery-operated clock. This self-synchronizing LED clock, constructed on a large scale, features a segmented array of LED lights with digits and colons to represent hours, minutes, and seconds, to produce a display that is easily visible from great distances. The unique feature of the design is that it uses time stamp inputs from an Internet connection to keep the time synchronized to an accuracy of one second. The device is useful for combining precise time measurement into an inspiring wall decoration.

SOLAR TRACKING AND LIGHTING DESIGN FOR A MULTIMEDIA SCULPTURE
by: Alexandra C. Ferguson, Cody J. Middleton, and Chelsea L. Russell
Sponsors: Dale Quattrin, Ph.D., Ryan Ransom, Charles Luchies
Coloma High School
Faculty Advisors: Raghe Gejji, Ph.D. and Damon Miller, Ph.D.
11:30 a.m. 11:55 a.m.

A lighting system utilizing solar energy was built to illuminate a wireframe multimedia sculpture. Increased power generation from the solar cells was achieved using a solar tracking mechanism. Color-selectable light emitting diodes were used to provide the user with unlimited customization options. A digital control system was designed using an Arduino microcontroller to configure the color of the lights and the positioning of the solar panel. The sculpture will create a sense of community and sustainability among students at the school.

CHAINLESS BICYCLE ELECTRONIC CONTROL SYSTEM
by: Demeury Naranjo-Rodriquez, Fabian Luis Lopez, and Mojtaba Al Jaffar
Sponsor: Sandra Harper, Parker Hannifin Corporation
Faculty Advisor: Damon Miller, Ph.D.
1:30 p.m. – 1:55 p.m.

An electronic control system was designed to facilitate operation of a hydraulic bicycle developed by students of the Engineering Design, Manufacturing, and Management Systems Department. The system was designed to control the operation sequence of several hydraulic valves with minimal intervention from the rider. A custom-made microcontroller-based control panel was built to make all system functions available to the rider in one location. A smart display was incorporated in the design to provide feedback on the operation of the hydraulic system and the vehicle speed. A switching power box was also developed.

PORTABLE, LOW-COST AMBIENT LIGHT SENSOR
by: Abdullah AlZaher, Lucas Everts, and Joseph Hagan
Sponsor: John Kapenga, Ph.D., Department of Computer Science
Faculty Advisor: Dean Johnson, Ph.D.
2:00 p.m. – 2:25 p.m.

Light is undoubtedly an incredibly important part of human life. Light, or lack thereof, is important in how humans sleep. Being exposed to ambient light for many hours during different times of the day has an effect on human health. A portable light sensor that can be used in field tests to determine if ambient lighting is healthy for humans during different times of the day was designed. A light source is healthier if it emits more blue light during the day and less at night. Ideally, this apparatus would utilize sensors to determine how much unhealthy light is present.

ENGINEERING DESIGN, MANUFACTURING, AND MANAGEMENT SYSTEMS

Session Chair – Betsy Aller, Ph.D.

Room D-201

RAPID MOLD DEVELOPMENT

by: Steven Mawu, Collin Morlock, and Tyler Psychas

Sponsor: Joe Korzilius, Industrial Firebrick

Faculty Advisors: Sam Ramrattan, Ph.D. and Pavel Ikonomov, Ph.D.

8:00 a.m. – 8:25 a.m.

Rapid mold development for metal casting using machinable ceramic tiles eliminates many laborious and costly pattern-making steps and reduces the total time for prototype production. This technology significantly decreases the number of processing steps in producing complex molds. The process developed uses ceramic tile that can be precision machined using 3D solid modeling software to develop the mold cavity quickly. The mold cavity is built tile layer by tile layer into a one-piece mold, with precisely machined cores and internal features. The completed molds are strong and can be stored or shipped offsite to be cast with any type of alloy.

LEADERSHIP REACTION COURSE PROPOSAL

by: Andrew Wickens and Race Bedell

Sponsor: Western Michigan University ROTC

Faculty Advisors: LTC Decker Hains, Ph.D. and Betsy Aller, Ph.D.

8:30 a.m. – 8:55 a.m.

A need exists for a leadership reaction course (LRC), which will challenge participants both mentally and physically in order to enhance their leadership abilities. Manuals for both the overall facility and individual challenges were developed to ensure the facility is used properly and facilitates leadership development. The course's design limits its overall size and environmental impact through creation of interchangeable lanes and challenges. Standardized equipment sizes coupled with variable lanes will reduce the facility's cost and size. The resulting design, procedure, and layout of this facility provide a foundation on which to format a proposal for its construction.

DEVELOPING A DECISION SUPPORT SYSTEM TO DETERMINE OPTIMAL SAMPLE SIZE FOR A PRODUCT

by: Mark Thornton and Chris Woods
Sponsor: Jeff Kiel, Sterling Industries
Faculty Advisor: David Lyth, Ph.D.
9:00 a.m. – 9:25 a.m.

Consumers demand high quality products and services at reasonable cost. To meet these expectations, quality engineers need to identify the sequential sampling plan that will optimize the total cost of the inspection process. A production process was analyzed using statistical methods to determine its current level of performance and to develop a decision support system (DSS) to simplify the inspection system design process. This DSS uses cost to inspect and cost of failure to minimize the total quality cost of the process. A new process was then developed from the results using control charts and determining a sample size to fit the need of the order.

REVERSE ENGINEERING OF AN ETHMOID BONE MODEL

by: Gregory Foresi, Jordan Matthews, Kayla Webster, and Shannon Zemlick
Faculty Advisor: Mitchel Keil, Ph.D.
9:30 a.m. – 9:55 a.m.

There is a great demand for hands-on learning in the medical field, but human cadavers and accurate learning tools are costly and not readily available. Students are thus limited when studying highly complex features like the ethmoid bone, a small bone located centrally in the skull behind the eye sockets. A handmade model was scanned with a white light 3D scanning device and point clouds were imported into Geomagic Design X software for processing. The final detailed parametric model, created in SolidWorks solid-modeling software, is fully scalable and can be converted to multiple file types to be 3D printed into a functional model. This model will provide a valuable hands-on learning experience for students in the medical field.

PROCESS IMPROVEMENT BY AUTOMATION

by: Ariel Hamilton and Stephanie Hatfield
Sponsors: John Dillworth, Greg Root, and Doris Tipken, Goodwill Industries of Southwestern Michigan
Faculty Advisor: Jorge Rodriquez, Ph.D.
10:00 a.m. – 10:25 a.m.

Process improvements can make a significant impact on a company. At Goodwill Industries of Southwestern Michigan (Goodwill SWMI), process improvements in the clothing sorting and hanging areas were examined. Automation and semi automation were key features that were explored. Time studies, ergonomics tests, and non-value added charts helped determine how to improve the processes. Proposed improvements will reduce the error rate and lead time while improving profitability.

AN EVALUATION AND OPTIMIZATION OF SERVICE CENTERS' ELECTRONIC DOCUMENT MANAGEMENT SYSTEM

by: Brett Davis, Joshua McPartlin, Dane Meter, and Yiga Ngbogbara
Sponsors: Krisha Akerman and Darcy Musser-Mitchell, Kellogg's
Faculty Advisor: Larry Mallak, Ph.D.
10:30 a.m. – 10:55 a.m.

Electronic document management systems are used in industry to secure, simplify, and steamline major business operations. Kellogg Company's Global Business Services centers wanted to improve the quality of their desktop procedures for accounts payable and document imaging operations. Through the use of flowcharting, format reconstruction, and simplification techniques, the desktop procedures have been optimized to improve productivity, to simplify the learning process for new users, and to provide a more intuitive user interface for employees.

HYBRID 3D METAL PRINTER – ROTATIONAL AXIS TABLE DESIGN

by: Joshua Jones, Jeff Rudel, and Alexander Updegraff
Faculty Advisor: Pavel Ikonomov, Ph.D.
11:00 a.m. – 11:25 a.m.

When producing a part, Western Michigan University's hybrid 3D metal printer is limited to three linear axes. For the machine to reach a much higher potential in part capability, a fourth and fifth axis rotational table was designed and manufactured. Using SolidWorks, end mills, lathes, and CNC mills, a design became reality to produce 5-axis components. With 5-axis capability, the hybrid 3D metal printer will be able to produce more complex designs that require both linear and rotational programs.

HUMAN-ASSISTED FLUID POWER VEHICLE

by: Andrew Bonter, Cameron Brown, Aaron Huntoon, and Austin Vojcek
Sponsor: Parker Hannifin and the National Fluid Power Association
Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriguez, Ph.D.
11:30 a.m. – 11:55 a.m.

The effect of emissions on the environment has created a need for clean alternative power driven systems. The Chainless Challenge competition gives students the opportunity to design, build, and test a human-assisted fluid power vehicle. An upright bicycle frame was designed to accommodate a hydraulic system used for power transmission to operate the vehicle. Initial designs were evaluated for performance and efficiency, and to determine the optimal system configuration. Modeling and simulation software were used for frame/mounting design and analysis. The final design was fabricated, and the complete system was tested post-production. The hydraulically powered vehicle designed to compete in the Chainless Challenge meets all criteria and can be used as a concept for future alternative power vehicles.




INDUSTRIAL AND ENTREPRENEURIAL ENGINEERING & ENGINEERING MANAGEMENT

Session Chair – Azim Houshyar, Ph.D.

Room D-212

SCRAP PROCESSING COST ANALYSIS THROUGH STOCHASTIC SIMULATION

by: Sinan Kapucu, Love Kumar, and John Lewkowicz

Sponsor: Schupan & Sons Incorporated

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

9:30 a.m. – 9:55 a.m.

In the industrial scrap industry, it is difficult to determine the value of recycling contracts due to changing commodity pricing and processing times. Several recycling contracts were analyzed to identify the cost structure of contracts. Time studies were conducted to determine the processing times of various commodities. Monte Carlo simulation was performed to determine the value and distribution of earnings for contracts. Changes to the process used to develop pricing were proposed.

CAPACITY PLANNING AND OPTIMIZATION OF PRODUCTION

by: Michael Alvis, Anthony Pripusich, Matt Ryan, and Mohammed Tashkandi

Sponsor: Chris Orlowski, General Manager of X-L Machine Company Inc.

Faculty Advisors: Lee Wells, Ph.D. and Azim Houshyar, Ph.D.

10:00 a.m. – 10:25 a.m.

A local machining company was uncertain of their machines' annual capacity. With a goal of developing and improving processes at the machine shop, time studies, work design, line balancing, ergonomic analysis, and ProModel were used to develop solutions. Studies were performed on a production area that runs six different part numbers to determine the proper capacity planning as well as create an overall optimized production area.

SPACE UTILIZATION AND FLOW ANALYSIS OF MATERIALS IN THE STERILIZATION ROOM AND SURGERY CART PREP AREA OF A HOSPITAL

by: Ryan Harper, Phil Roth, Mustafa Tashkandi, and Matthew Weller

Sponsor: Kevin Pitcher, Metro Health Hospital

Advisor: Tycho Fredericks, Ph.D.

10:30 a.m. – 10:55 a.m.

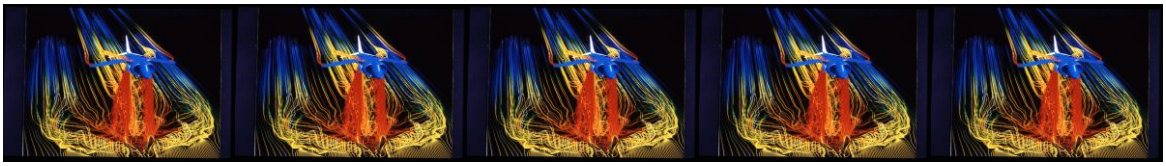
The hospital was having material handling issues in their Sterilization Room and Surgery Cart Prep area. With an increasing number of surgeries over the years, the material handling process had not been re-evaluated for the better method. With that in mind, the primary objectives for the project were to decrease the workload per case cart, increase the throughput, and reduce factors affecting the nosocomial infection rate. Root cause analysis, process flow charts, simulation, and facility design (SLP) were used to evaluate and improve the process of material handling in the Sterilization Room and Surgery Cart Prep area.

MATERIAL HANDLING OPTIMIZATION AT STERLING INDUSTRIES
by: Erik Humes, Eugene Manin, and Jason Stryjewski
Sponsor: Jeff Kiel, Sterling Industries
Advisors: Azim Houshyar, Ph.D. and Bob White, Ph.D.
11:00 a.m. – 11:25 a.m.

The material handling system at a local manufacturing plant was studied to improve efficiency, and an expansion plan was developed to accommodate company growth. Time studies, Pareto analysis, facility layout, and simulation modeling were used to analyze and improve the current system. The proposed expansion plan reduces cost and expands the capacity of the material handling system.

THE OPTIMIZATION OF A PAINT LINE MATERIAL HANDLING SYSTEM
by: Matthew Bracey, Ryan Fendley, Ryan Mabie, and Abdulaziz Saadawi
Sponsor: Kal Kalkowski, Landscape Forms, Inc.
Advisor: David Meade, Ph.D.
11:30 a.m. – 11:55 a.m.

The organization and sequencing of material before, during, and after painting can have a significant impact on the work-in-process, line density, cycle time, and throughput of finished product in a manufacturing facility. An analysis of current methods was conducted in order to document the current state process using time-studies, direct observations, and operator interviews. Process charts were used to map the flow of material before, during, and after the paint line. Production scheduling and staging techniques were used to improve flow of material. The new material handling system will decrease the lead time for finished products, as well as non-value added labor.



MECHANICAL AND AEROSPACE ENGINEERING A

Session Chair – Bade Shrestha, Ph.D. and Muralidhar Ghantasala, Ph.D.

Room D-109

STANDARD REGISTER MACHINE DESIGN AND COST ANALYSIS

by: Jeromy Dobbin, and Reed Isenhart

Sponsor: Eric Pantelleria, Summit Polymers, Inc.

Faculty Advisor: Daniel Kujawski, Ph.D.

9:00 p.m. – 9:25 p.m.

A new standard design was created for equipment assembling automobile register vanes. The goal was to try to eliminate a slide out plate completely and to reduce the cost of an overall machine. Four alternative designs were developed in Solidworks, parametric solid modeling software. These designs had a total cost rundown in order to deem if the new design(s) are reducing the machine's price. The designs are used as a prototype for the standard design for register vane assembly machines.

FORMULA SAE PADDLE SHIFT IMPLEMENTATION

by: Nick Frank, Ateet Shah, and Chad Werner

Sponsors: Patrycja Charubin, Unitronics and Tom Verbeek, Humphrey Products

Faculty Advisor: Jennifer Hudson

9:30 a.m. – 9:55 a.m.

FSAE vehicles of previous years offered a mechanical push-pull shifting lever, requiring the driver to remove their right hand from the steering wheel to perform a shift. This manual system resulted in increased shift times and decreased vehicle control. The implemented pneumatic system is responsible for shifting operation and receives driver input through the use of paddle switches located on the rear of the steering wheel. A no-lift shifting protocol negates the need for the driver to lift their foot from the accelerator pedal to perform an upshift, increasing vehicle acceleration while decreasing shift times. Extensive research, design and testing proved the system to be both safe and reliable.

BALLOON ALTITUDE CONTROL MECHANISM
by: Cameron Carson, Muqeet Farhad, Syed Hamza Mehdi, and Timothy Jon-Alan Taylor
Faculty Advisor: Kristina Lemmer
10:00 a.m. – 10:25 a.m.

Obtaining atmospheric data can become quite an expensive task. Generally, latex balloons are launched and will eventually burst at a maximum altitude. A constant altitude balloon device to level out at a desired altitude for a set period of time was built. SolidWorks and numerous other software package were used to design and test different mechanisms. A solenoid valve was programmed to halt the flow of gas into the balloon after the desired buoyancy level was achieved. The device can now be effectively used to gather atmospheric data or obtain imagery from a high altitude.

REDESIGN OF 125 SERIES PNEUMATIC VALVE
by: Jordan Kananen, and James Thornton
Sponsors: Todd Bordewyk and Steve Mohney, Humphrey Products
Faculty Advisor: Sam Ramrattan, Ph.D.
10:30 a.m. – 10:55 a.m.

The purpose of this project is to replace the current manufacturing method for the 125 series pneumatic valve implemented by Humphrey products with a die casting process which would allow for internal orifice improvements. The newly designed orifice would allow for improved air flow rate through the valve. The current design is limited to a round orifice due to the current machining process and will be redesigned to a kidney shaped orifice in the new design in order to allow for an increase in air flow through the valve. This process will also save Humphrey products up to 20% in yearly production costs.

NEOVENT (LOW-COST DEVICE TO HELP PREMATURE NEONATES BREATHE)
by: Nick Habben, and Hoa Le
Sponsors: Jim VanWeelden, Sigma Machine and Stephen John, AIM Tech Health
Faculty Advisor: Peter Gustafson, Ph.D.
11:00 a.m. – 11:25 a.m.

Bubble Continuous Positive Airway Pressure (Bubble CPAP) technology is widely used around the world for premature neonates with mild to moderate respiratory distress. However, it is inadequate for infants in greater respiratory distress. Dual Positive Airway Pressure (Biphasic PAP or NIPPV) is a treatment that helps stabilize the alveoli of the infants and thus improves outcomes in more severe cases. NeoVent is a low cost bubble Biphasic PAP as well as bubble NIPPV intended for use in low resource settings. The NeoVent design was refined for ease of use, reliability, and low cost manufacturing in preparation for clinical trials.

CARBON FIBER WING REDESIGN FOR UNMANNED AIRCRAFT
by: Kurtis Brushaber, Ethan Cummings, and Timothy Myer
Faculty Advisor: Peter Gustafson, Ph.D.
11:30 a.m. – 11:55 a.m.

Current Unmanned Aircraft Vehicles have limited range. By constructing a new wing with an increased aspect ratio, an increase in the vehicle's range is possible. Using mathematical software, wing designs are simulated to model flight performance. Analysis was completed to improve the range and endurance of the aircraft. Lightweight 12k carbon fiber was used to offer a high structural strength to weight ratio. Structure testing was completed to ensure proper safety factors are met. The newly designed wing has the capability to be installed on existing aircraft, increasing its versatility.

Session Closed to Public

VARIABLE VALVE ACTUATION
by: Andrew Fallon, Parker Glass, Eric Goeckel, and Alexander Horn
Sponsors: Eric Yankovic, Dr. James E. McCarthy, Jr., Eaton
Faculty Advisor: Rick Meyer, Ph.D.
1:00 p.m. – 1:25 p.m.
Session Closed to Public

Investigate various forms of OBD on VVA systems.

NOISE AND VIBRATION REDUCTION IN A DUAL-CLUTCH TRANSAXLE
by: Ken Andrews, Coby Clark, and Kyle Kadlec
Sponsor: Neil Jackson, GETRAG Transmissions Corporation
Faculty Advisor: Rick Meyer, Ph.D.
1:30 p.m. – 1:55 p.m.

Dual-Clutch transmissions are prone to an undesired noise, termed "grattle", which originates from vibrational excitation of the large spinning masses outside the load path of the driven gear. It is proposed that by inducing drag on the unloaded, rotating masses the vibrations can be damped and grattle traces can be eliminated. As a proof of concept, a "Drag on Demand" feature that utilized an alternator was designed, prototyped and tested. This feature is able to induce drag as well as to conserve the lost energy as electric energy for use elsewhere in vehicle.

ROTARY BIOREACTOR
by: Kenneth Sage, and Austin Trusty
Faculty Advisor: William W. Liou
2:00 p.m. – 2:25 p.m.

Cell testing is required to properly create any type of modern medicine. There are different types of devices that can be used to grow cells for testing; petri dish, suspension, and rotational growth. The three different types of growth were tested against each other to determine which device grew the best representation of human cells. A three dimensional modeling software was utilized to create a customized rotary bioreactor that fit the self-made constraints. There was a desire for the most compact and lightweight rotary device that surpassed the capabilities of the two controls.

DESIGNING AN ACCESSIBLE HALL EFFECT THRUSTER
by: Matthew Baird,Nagual Simmons, Joel Thompson
Sponsor: Kristina Lemmer, Ph.D.
Faculty Advisor: Kristina Lemmer, Ph.D.
2:30 p.m. – 2:55 p.m.

A Hall Effect thruster (HET) is a relatively simple but expensive type of electric propulsion that is difficult to design. Normally, it is outside the research capabilities of university students. Using a small number of components to produce an electric field, the HET accelerates xenon ions to extremely high velocities to provide thrust. The design goal is to model using COMSOL software, build, and test a small HET that is accessible to any university with standard resources. It is with this thruster that future HET research will be performed thus opening the field of study to many more researchers.

MECHANICAL AND AEROSPACE ENGINEERING B

Session Chair – Rameshwar Sharma Ph.D. and Tianshu Liu, Ph.D.

Room D-210

FLOW CONTROL AND ELECTRIC ACTUATORS

by: Zachary Berning, Thomas Blount, and Devin Leach

Sponsor: Bill Widman, Thermal Tech Engineering

Faculty Advisor: Christopher Cho, Ph.D.

9:00 a.m. – 9:25 a.m.

Control valves are an important asset to nearly all plants. They can be used to control the flow through a pipe to a certain pressure or flow rate. Many applications may require certain pressures or flow rates to keep the fluid in liquid or gaseous form, satisfy process requirements, or various other reasons, including safety. A piping skid is created to test the repeatability, accuracy, and response time of an electric actuator versus the traditional pneumatic actuator. The results will yield the feasibility of utilizing differential pressure transmitters to regulate flow, and reduce the need for compressed air in plants.

CUBESAT GROUND STATION

by: Tyler Baines and Anthony Murawski

Faculty Advisor: Jennifer Hudson, Ph.D.

9:30 a.m. – 9:55 a.m.

Every satellite, no matter the mission, needs a means of communication with the ground. A ground station that sends and receives data, all while tracking the satellite as it crosses overhead, has been designed. The ground station has two main systems that allow the station to work: the rotating antenna system, and the computer system. The computer system is designed to control the transmission, reception and rotation of the antenna system. The rotation of the antenna system is controlled using DC electric motors. The satellite tracking will be done using orbital simulation software in the computer system once launch details are known.

OPTIMIZATION OF A SUSTAINABLE BICYCLE GENERATOR
by: Erika Fojtik, and Kelsey Pitschel
Sponsor: Harold Glasser, Ph.D., WMU Office of Sustainability
Faculty Advisor: Damon Miller, Ph.D.
10:00 a.m. – 10:25 a.m.

Human powered energy is an underutilized form of renewable energy that is able to combat small-scale dependencies on natural gas and coal. This project focuses on optimizing overall power output of a cost effective bike generator for home and office applications. Benefits include promoting wellbeing through exercise during the winter months, low life cycle and environmental impacts, a modular system that is portable and replicable, and a solution for remote energy needs via portable batteries. The generator can act as an add-on to stationary bicycles with easy set-up and teardown.

STEAM TUNNEL FINISHER
by: Huy Bui, Heisheung Cheng, and Adam DeMeyere
Sponsor: John Voris, thredUP Inc.
Faculty Advisor: Judah Ari-Gur, Ph.D.
10:30 a.m. – 10:55 a.m.

Wrinkled clothing is common in industries that distribute clothing in packaged boxes. Current processing methods of minimizing the folds and creases are time consuming where each piece of clothing is manually treated with an iron press or steamer, which is inefficient and cannot be produced in mass quantities. A machine was designed to automate and create a more efficient workflow cycle. By loading garments onto a conveyer system through an enclosed chamber, sections of the chamber treat that fabric by exposing it to saturated steam, which relaxes the fibers and makes it more formable. A vertical circulating airflow then allows the garment to straighten out as well as dry in the process. This machine will treat clothing and remove wrinkles on an industrial scale.

IMPLEMENTATION OF MAGNETO RHEOLOGICAL (MR) FLUID FOR VARIABLE VALVE
by: Christopher Clarence Arnold, Imani G Nasari, and Garrett T Piers
Sponsor: Mark Van Windergen and James E McCarthy, Ph.D., Eaton Corporation
Faculty Advisor: Rich Meyer, Ph.D.
11:00 a.m. – 11:25 a.m.

Magneto-Rheological (MR) fluid is a type of smart fluid in a carrier fluid, usually a type of oil. When subjected to a magnetic field, the fluid greatly increases its viscosity, to the point of becoming a viscoelastic solid. This project will demonstrate possible use for MR fluid in a variable valve actuation (VVA) valvetrain system.

A PORTABLE BIOGAS SEPARATOR AND STORING SYSTEM
by: Mitchell Mckenna
Faculty Advisor: Bade Shrestha, Ph.D.
11:30 a.m. – 11:55 a.m.

As landfills and composters decompose organic waste, they create biogas. This biogas is mainly carbon dioxide and methane, (methane is a major constituent of natural gas). The proposed system design captures this waste gas, and separates out the methane. The stored methane is then used as a fuel source for cooking, heating or running engines. The system has been designed to allow a single person to travel rural areas and collect biogas from small, local composters, so that it can be used elsewhere, creating a new market with a side effect of keeping methane, a potent greenhouse gas, out of the atmosphere.

WIND TURBINE GENERATOR, WIND FLOW THROUGH A NARROW CHANNEL
by: Tyler Blake, Mercy Mutuku, and Thanaselan Selvarajoo
Sponsor: Daniel M. Mutuku, Consumers Energy
Faculty Advisor: William Liou, Ph.D.
1:00 p.m. – 1:25 p.m.

The adverse impacts on the environment from fossil fuels have shifted the global focus towards renewable energy sources. A model was built to show the benefit of placing a wind turbine in narrow channels. Additionally, a Computational Fluid Dynamics analysis provided wind flow patterns that enabled harnessing of wind energy with the placement of wind turbines in a tunnel. The decreased area in the tunnel increased the kinetic energy of the air, which was then harnessed by the turbines. The research provided can by utilized in existing buildings providing and efficient and cost effective solution to save on energy costs.

SUNSEEKER 2016 BATTERY THERMAL DESIGN
by: Cameron Knight and Denis Kimuhu Maina
Faculty Advisor: Mitch Keil, Ph.D.
1:30 p.m. – 1:55 p.m.

The 2016 Sunseeker solar vehicle will feature a battery pack composed of 420 Li-ion 18650 batteries in order to store the energy collected by the photovoltaic array. Given the sensitivity to heat of the lithium batteries, a robust heat dissipation system is required to ensure safety and reliability of the vehicle. A 3-D model was designed via Siemens NX and simulated in Autodesk CFD Simulation. The designed system will be a staple feature during the upcoming American Solar Challenge in which the vehicle will compete.

STANDARD REGISTER MACHINE DESIGN AND COST ANALYSIS

by: Jeromy Dobbin, and Reed Isenhart
Sponsor: Eric Pantelleria, Summit Polymers, Inc.
Faculty Advisor: Daniel Kujawski, Ph.D.
2:00 p.m. – 2:25 p.m.

A new standard design was created for equipment assembling automobile register vanes. The goal was to try to eliminate a slide out plate completely and to reduce the cost of an overall machine. Four alternative designs were developed in Solidworks, parametric solid modeling software. These designs had a total cost rundown in order to deem if the new design(s) are reducing the machine's price. The designs are used as a prototype for the standard design for register vane assembly machines.

CHEMICAL AND PAPER ENGINEERING

Session Chair – Andrew Kline, Ph.D.
Room D-208

RECYCLING OF POLYETHYLENE COATED PAPER

by: Gina Tallent
Faculty Advisor: Alexandra Pekarovicova, Ph.D.
9:00 a.m. – 9:25 a.m.

Polyethylene coated paper provides an impermeable barrier that is commonly used in consumer packaging. Since polyethylene is not a biodegradable compound, these paper products are unable to decompose in landfills. In an attempt to separate the polyethylene from the paper, samples were studied and repulped in different solutions. These solutions contained different concentrations of water, sodium hydroxide, toluene, trichloroethane, cellulose or xylanase. The percent weight of polyethylene was calculated to determine how well the polyethylene separated from the paper. The separation of the polyethylene from the paper would decrease the impact this type of packaging currently has on the environment.

TESTING OF NANOFIBRILLATED CELLULOSE AS A SURFACE ADDITIVE

by: Derek Kester
Faculty Advisor: Margaret Joyce, Ph.D.
9:30 a.m. – 9:55 a.m.

Nanofibrillated Cellulose (NFC) is of growing interest in the field of paper technology. A solution of NFC and starch was applied as a surface additive to the wet end of a paper machine. The treated paper was then tested for tensile, tear, smoothness, and porosity following TAPPI standards and conditions. The results were compared to various ratios of NFC to Starch in the applied solution. This work shows possible benefits of using NFC as a surface additive in terms of strength and other property increases while using small amounts of NFC.

MODIFYING AN OPEN WATER SYSTEM TO A CLOSED SYSTEM

by: Katie Gaviglio, Stephen Miller, and Daniel Schillinger
Sponsors: Mike Lahti, and Frank Knowles; USG Otsego Paper, Inc.
Faculty Advisor: Andrew Kline, Ph.D.
10:00 a.m. – 10:25 a.m.

In paper production it is common for the process to yield a high volume of water effluent. With additional water treatment, it is possible to recycle water back into the papermaking process to reduce the amount of fresh water intake needed and water effluent being discharged to the Kalamazoo River. This effectively turns an open system into a closed system to proactively improve the paper mill's environmental sustainability.

PAPER MACHINE SPEED VARIATIONS: CAUSES AND SOLUTIONS
by: Darven Raaj Chan, Brendan M. Galloway, and Danielle C. Valdivia
Sponsors: Lindsay Fisher, and Forest Adams; Graphic Packaging International Inc.
Faculty Advisor: Andrew Kline, Ph.D.
10:30 a.m. – 10:55 a.m.

Paper machines are very complicated and demanding pieces of equipment, needing continuous maintenance and troubleshooting to solve issues affecting the final product. Recently, a local paper machine that produces 100% recycled paperboard, discovered speed variations throughout production which could be caused by any number of factors including stock freeness, stock consistency, furnish, caliper, coat weight, steam loading, and steam availability. Once the factors were determined, options were explored to solve the issues and an optimum cost solution to prevent the speed variations was developed and analyzed economically.

CLEANING PROCEDURE CONSOLIDATION
by: C. Kudary, and K. Murray
Sponsor: Bret Nordland, Amway
Faculty Advisor: Andrew Kline, Ph.D.
11:00 a.m. – 11:25 a.m.

Current production of oral care products are being moved from the Pressure Packaging Plant to Cosmetics Manufacturing. Both facilities are located at the headquarters in Ada, Michigan. The relocation of the oral care products is driven by opportunities to optimize costs in each plant. To achieve this, cleaning processes were developed by adapting current process in each plant to accommodate the additional products in Cosmetics. This was accomplished by grouping the products into new and previously developed product families, and then designing cleaning procedures in order to maintain an effective level of cleanliness and quality.

MODELING OF PRODUCT COOLING FOR BAKED AND SNACK CRACKERS
by: Joseph Clayton, Jenna Hagenloch, Anusha Rabindranath, and Brian Stygar
Sponsors: Jim Molchan, Adam Gardebrecht, and Adrian Harrell; The Kellogg Company
Faculty Advisor: Andrew Kline, Ph.D.
11:30 a.m. – 11:55 a.m.

The cooling of snack crackers, after the baking process, is an important step prior to packaging. A model was developed for cooling the crackers. The model allows for the adjustment of multiple operating conditions, such as temperature, depth of the crackers, and the speed of the line. The completed model provides the user with the ability to predict cooling requirements and to validate pre-existing equipment operating conditions. The model will aid the design of new equipment as well as modifications to improve existing installations to operate within the desired specifications for each process.

STEAM CONDENSATE RECOVERY
by: Marnie Fettig, Tom Green, and Ha Phan
Sponsors: Jason Buero and Dave Gordon; Kalsec
Faculty Advisor: Andrew Kline, Ph.D.
2:00 p.m. – 2:25 p.m.

Recovery of steam condensate in a boiler system in essential for many industries to reduce operation costs. Water hardness and pH are common issues that limit the amount of steam condensate that is recoverable. A detailed analysis of potential sources of contamination was carried out for the goal of recovering more steam condensate. Moreover, alternative treatment methods for water hardness and pH were taken into consideration. The final analysis provided several available options to reduce the hardness of the steam condensate, which resulted in a higher recovery percentage.

DESOLVENTIZER TOASTER DESIGN EVALUATION FOR MAINTENANCE RELIABILITY
by: Stephanie Kilbourn, Danielle Smolinski, and Seth Waits
Faculty Advisor: Kalyana Pingali, Ph.D.
2:30 p.m. – 2:55 p.m.

Organic solvents are utilized in an extraction process that removes the desired products from raw plant materials. Following extraction, the Desolventizer Toaster (DT) reclaims the remaining solvent to produce a dry spent material for transit. Due to high maintenance costs and downtime associated with this system, alternative solutions will be evaluated to ensure a more reliable and efficient drying system.

NEW MIX TECHNOLOGY OPTIONS APPLIED TO TABLET COMPRESSION FORMULATION
by: Bryce Bodtke, Raymond Browder, Cameron Brutsche, and Demetri Edwards
Sponsor: Perrigo
Faculty Advisor: Kalyana Pingali
3:00 p.m. – 3:25 p.m.

Every day, thousands of generic and prescription medications are utilized for various causes. With the use of different mix technologies, these tablets are formulated, compressed, and coated for final use. Through a planned restructuring of current mix technologies, the old technology will be replaced as preventative maintenance. This restructuring not only removes older technology currently in place, but will maintain the quality of the final product, while utilizing the most cost effective process. The completed model will allow for improved allocation of plant resources.

The College of Engineering and Applied Sciences offers a wide variety of programs:

Civil and Construction Engineering (269) 276-3210

- Civil Engineering
- Construction Engineering

Computer Science (269) 276-3101

- Computer Science - Theory and Analysis
- Computer Science - General option

Electrical and Computer Engineering (269) 276-3150

- Computer Engineering
- Electrical Engineering

Industrial and Entrepreneurial Engineering & Engineering Management (269) 276-3350

- Industrial and Entrepreneurial Engineering

Engineering Design, Manufacturing, & Management Systems (269) 276-3554

- Engineering Design Technology
- Engineering Management Technology
- Manufacturing Engineering Technology

Mechanical and Aerospace Engineering (269) 276-3420

- Aerospace Engineering
- Mechanical Engineering

Chemical and Paper Engineering (269) 276-3500

- Chemical Engineering
- Paper Engineering
- Graphic and Printing Science

College of Engineering and Applied Sciences Advising Office (269) 276-3270

The **Master of Science in Engineering** is offered in chemical, computer, electrical, mechanical, and industrial engineering. The **Master of Science** is offered in chemical engineering, computer science, construction engineering, engineering management, manufacturing engineering, and paper and printing science. The **Ph.D.** is offered in chemical engineering, computer science, electrical and computer engineering, industrial engineering, mechanical engineering, and paper and printing science.

Information about the College of Engineering and Applied Sciences at Western Michigan University

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.

CEAS Four Cornerstones

- 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

CEAS Administration

- Dean of Engineering: Dr. Houssam Toutanji
- Chair of Civil and Construction Engineering: Dr. Osama Abudayyeh
- Chair of Computer Science: Dr. Steven Carr
- Chair of Electrical and Computer Engineering: Dr. Steve Durbin
- Chair of Engineering Design, Manufacturing and Management Systems: Dr. Steve Butt
- Chair of Industrial and Entrepreneurial Engineering and Engineering Management: Dr. Steve Butt
- Interim Chair of Mechanical and Aerospace Engineering: Dr. Juda Ari-Gur
- Interim Chair of Chemical and Paper Engineering: Dr. William Rantz

CEAS Contact Information

- CEAS Advising Office: (269) 276-3270
- CEAS Dean's Office: (269) 276-3253
- CEAS Student Outreach and Recruitment Coordinator: Scot Conant – (269) 276-3272
- CEAS Website: www.wmich.edu/engineer