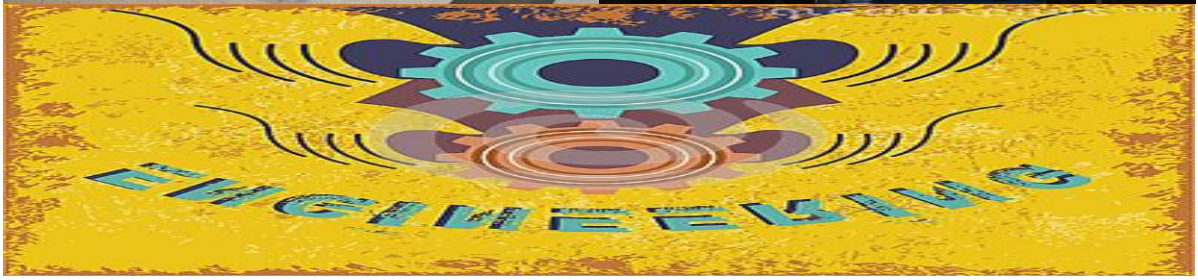
4-2015

56th Conference on Senior Engineering Design

College of Engineering and Applied Sciences



56TH CONFERENCE ON SENIOR ENGINEERING DESIGN

TUESDAY, APRIL 21ST, 2015 - 8:00 A.M. TO 4:00 P.M.

College of Engineering and Applied Sciences

Conference on Senior Engineering Design Project

You are invited to attend the fifty- sixth Conference on Senior Engineering Design Projects. The conference will be held from 8:30 a.m. to 4:00 p.m., **Tuesday, April 21st** 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 2:00 p.m.	p.12
Engineering Design, Manufacturing, and Management Systems	D-201	9:00 a.m. to 2:00 p.m.	p.15
Industrial and Entrepreneurial Engineering & Engineering Management	D-212	10:00 a.m. to 12:00 p.m.	p.18
Mechanical and Aerospace Engineering A	D-109	8:30 a.m. to 4:00 p.m.	p.20
Mechanical and Aerospace Engineering B	D-210	8:30 a.m. to 2:00 p.m.	p.25
Chemical and Paper Engineering	D-208	9:00 a.m. to 4:00 p.m.	p.29

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
8:30	D-115 CCE	FLAT RIVER DAM OVERLOOK
	D-109 MAE A	BRASS PTC ASSEMBLY CELL
	D-210 MAE B	REDESIGN OF ASITRADE CUTTER BACKPLATE
		FLAT RIVER DAM OVERLOOK
9:00	D-115 CCE	KVCC UTILITES RELOCATION
	D-202 CS	SECURE INFORMATION TECHNOLOGY SOLUTIONS
	D-204/205 ECE	ECO-FRIENDLY OUTDOOR LIGHTING AND CHARGING STRUCTURE
	D-201 EDMMS	CASTING AND FIXTURE RE-DESIGN FOR ASSEMBLY PROCESSES
	D-109 MAE A	FEASIBILITY OF SMALL SCALE WIND TURBINE FARMS
	D-210 MAE B	DESIGN OF NOVEL RESPIRATORY EQUIPMENT
	D-208 ChP	CONTINUOUS DISTILLATION OF SPICE EXTRACTS
9:30	D-115 CCE	M-50 & I-96 BRIDGE RECONSTRUCTION USING SIBC
	D-202 CS	SECURE INFORMATION TECHNOLOGY SOLUTIONS
	D-204/205 ECE	KINETIC SCULPTURE DRAG COEFFICIENT MEASUREMENT SYSTEM
	D-201 EDMMS	THE DESIGN OF A WAREHOUSE INVENTORY MANAGEMENT SYSTEM
	D-109 MAE A	INJECTION MOLD WATER COOLING (CONFIDENTIAL PRESENTATION)
	D-210 MAE B	DESIGN AND ANALYSIS OF 2016 FORMULA SAE AERODYNAMICS PACKAGE
	D-208 ChP	FLOTATION SEPARATION OF NATURAL PRODUCTS
10:00	D-115 CCE	MIXED USE DEVELOPMENT PROJECT
	D-202 CS	ZvH WMU (ZOMBIES VS. HUMANS)
	D-204/205 ECE	MAXIMUM POWER POINT TRACKER ARRAY CONTROLLER
	D-201 EDMMS	EXAMINING HEAT TRANSFER INFLUENCE ON THERMOPLASTIC OLEFIN INJECTION MOLDED PARTS

	D-212	**IEE & EM**	**DESIGN OF AN ECO-FRIENDLY FOUNTAIN STRUCTURE**
	D-109	**MAE A**	**AUTOMOTIVE EXHAUST WASTE HEAT RECOVERY SYSTEM USING THERMOELECTRIC**
	D-210	**MAE B**	**IMPLEMENTATION OF ADVANTIX DEHUMIDIFICATION USING UNIVERSAL FRAME**
	D-208	**ChP**	**OPTIMIZATION OF DEHYDRATION OF CARROT CUBES**
10:30	**D-115**	**CCE**	**KALAMAZOO COUNTY GULL ROAD FACILITY CHAINLESS BICYCLE CONTROL**
	D-202	**CS**	**LED TECHNOLOGY AND RESEARCH WEBSITE**
	D-204/205	**ECE**	**DYNAMIC SAND TESTING**
	D-201	**EDMMS**	**OPTIMIZATION OF A SEMI-AUTOMATED WIRE STRIPPER & ASSEMBLY LINE**
	D-212	**IEE & EM**	**COOLING SPOOL ANALYSIS FOR TOP ENTRY MIXER SEALS**
	D-109	**MAE A**	**COMPRESSED AIR VEHICLE**
	D-210	**MAE B**	**OPTIMIZATION OF A MINT EXTRACT**
	D-208	**ChP**	**DISTILLATION PROCESS**
11:00	**D-115**	**CCE**	**M-86 ROADWAY RECONSTRUCTION BROCHURE**
	D-202	**CS**	**BEHAVIORAL MAPPING SYSTEM**
	D-204/205	**ECE**	**SUNSEEKER SUPERCAPACITIVE REGENERATIVE BRAKING**
	D-201	**EDMMS**	**KFG DECISION SUPPORT SYSTEM**
	D-212	**IEE & EM**	**SINGLE BILLET TO TEST MULTIPLE METAL FACTORS**
	D-109	**MAE A**	**FLOW PATH STUDY FOR HYDRAULIC HYBRID TRANSMISSION**
	D-210	**MAE B**	**PUMP TESTING FILTER SELECTION AND CHANGE-OUT SCHEDULE**
	D-208	**ChP**	**ALTERNATIVE PESTICIDE REMOVAL METHODS FOR MINT OIL PRODUCTS**
11:30	**D-202**	**CS**	**AGENT BASED FLU-MODEL SIMULATION**
	D-204/205	**ECE**	**ENERGY SAVING CONTROL DEVICE FOR REFRIGERATORS**
	D-201	**EDMMS**	**3D MOTION PLATFORM FOR MULTI-VEHICLE SIMULATOR**
	D-212	**IEE & EM**	**WAREHOUSE PROCESS IMPROVEMENT & OPTIMIZATION**
	D-109	**MAE A**	**HEAT POWERED CELL PHONE CHARGER**
	D-210	**MAE B**	**INTEGRATED HOVERCRAFT THROTTLE SYSTEM**

	D-208	**ChP**	**EVALUATION OF OVEN EXHAUST MITIGATION TECHNOLOGY**
1:00	**D-202**	**CS**	**ULTROS 3D PRINTER**
	D-204/205	**ECE**	**TRUE RANDOM NUMBER GENERATOR**
	D-201	**EDMMS**	**PROCESS IMPROVEMENT FOR EVALUATING INTERNATIONAL STUDENT APPLICATIONS AT WMU**
	D-109	**MAE A**	**ROBOTIC ARM FOR SUAS TECHNOLOGY DEMONSTRATION**
	D-210	**MAE B**	**AFFORDABLE BICYCLE POWERED PUMP**
	D-208	**ChP**	**COATING TO ADVANCE THE VIABILITY OF NANO-SILVER FLEXOGRAPHIC PRINTED SMART LABELS**
1:30	**D-204/205**	**ECE**	**WIRELESS POWER TRANSMISSION**
	D-201	**EDMMS**	**THE VELOCIPEDE: PARKER HANNIFIN CHAINLESS CHALLENGE 2015**
	D-109	**MAE A**	**DESIGN OF A PNEUMATIC WEEDING ACTUATOR**
	D-210	**MAE B**	**DIRT BIKE LIFT SYSTEM FOR PICKUP TRUCK RECEIVER**
	D-208	**ChP**	**DESIGN OF A CENTRALIZED IRON REMOVAL SYSTEM**
2:00	**D-109**	**MAE A**	**COLD GAS CONTROL SYSTEM FOR HIGH ALTITUDE BALLOON**
	D-208	**ChP**	**MANAGING BIOCHEMICAL OXYGEN DEMAND IN PAPER MILL WATER STREAMS**
2:30	**D-109**	**MAE A**	**DESIGN OF A SCALED-DOWN ROBOTIC RELIEF TRANSPORT VEHICLE FOR 2015 ASME STUDENT DESIGN COMPETITION**
	D-208	**ChP**	**CHILLED WATER BIOBURDEN TREATMENT SYSTEM UPGRADE**
3:00	**D-109**	**MAE A**	**COLD GAS PROPULSION SYSTEM FOR STABILIZATION AND MANEUVERABILITY OF A HIGH ALTITUDE RESEARCH BALLOON**
	D-208	**ChP**	**SUBSTANTIATE PERCENT YIELD WITHIN AEROSOL PERSONAL CARE PLANT**
3:30	**D-109**	**MAE A**	**THIN FILM CARBON NANOTUBE SENSOR**
	D-208	**ChP**	**LASER MARKER DEVELOPMENT**

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 2015. 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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Zombies vs. Humans: Western Michigan University Chapter

CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – Decker Hains, Ph.D.

Room D-115

FLAT RIVER DAM OVERLOOK

by: Brenda Hodgell, Leah Weis, and Joseph Williams

Sponsor: Mark Howe, City Manager, City of Lowell

Faculty Advisor: Decker Hains

8:30 a.m. – 8:55 a.m.

Scenic overlooks are an ideal complement to any city's character. Currently, an underused plot of land just two blocks from Lowell City Hall is the prospective site for such a development. In Lowell, Mi, the Flat River is a major part of everyday life. An overlook near the King Mill dam would pay homage to a major feature of the town's history. The project features the structural design and evaluation of a deck and walkway along the Flat River and will be funded by the city government with the intent to make the area safer, more presentable and accessible for everyone.

KVCC UTILITIES RELOCATION

by: Nick Barnett, Nathaniel Barton, and Jordan Scher

Sponsor: City of Kalamazoo, Matt Johnson

Faculty Advisor: Decker Hains

9:00 a.m. – 9:25 a.m.

Kalamazoo Valley Community College and Bronson Methodist Hospital have proposed a new development in the City of Kalamazoo. The development includes a new culinary institute, food production facility, and mental health care facility. The site is currently zoned residential, which may pose a problem with existing water mains, sanitary sewer, and storm sewer networks serving the property. The City requires an analysis and recommendation for design of the existing utility networks to ensure capacities, demands, and environmental regulations are met. The project also requires a traffic management plan, cost analysis, and comparison of alternative methods for construction.

M-50 & I-96 BRIDGE RECONSTRUCTION USING SIBC
by: Simon Matar, Timothy Schnell, Ramon Perazza, and Felix Bautista
Sponsor: Michigan Department of Transportation, Charlie Stein
Faculty Advisor: Upul Attanayake, P.E., Haluk Aktan, P.E.
9:30 a.m. – 9:55 a.m.

The bridge reconstruction project involved the replacement and widening of the M-50 bridge using Slide-In Bridge Construction (SIBC). The M-50 bridge carries an average daily traffic value of 11,100 vehicles over I-96. Local standards, economic viability, and structural integrity were taken into account during the bridge design. The designed bridge also meets MDOT's 4R standards which pertain to all new funded construction projects. A comparison of SIBC to other Accelerated Bridge Construction (ABC) techniques was performed. This project represents a new paradigm in bridge replacement and established Michigan as a leader in ABC.

MIXED USE DEVELOPMENT PROJECT
by: Mohamed Ahmed, Tyler Bennett, Christopher Kaufmann, and Anthony Pontone
Sponsor: Byce & Associates, Bryan Webster, and Peter Oudsema
Faculty Advisor: Xiaoyun Shao, Ph.D. and Yufeng Hu, Ph.D.
10:00 a.m. – 10:25 a.m.

The Mixed Use Development Project consists of a 90, 180 sq. ft. four-story structure located just off of Western Michigan University's Main Campus. The first story is commercial and the remaining three stories are residential. To determine proper design strength of the structural system, structural analysis was first performed using Autodesk Robot Structural. Then the project proceeded with the design of the steel structure including beam-to-column connection and foundation. A cost comparison of steel and precast concrete vs. post-tensioned concrete vs. light gauge framing system was performed, as well as scheduling and sequencing of construction.

KALAMAZOO COUNTY GULL ROAD FACILITY
by: Alvaro Garibay, Lorenzo Martinez, and Alex Paret
Sponsor: AVB, Ryan Leaser
Faculty Advisor: Decker Hains
10:30 a.m. – 10:55 a.m.

The new Kalamazoo County Gull Road courthouse is a new courthouse built near the juvenile courthouse in response to growing populations and updated security protocols. Construction includes the function in a structural design based on the Michigan building codes. Cost comparison and sustainability issues were considered.

M-86 ROADWAY RECONSTRUCTION BROCHURE

by: Kyle Damerow, Sean Davis, and Travis Hall
Sponsor: Michigan Department of Transportation, Michelle O'Neill, P.E.
Faculty Advisor: Valerian Kwigizile, Ph.D.
11:00 a.m. – 11:25 a.m.

The M-86 highway running through downtown Three Rivers, MI has reached the end of its useful life. A proposal for total reconstruction of a 1.3 mile span of M-86 was prepared using the MDOT Road Design Manual. The proposal includes highway typical cross sections, an HMA pavement design, permanent signage plans, a non-motorized/pedestrian pathways plan, proposed drainage improvements, and a storm sewer design. An investigation of crash data was used to make recommendations for safety improvements. Also, total reconstruction cost estimates were prepared, and the completed proposal will aid MDOT in the total reconstruction of this highway.

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

SECURE INFORMATION TECHNOLOGY SOLUTIONS
by: Timothy Hughes, Walter Pabis, and David Rice
Sponsor: Western Michigan University, Department of Computer Science, John Kapenga Ph.D.
Faculty Advisor: John Kapenga, Ph.D.
9:00 a.m. – 9:25 a.m.

Users from all backgrounds, whether from business or personal use, require solutions to IT problems. The S.I.T.S team is dedicated to providing that solution through a Ruby on Rails Application that details common IT problems and solutions, from installation guides of different distributions of Linux, to security and software recommendations, and much more. This project also serves as a start to the long-term project of a student-led venture at WMU that will build and expand on this project.

SECURE INFORMATION TECHNOLOGY SOLUTIONS
by: Timothy Hughes, Walter Pabis, and David Rice
Sponsor: Western Michigan University Department of Computer Science, John Kapenga, Ph.D.
Faculty Advisor: John Kapenga, Ph.D.
9:30 a.m. – 9:55 a.m.

Viable solutions to computer security issues, general configuration on different OS systems, and various hardware configurations. The second goal of this group is to act as a start to an ongoing student run venture that will provide ongoing support and expand on the project into more technical coverage and wider client base.

ZvH WMU (ZOMBIES VS. HUMANS)
by: Waleed Gudah, Kimberly LaChance, and Timothy Lee
Sponsor: Zombies vs. Humans: Western Michigan University Chapter, Darrius Lane
Faculty Advisor: John Kapenga, Ph.D,
10:00 a.m. – 10:25 a.m.

WMU Zombies vs. Humans is in need of a system that can provide real-time information to a variety of users across campus in a standardized, easy to use interface. A ruby on rails web app running the Google Maps API provides real-time location mapping of currently playing users. Global, team, and private chat provide flexible communication options. A database allows current statistics, friend lists, and single button game joining. Organizing massive games on campus will never be easier with seamless integration with campus activities so as not to be disruptive, centralized communication, and features that add extra elements of strategy.

LED TECHNOLOGY AND RESEARCH WEBSITE
by: Thinh Nguyen, and Cody Potter
Sponsor: John Kapenga, Ph.D.
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. – 10:55 a.m.

With new LED technologies rising, there are many opportunities to take part in the research and contribute findings to the growing industry. A website was created to display LED findings from both the newly purchased LED research station and general findings to the public. Acting as a hub to both home and commercial use, users can stay updated with rising LED technology in the industry and also various related research. Users can calculate energy cost and savings when switching over to LED technology. The completed website will provide a structured location for the future studies of LED technology.

BEHAVIORAL MAPPING SYSTEM
by: Joseph Alflen, Joshua Inniger, and Ailun Shen
Sponsor: Western Michigan University Homer Stryker M.D. School of Medicine, Michael Liepman, Ph.D.
Faculty Advisor: John Kapenga, Ph.D.
11:00 a.m. – 11:25 a.m.

Finding a relationship between actions and behaviors can be a complicated task. A web-based interactive tool was developed to help medical professionals work alongside patients in discovering the link between action and behavior. This tool provides a mean to view and interpret this link. The display is known as a behavioral map and allows for discussion and reference between the patient and medical professional to further positive development.

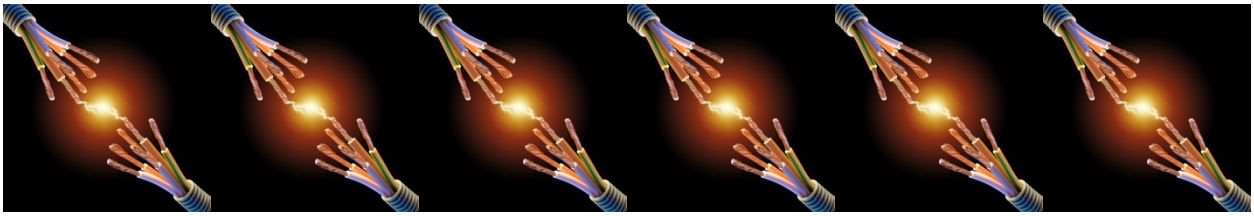
AGENT BASED FLU-MODEL SIMULATION
by: Dillon Burton, Corey Sarnia, and John Treadway
Sponsor: Western Michigan University, John Kapenga, Ph.D.
Faculty Advisor: John Kapenga, Ph.D.
11:30 a.m. – 11:55 a.m.

Students are taught very little about disease control. "Flu-simulator" is an agent-based flu-model simulation software aimed at high-school students. Teachers will assign groups and students will work together to stop the spread of the flu. The application has a front end website written using Ruby on Rails, and a game client written in HTML5 and Javascript. The back end simulation is written in Java, and is stored on the server. The website holds many tools and resources for teachers and students. The end goal will be to teach students various STEM concepts in a fun and interactive way.

ULTROS 3D PRINTER

by: Andrew Brower, Quincy Campbell, and Jordan Hinds
Faculty Advisor: John Kapenga, Ph.D.
1:00 p.m. – 1:25 p.m.

Within the medical field, accurate bone models are needed in order to properly educate future medical professionals. Unfortunately, such models are rather expensive. The Ultros 3D printer, is a modification of the mass-produced Kossel delta printer. It is capable of printing very tall objects with up to 4 different types of plastic, allowing for accurate bone models to be manufactured very cheaply. Additionally, the printer can make a variety of functional parts, including wings for remote controlled aircraft, and rapid prototyping of wind turbine components.



ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – Ralph Tanner, Ph.D.
Room D-204/205

ECO-FRIENDLY OUTDOOR LIGHTING AND CHARGING STRUCTURE

by: Wade Briggs, Alexander Kay, and Eric Szczesny
Sponsor: Landscape Forms Studio 431
Faculty Advisor: Steve Durbin, Ph.D.
9:00 a.m. – 9:25 a.m.

Western Michigan University's campus planning group is remodeling the Miller Fountain area. Campus planning is collaborating with Landscape Forms Studio 431 in order to install three structures in the fountain area. Through many discussions it has been decided to add solar cells, lighting, and USB charging to the structure. The structures will be aesthetically pleasing while providing an environmentally friendly way for students to interact with the structures.

KINETIC SCULPTURE DRAG COEFFICIENT MEASUREMENT SYSTEM

by: Eric DeGarmo, Macarthur Engbers, and Aaron Linke
Sponsor: John Kapenga, Ph.D.
Faculty Advisor: Janos Grantner, Ph.D.
9:30 a.m. – 9:55 a.m.

A structure can only withstand a certain amount of force before failure. The amount of force a structure can withstand depends on the materials used and the geometry of the structure. Kinetic sculptures, those that move with the wind, can fail if constructed incorrectly. A strain measurement and weather monitoring system was created using strain gages and a Raspberry Pi Microcomputer. The system allows users to view strain of the sculpture under various weather conditions. The completed system will provide useful information in determining materials and designs that can be used for the sculpture.

MAXIMUM POWER POINT TRACKER ARRAY CONTROLLER
by: Jevin Barnett, Austin Cross, Joel Dewey, and John Lynch
Sponsor: WMU Sunseeker Solar Car Project, Bradley Bazuin, Ph.D.
Faculty Advisor: Bradley Bazuin, Ph.D.
10:00 a.m. – 10:25 a.m.

The Sunseeker solar car team is designing a new car with new subsystems for racing in 2016. The Office for Sustainability provided a grant for new and more advanced Maximum Power Point Trackers (MPPT), devices that convert solar cell energy into energy to drive the car or store in the battery. The Array Controller developed supports the new features and capabilities of the MPPTs; monitoring and controlling the MPPTs, providing solar energy status to the driver and telemetry system, and coordinating with other car subsystems to maximize solar energy delivered to the car under all operating conditions. The Array Controller consists of a custom printed circuit board containing an embedded microcontroller, two independent CAN interfaces, an external port for PC monitoring, coulomb counting for a solar energy "gas gauge" and multiple temperature sensors. The Array Controller will debut in the 2016 model of Sunseeker.

CHAINLESS BICYCLE CONTROL
by: Abdulrahman Gobir, Jason Hendricks, and Omer Kakel
Sponsor: Parker Hannifin
Faculty Advisors: Massood Atashbar, Ph.D., Jorge Rodriguez, Ph.D., Choudhury Alamgir, Ph.D.
10:30 a.m. – 10:55 a.m.

The Chainless Challenge competition requires building a vehicle powered using a hydraulic system. In the past, riders were required to operate everything manually. To improve the tricycle performance, a control system is developed. This system consists of a microcontroller which operates the solenoid switch and valves to utilize the energy stored in the accumulator. Pressure sensors and a tachometer were utilized to provide information to the microcontroller. This new setup enhances function and operation of the system.

SUNSEEKER SUPERCAPACITIVE REGENERATIVE BRAKING
by: Robert Galman, Martin Peltz, and Michael Sharp
Sponsor: Sunseeker Solar Car team
Faculty Advisor: Brad Bazuin
11:00 a.m. – 11:25 a.m.

Collecting and storing energy efficiently is of utmost importance to the WMU Sunseeker solar car team and, more generally, the hybrid automotive industry. Lithium based battery systems may not source or sink current as fast as demanded by electric motors when accelerating or regenerative braking. A full scale working test system that utilized super capacitors able to absorb and release energy when the car stops or starts has been designed and prototyped. For safety and protection, an embedded microcontroller with custom software monitors and controls system operations, using contractors to coordinate connections between the battery, super capacitor, and the motors as driving conditions and driver actions dictate.

ENERGY SAVING CONTROL DEVICE FOR REFRIGERATORS
by: Santos Alberto
Sponsor: None
Faculty Advisor: Asumadu Johnson, Ph.D.
11:30 a.m. – 11:55 a.m.

A programmable temperature-controlled device was created using the Raspberry PI; a credit-card sized computer. The prototype device uses pulse-modulation-control (PMC) to control the anti-sweat-heaters (ASH) of the refrigerators and was also designed as a Supervisory Control and Data Acquisition (SCADA) system to remotely control the refrigerators. The completed model provides control of older refrigerators, to make them remotely programmable and eco-friendly.

TRUE RANDON NUMBER GENERATOR
by: Claudy Mejia
Sponsor: Department of Computer Science, John Kapenga, Ph.D.
Faculty Advisor: Ralph Tanner, Ph.D.
1:00 p.m. – 1:25 p.m.

Random numbers have numerous uses from security to gambling and game applications. These are usually generated by a Pseudo Random Number Generator (PRNG) using mathematical formulas that produce a sequence of numbers that appear to be random. In contrast with PRNGs, a True Random Generator (TRNG) is a device that uses random physical phenomena to generate random binary strings. This TRNG generates true random numbers (TRNs) by measuring electrical noise created by the noise generator circuit, converting it into digital signals and creating strings of TRNs. These strings are then transferred to a computer to be used in computer programs.

WIRELESS POWER TRANSMISSION
by: Zac Carpenter, Aruba IIyas, Michael Kinney, Kylee Maycroft
Sponsor: Tarun Gupta, Ph.D.
Faculty Advisor: Damon Miller, Ph.D. and Tarun Gupta, Ph.D.
1:30 p.m. – 1:55 p.m.

Wireless power transmission eliminates the inconvenience of being confined to a close proximity of an outlet and reduces the clutter of numerous power cords. In order to solve this problem, a wireless power transmission system was built to provide 90 Watts required to charge a robot. The device uses a two-coil magnetic coupling system and a radio frequency amplifier operating at 500 kHz. As this technology is utilized in more and more systems, society will be increasingly freed from the limits of power cords.

ENGINEERING DESIGN, MANUFACTURING, AND MANAGEMENT SYSTEMS

Session Chair – Betsy Aller, Ph.D.

Room D-201

CASTING AND FIXTURE RE-DESIGN FOR ASSEMBLY PROCESSES

by: Bryan Alger, Emily Farrance, and Aaron Visser

Sponsor: Landscape Forms, Inc., Steve Burkhardt

Faculty Advisor: Jorge Rodriquez, Ph.D.

9:00 a.m. – 9:25 a.m.

Many manufacturing processes involving assemblies are timely, inaccurate, and outdated. These processes utilize methods to cover up issues rather than fixing them. Many current jigs and fixtures do not utilize Lean principles and involve unnecessary equipment, poor tolerancing, and excessive tools. By applying current technologies, an improved design can reduce production time, decrease tolerancing, and eliminate unnecessary steps for assembly.

THE DESIGN OF A WAREHOUSE INVENTORY MANAGEMENT SYSTEM

by: Andrew Horner, Brian McClure, Mike Palombo, and Connor Tierney

Sponsor: Bendix Spicer Foundation Brake, Brian St. John and Troy Flodin

Faculty Advisor: Larry Mallak, Ph.D.

9:30 a.m. – 9:55 a.m.

Warehouses can be hazardous, inefficient, and costly if not managed correctly. A commercial brake testing facility sought a warehouse inventory management system to reduce cost, save time, and minimize storage area. A tool was designed using Microsoft Excel to organize items in inventory and eliminate unnecessary items. This reduction allowed for the option to relocate the storage area. A cost analysis involving data collection and CAD floor plans showed savings in time, cost, and area. The inventory management system is easy to implement and utilize.

EXAMINING HEAT TRANSFER INFLUENCE ON THERMOPLASTIC OLEFIN INJECTION MOLDED PARTS

by: Adam Arb, Scott Smith, Tim Slaughter, Tyree Grasty
Sponsor: GM, Autodesk
Faculty Advisor: Jay Shoemaker
10:00 a.m. – 10:25 a.m.

Plastics play a crucial role in manufacturing consumer products. After extensive research and analysis, studies on the Heat Transfer Coefficients (HTC) determined if the coefficients are sufficient for all plastic injection molded parts. The studies were created using Moldflow software; physical parts were made at the General Motors (GM) Tech Center in Warren, MI. This research can help GM and other plastic producing companies to reduce the amount of defective parts, costs, and energy.

DYNAMIC SAND TESTING

by: Mike Banion, Andy Foster, and Ross Henry
Faculty Advisor: Sam Ramrattan, Ph.D.
10:30 a.m. – 10:55 a.m.

Sand casting is a metal casting process that utilizes bonded sand as the mold material. Due to a lack of control in dynamic sand properties, the Modified Cone Jolt and the Thermal Erosion Tester (TET) were previously designed and developed at WMU. The Cone Jolt and TET were redesigned for increased reliability, repeatability, and manufacturability. Computer-aided engineering software such as a Catia, Inventor, and LabView were used to develop the new and improved machines and testing capabilities. Dynamic sand testing will provide foundries with higher quality castings and fewer defects, resulting in increased profits.

KFG DECISION SUPPORT SYSTEM

by: Maxwell Mills, William Hofsess, Cullen DeQuoy, and Kyle Sankey
Sponsor: Kalamazoo Flower Group
Faculty Advisor: David Lyth
11:00 a.m. – 11:25 a.m.

With forecasting-intensive markets such as bedding-plants, it can be difficult to know which products provide the best returns when planning for upcoming seasons. In order to streamline and clarify this process, a decision support dashboard was designed using common identification numbers, tables, charts, and other visuals to provide an interactive display of forecasts and sales figures. Allowing for easy manipulation of costs, sales, and profits for each product company wide, visuals are displayed in Excel and linked to databases in Access. This management tool allows for effective business decisions, minimizing guesswork and maximizing profits.

3D MOTION PLATFORM FOR MULTI-VEHICLE SIMULATOR
by: Tyler Bourassa, Jacob Sanford, and Andrew Wyman
Faculty Advisor: Pavel Ikonomov, Ph.D.
11:30 a.m. – 11:55 a.m.

Available 3D motion platforms used for simulators are bulky, heavy, and extremely expensive, and typically simulate only one scenario. Using SolidWorks CAD software, a new conceptual platform was designed and built to simulate the motion of a car, plane, and bicycle at a reduced cost. The new platform will consist of a modular design that will reenact vehicle motions. The updated platform will allow WMU to accurately simulate various future vehicle motions for research.

PROCESS IMPROVEMENT FOR EVALUATING INTERNATIONAL STUDENT APPLICATIONS AT WMU
by: Omar Alalloush, and Luke Goodman
Sponsor: Western Michigan University International Office
Faculty Advisor: Kailash Bafna, Ph.D.
1:00 p.m. – 1:25 p.m.

The process for reviewing applications and admitting international students to Western Michigan University takes approximately four to six weeks, potentially causing a decrease in the number of international students attending. The use of process flowcharts and interviews helped determine the locations of bottlenecks in the process. Recommendations for restructuring the steps in the current process are made so that students' performance criteria are evaluated earlier in the process. The recommended process and structure will help to reduce the time between the students submitting their application and receiving their admission notice, helping to potentially increase the number of international students coming to WMU.

THE VELOCIPEDE: PARKER HANNIFIN CHAINLESS CHALLENGE 2015
by: Jeffrey Morris, Jordan Seidl, and Trevin Trevino
Sponsor: Parker Hannifin Corporation, Sand Harper and Matt Simon
Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriquez, Ph.D.
1:30 p.m. – 1:55 p.m.

Alternative means of "green" transportation have sparked change amongst consumers and innovators, due to increasing environmental conservation and awareness. A hydraulic-powered tricycle was designed with the intent of maximizing the overall efficiency by reducing the amount of work required to produce the maximum possible energy output. The tricycle went through a series of refinements, including component weight reduction, gear train modifications, and enhancements to the hydraulic and accumulation systems. This new design can serve as a model for future, more innovative "green" modes of transportation.

INDUSTRIAL AND ENTREPRENEURIAL ENGINEERING & ENGINEERING MANAGEMENT

Session Chair – Azim Houshyar, Ph.D.

Room D-212

DESIGN OF AN ECO-FRIENDLY FOUNTAIN STRUCTURE

by: Johan Mejia Tejeda, Zachary Morhous, and Sebastian Paniagua

Sponsor: Landscape Forms, Tony Rizzo and Brandon Renouf

Faculty Advisors: Steven Butt, Ph.D. and David Middleton

10:00 a.m. – 10:25 a.m.

Commissioned by WMU Campus Planning as part of their larger Fountain Redesign Project, shade structures with USB charging ports, accent lighting, and various seating options were designed for installation into the Miller Fountain Plaza on main campus. Ergonomics testing, product design, 3D modeling, full scale modeling, and location analyses were utilized in developing the design of these structures. The resulting design is student-focused. Features of this product encourage students to charge their electronic devices using solar power, give students a focal point to interact with other students, and provide a pleasant place to relax and do work.

OPTIMIZATION OF A SEMI-AUTOMATED WIRE STRIPPER & ASSEMBLY LINE

by: Ramsey Elshafei, Jonathan Rhodes, Robert Schubert, and Wesley "Robbie" Wandell

Sponsor: Stryker Instruments, Varun Annadi

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

10:30 a.m. – 10:55 a.m.

A local medical instruments company has a production line that requires a highly manual process demanding precision and fine motor skills. Process variability has caused ergonomic and quality issues. Work design, time studies, line balancing, and ergonomic analysis were used to improve process performance. In addition, an automated wire stripper was investigated to further improve throughput. Given the implementation of the automated wire stripper; profitability was increased by improving compliant units, cycle time and efficiency, as well as operator health and safety.

SINGLE BILLET TO TEST MULTIPLE METAL FACTORS

by: Luke Bednarczyk, Roberto De La Paz German, Darwin Haines, and Grant Lukjan

Sponsor: Falcon Lakeside Manufacturing

Faculty Advisors: Diana Prieto, Ph.D., and Sam Ramrattan, Ph.D.

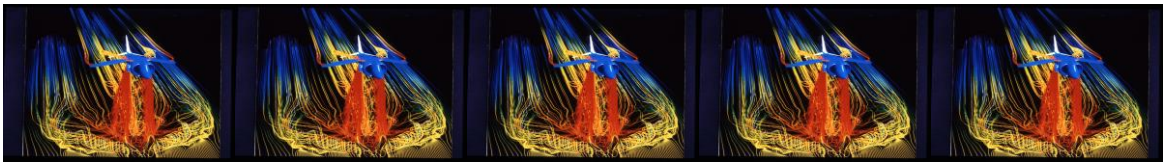
11:00 a.m. – 11:25 a.m.

Current metallurgical property testing methods require a different billet for each test. This is costly and increases inter-test variability. By using a novel single billet to test all metallurgical properties, one should significantly reduce cost and inter-test variability. A factorial statistical experiment was designed and conducted to characterize the operational conditions of the novel billet. If the new billet design shows promising results, industry will be able to conduct metallurgical testing more accurately and at lower cost.

WAREHOUSE PROCESS IMPROVEMENT & OPTIMIZATION

by: Jemal Headings, Melvin Keli, Arafat bin Mahabub, and Madeline Weiland
Sponsor: General Motors Company, Ryan Kamerad
Faculty Advisors: Azim Houshyar, Ph.D. and Bob White, Ph.D.
11:30 a.m. – 11:55 a.m.

The project is a comprehensive study of a newly established warehouse in Lansing, MI. The objective is to develop and improve processes at this warehouse. Warehouses are constantly faced with operation decisions that affect the efficiency and cost effectiveness of the plant. This study focused on learning curve techniques to develop recommendations on manpower utilization. Data was collected to eliminate material handling backtracking. Data was also used to optimize dedicated storage locations of containers in the warehouse, which considerably improved the process and flow of material handling devices while saving money and time.



MECHANICAL AND AEROSPACE ENGINEERING A

Session Chair – Bade Shrestha, Ph.D. and Roman Rabiej, Ph.D.

Room D-109

BRASS PTC ASSEMBLY CELL

by: Robert Potter, and Travis Hall

Sponsor: Parker Hannifin Corporation Fluid Systems Group

Faculty Advisors: Pavel Ikonomov, Ph.D., and Bade Shrestha, Ph.D.

8:30 a.m. – 8:55 a.m.

Assembly cells are widely used in manufacturing; they increase production, quality, and the overall efficiency of production. The combination of paced production, applied operation ergonomics, and cell efficiency produce a valued output. An automated assembly cell will be presented conceptually along with detailed tooling design in reference to a new line of connector fittings. Through the use of Autodesk the concept will be designed and simulated to demonstrate operation.

FEASIBILITY OF SMALL SCALE WIND TURBINE FARMS

by: Kenneth Brooks and Joshua Dunaj

Faculty Advisor: Parviz Merati, Ph.D.

9:00 a.m. – 9:25 a.m.

In order to meet the EPA's new emissions guidelines the power sector will need to utilize one of the cleanest forms of energy generation, wind power. A feasibility study was completed to determine if small-scale turbines could be used where large-scale turbines are impractical. Information on existing turbines such as, energy generation, wind requirements, and cost were compiled into a database. Cost analysis and efficiency calculations were used to determine the optimal solution. From the analysis the feasibility of this solution was determined. If feasible, small-scale wind farms will allow for a widespread increase.

"CONFIDENTIAL PRESENTATION-NO PUBLIC ALLOWED"

INJECTION MOLD WATER COOLING

by: Lauren Prince, and Melissa Woodward
Sponsor: Mold and Die Design Department, Mike Buckle
Denso Manufacturing, Tony Bienz
Faculty Advisors: Christopher Cho, Ph.D. and Larry Ahleman, Ph.D.
9:30 a.m. – 9:55 a.m.

Repetitive strain injury (RSI) to associates and slow cooling rates for injection molding are common problems in manufacturing facilities. Research, analysis and testing were done to calculate the cooling rate and process plastic tanks should be cooled at after being injection molded. A three dimensional modelling program was then used to design the machine for an automated cooling process. Two dimensional prints were then created and sent out to companies that would create the parts to assemble the machine.

AUTOMOTIVE EXHAUST WASTE HEAT RECOVERY SYSTEM USING THERMOELECTIC TECHNOLOGY

by: Abdulaziz Alsegaihi, Andrew Seurynck, and Neil Suva
Sponsor: American Green Technology, Gordy Norquist
EDM Zap Parts Inc., Dave Zebutis
Faculty Advisor: HoSung Lee, Ph.D.
10:00 a.m. – 10:25 a.m.

The average internal combustion engine is only 14-30% efficient, losing 58-62% of the energy supplied by fuel to thermal energy. A Thermal Electric Generator (TEG) using the principles of the Seebeck effect converts wasted thermal energy to electricity. A computational fluid dynamic simulation model was created using ANSYS/Fluent, a simulation software. A TEG was designed, built, and tested. The results from the testing of the TEG were then compared to the simulation results showing the accuracy of the simulation model. Both the physical and simulated models may be used to aid future studies in the quickly advancing field of thermoelectric and the implementation of this technology to the automotive industry.

COOLING SPOOL ANALYSIS FOR TOP ENTRY MIXER SEALS

by: Christopher Cudney, Michael Curtis, and Erich Stuedemann
Sponsor: Flowserve Corporation, Bill Dietzel
Faculty Advisor: Claudia Fajardo, Ph.D.
10:30 a.m. – 10:55 a.m.

Cooling spools are used in high-temperature mechanical seal applications to aid in heat soak removal from the seal chamber and increase the life expectancy of the mechanical seal. Heat soak equations were researched and refined to create a program that outputs the amount of heat removed by a cooling spool based on the spool dimensions, flow rate, material, etc. The program outputs were validated by modeling a cooling spool in ANSYS computational fluid dynamics software, and testing a physical model. The validated program provides a tool to improve the accuracy, consistency, and ease of calculations of heat soak removal for Flowserve engineers and designers.

FLOW PATH STUDY FOR HYDRAULIC HYBRID TRANSMISSION
by: Anthony Drewicz, and Stefan Sekula
Sponsor: Parker Hannifin-Hybrid Drive System Division, Brian Ralph, Matt Simon, and Thomas Finsel
Faculty Advisor: Javier Montefort, Ph.D.
11:00 a.m. – 11:25 a.m.

Parker Hannifin is developing a hydraulic hybrid transmission which uses the energy from braking to drive hydraulic pumps and motors to assist in acceleration to reduce fuel consumption. Accurate pressure drop values for the hydraulic components were needed to gauge the performance of the pumps and motors. The performance data is expected to aid in the understanding of fuel mileage gained through this technology. A test stand was developed to model operating conditions and the flow was to match Computational Fluid Dynamics for further analysis and optimization purposes.

HEAT POWERED CELL PHONE CHARGER
by: Corbin Feldpausch, and Pastor Hurtado
Faculty Advisor: Christopher Cho, Ph.D.
11:30 a.m. – 11:55 a.m.

The UN estimates that there are around 6 billion phone users throughout the world with average battery lives ranging from five to ten hours typical usage before recharging at an outlet is necessary. To increase the life of a cellular battery, a thermoelectric generator (TEG) module was used that converts a temperature gradient into electrical power to charge the cellular battery. Using NI LabVIEW, the temperature gradient was determined. With this temperature gradient, a TEG was designed using MathCAD and ANSYS to optimize the power generated. The Designed TEG was integrated into a device that has the capability of extending cell phone battery life without the use of an electrical outlet.

ROBOTIC ARM FOR SUAS TECHNOLOGY DEMONSTRATION
by: Kyle Burger, Michael Churchill, and Joseph Urso
Faculty Advisor: Kapseong Ro, Ph.D.
1:00 p.m. – 1:25 p.m.

A technology demonstration has been performed at Western Michigan University featuring a multi rotor drone. This drone autonomously navigates around a room, picks up an object, carries the object to a new location, drops the object, and then returns to its starting position. This mission requires a highly specialized robotic arm to grab and hold the target object. The fabrication and testing of the arm requires an in-depth design analysis. The arm is made from carbon fiber, has three degrees of motion, contains a sensor to locate the object, and does not affect drone flight.

DESIGN OF A PNEUMATIC WEEDING ACTUATOR
by: David Duda, Benjamin Kanda, and Benjamin Meli
Sponsor: Parker Hannifin-Pneumatic Division North America, Rob Knepple
Faculty Advisor: Kapseong Ro, Ph.D.
1:30 p.m. – 1:55 p.m.

Currently in agriculture, it is a common practice to treat crops with herbicides to combat unwanted vegetation. In the event an herbicide is unusable, the requisition of manual labor is warranted. The former results in adverse effects on the environment and the latter tend to be expensive. As an alternative to these methods of weed removal, the design of a unique pneumatic weeding actuator was undertaken. A mathematical model for the performance of the actuator was developed. After the model was created, an optimization process, with regards to accuracy, response time, settling time, and overshoot was undertaken to ensure peak performance.

COLD GAS CONTROL SYSTEM FOR HIGH ALTITUDE BALLOON
by: Jonathan Cross, Andrew Martin, Heath Martin, and Justin Rittenhouse
Faculty Advisor: Jennifer Hudson, Ph.D.
2:00 p.m. – 2:25 p.m.

Engineers are looking for innovative ways to stabilize high altitude balloon payloads in the upper atmosphere. Cold gas propulsion could be a low cost solution to this engineering problem. This method of propulsion was tested on a high altitude balloon. The goal was to control rotation of the payload when encountering outside forces during flight. Using a programmable control module and an inertial moment unit, the payload motion was accurately measured and the proper PID response calculated to stabilize the flight vehicle. This project was done in conjunction with another group responsible for the propulsion portion of this research project.

DESIGN OF A SCALED-DOWN ROBOTIC RELIEF TRANSPORT VEHICLE FOR 2015 ASME STUDENT DESIGN COMPETITION
by: William Nichols, and Zach Smith
Faculty Advisor: Koorosh Naghshineh, Ph.D.
2:30 p.m. – 2:55 p.m.

The ASME 2015 student design challenge required competitors to generate designs for a scaled-down vehicle which would deliver supplies safely to those in need in third world states or areas destroyed by natural disasters. Competitors were required to build a battery powered, remote controlled vehicle that would traverse a course having varying levels of water, sand, and steps to drop a granular payload into a receiving container. The final design was obtained with the use of AutoCAD/Inventor, 2D and 3D solid modeling software. Four fully rotational components are used to navigate through the simulated terrain powered by high torque motors and a LiPo rechargeable battery. This design allows relief to be transported into multiple terrains beyond the competition course layout. A prototype of the final design was manufactured and tested for the purpose of participation in the ASME Design Competition held in Wisconsin at Milwaukee School of Engineering, in April 2015.

COLD GAS PROPULSION SYSTEM FOR STABILIZATION AND MANEUVERABILITY OF A HIGH ALTITUDE RESEARCH BALLOON

by: Taimoor Ahmed, Kenneth Domingue, Andrew Kechner, Reza Kordbacheh, and Justus Ongeri
Faculty Advisor: Kristina Lemmer, Ph.D.
3:00 p.m. – 3:25 p.m.

High altitude research balloons are often used to test research instruments, prototypes, and other equipment for use and data collection. A gas cold propulsion system that was designed, built, tested, and launched provided control to the balloon and ensured stability and maneuverability during flight. This allows for more accurate data collection during flight. The system works by utilizing a pressure vessel filled with Nitrogen, electronically controlled solenoid valves to control the flow of the propellant. This project will benefit future research projects that require high altitude testing, such as cube satellites and weather balloons.

THIN FILM CARBON NANOTUBE SENSOR

by: Charles Schlansker, Samuel Wilson, and Bailey Windle
Faculty Advisor: Muralidhar Ghantasala, Ph.D.
3:30 p.m. – 3:55 p.m.

A carbon nanotube (CNT) thin film sensor was developed and tested utilizing chemical nanocomposite preparation methods, Microwave Chemical Vapor Deposition (MWCVD) and other nanofabrication techniques. The films were deposited on a nickel catalyst layer placed on silicon, glass and other substrates which were then characterized for structure, microstructure and resistance. These films were patterned to determine the suitability for use as strain gauges.

MECHANICAL AND AEROSPACE ENGINEERING B

Session Chair – Ram Sharma, Ph.D., and Pnina Ari-Gur, Ph.D.

Room D-210

REDESIGN OF ASITRADE CUTTER BACKPLATE

by: Anthony Kopp, and Brock Mater

Sponsor: Michigan Packaging Company, Jason Haring

Faculty Advisor: Roman Rabiej, Ph.D.

8:30 a.m. – 8:55 a.m.

Having a successful operation of a continuous flow process means that all of the pieces must be in working order at all times. When one piece breaks, the machine must be shut down, this costs time and money. When the Asitrade corrugator jams, the first piece to break is the plastic fingers of the vacuum conveyor. Using simulation and live testing techniques multiple designs were tested and evaluated. Redesigning this piece reduced the time needed to replace the part along with the cost of the plastic fingers.

DESIGN OF NOVEL RESPIRATORY EQUIPMENT

by: Joseph Barnett, and Stephen John

Sponsor: Respiratory Therapist Without Borders, Eric Cheng

Sigma Machines Inc., Jim Van Weelden

Faculty Advisor: Peter Gustafson, Ph.D.

9:00 a.m. – 9:25 a.m.

For infants suffering moderate-severe respiratory distress, the widely used bubble Continuous Positive Airway Pressure (CPAP) treatment is insufficient. However, medical facilities in developing countries often lack the resources to deliver the necessary dual level pressure waveforms, leading to preventable neonatal death. A novel dual level respiratory device was designed as a simple add on to existing bubble CPAP setups. The device was optimized through extensive testing of machined and 3D printed parts and a numerical simulation. The patent pending technology reliably delivers clinically relevant pressure waveforms at an affordable price point while requiring no more energy than bubble CPAP.

DESIGN AND ANALYSIS OF 2016 FORMULA SAE AERODYNAMICS PACKAGE
by: Mike Campo and Jose Perez
Faculty Advisor: William Liou, Ph.D,
9:30 a.m. – 9:55 a.m.

Aerodynamic devices such as wings and splitters have become extremely commonplace on Formula SAE vehicles. A three-dimensional model of a planned aerodynamics package was created using SolidWorks, a solid modeling software package. Using Star-CCM+, a computational fluid dynamics program, changes in lift and drag due to modifications in various parameters were studied, and the model was then optimized for overall lift-to-drag ratio. The final design will be manufactured and used on the WMU 2016 Formula SAE racecar to help improve the car's performance.

IMPLEMENTATION OF ADVANTIX DEHUMIDIFICATION USING UNIVERSAL FRAME
by: Charles Albrecht, Ryan Avery, and Kyle Potapa
Sponsor: Windy City Representatives, Kevin McHugh and Pete Radecki
Faculty Advisor: Daniel Kujawski, Ph.D.
10:00 a.m. – 10:25 a.m.

A universal frame was designed for the DT-Small dehumidification unit from Advantix Systems. This frame allows for the unit to be used in any situation including construction site dehumidification, disaster restoration, and/or process dehumidification. The design met various specifications listed by Windy City Representatives and their requirements for safe use. This design allows any customer to use the dehumidification unit without training.

COMPRESSED AIR VEHICLE
by: Ben Wolfman, Adam Boden, and Brian Larsen
Faculty Advisor: Bade Shrestha, Ph.D. and Muralidhar Ghantasala, Ph.D.
10:30 a.m. – 10:55 a.m.

A vehicle using compressed nitrogen was designed and built. Compressed nitrogen as a fuel offers an economic and environmentally friendly solution for short range transportation needs. The gear train and power requirements were calculated using Excel. Finite element analysis of the frame, drive train, and component mounts was performed using software provided by the CEAS computer lab. It was built via retrofitting a go kart with a compressed air motor and the necessary control system to manage vehicle movement. The completed vehicle displays the capability of using compressed nitrogen as an alternative fuel for short travel.

PUMP TESTING FILTER SELECTION AND CHANGE-OUT SCHEDULE
by: Tronic Williams, Nick Farrell, and Patrick Mutch
Sponsor: Parker Hannifin, Hydraulic System Division, Keith Tustin
Faculty Advisor: Bade Shreshta, Ph.D.
11:00 a.m. – 11:25 a.m.

Pump filters are objects containing small porosities that maintains the flow of a liquid or gas but captures any loose unwanted particles. These filters can be very costly and lead to storage build up which reduces valuable space. At Parker Hannifin, we will design a solution to maximize the usage of these filters by utilizing a cost and benefit analysis based on routine customs and functionalities experienced through the pumps. We will test the performances of each type of pump filter at different pressures as well as different environments and compare the results. Also, we will research and discover methods to clean the filters if applicable.

INTEGRATED HOVERCRAFT THROTTLE SYSTEM
by: Chris Chapman, Charlie Dewildt, and John Stewart
Sponsor: Hoverstream, LLC, Jason Kuehn
Faculty Advisors: Bade Shrestha, Ph.D. and John Stahl
11:30 a.m. – 11:55 a.m.

As recreational hovercrafts become more widely used, the need for simplified driving controls continue to rise to encompass a larger range of driver skill levels. A throttle system was designed, built, and tested to integrate the two separate throttles of twin engine hovercraft into one, single throttle control for the driver. To withstand harsh saltwater conditions, the throttle system was subjected to Finite Elemental Analysis and Life-cycle analysis on a custom test stand. The throttle system allows for new levels of simplified driving for beginner drivers with accommodations for various payloads and ride heights while the hovercraft is in motion.

AFFORDABLE BICYCLE POWERED PUMP
by: Rayan Bardesi, Andrew Mora, and Jake Young
Faculty Advisor: Javier Montefort, Ph.D.
1:00 p.m. – 1:25 p.m.

People in poverty stricken areas spend a lot of time and energy traveling to collect water. The water that is easiest to collect may be contaminated leaving people sick. A bicycle powered water-pumping system was designed in SolidWorks. Stress test analyses were simulated in key areas of wear and tear. This allowed for the redesigning of parts which reduced costs and optimized the system. Additional cost reductions were utilized including alternative materials and using already mass produced components. The final design provides an affordable, energy efficient and safer option for retrieving water.

DIRT BIKE LIFT SYSTEM FOR PICKUP TRUCK RECEIVER

by: Tyler Coffin, Sean DeYoung, and Herman Washington
Faculty Advisor: Judah Ari-Gur, Ph.D.
1:30 p.m. – 1:55 p.m.

Loading a dirt bike into the bed of a pickup truck by a single person is a difficult task. A device to ease the process of loading a dirt bike into a pickup truck bed was designed. It was modeled using AutoCAD Inventor 2015, a three dimensional modeling software, and was analyzed under realistic loading condition to eliminate high stress concentrations and to optimize the design. As a result, a physical prototype was constructed and tested for functionality. The prototype serves as a proof of concept for the proposed product.

CHEMICAL AND PAPER ENGINEERING

Session Chair – Andrew Kline, Ph.D.

Room D-208

CONTINUOUS DISTILLATION OF SPICE EXTRACTS

by: Abbie Brackman, Matthew Darga, and Nicholas Jordan

Sponsor: Kalsec Incorporated, Dave Gordon and Greg Reynhout

Faculty Advisor: Andrew Kline, Ph.D.

9:00 a.m. – 9:25 a.m.

The manufacturing of spice extracts is important for the food and beverage industry. The current method is a batch process which is labor intensive and time consuming. The operating parameters of the current process are changed in accordance to whichever of the four types of spice was being processed. The four types of spices are low resin, high resin, heat sensitive and high solid concentration. A new process method was constructed that could handle at least two of the four spice types. The new method is run as a continuous process that met FDA limits.

FLOTATION SEPARATION OF NATURAL PRODUCTS

by: Lizz Rusin, Mark Winters, and Zachary Wolf

Sponsors: Kalsec Incorporated, Dave Gordon and John White, Ph.D.

Faculty Advisor: Andrew Kline, Ph.D.

9:30 a.m. – 9:55 a.m.

Current means for a natural product's separation from an organic material relies on solvent extraction that may not be organically compatible with an organic finished product. The purpose of this project was to research the viability of separation techniques via current flotation distillation technologies by isolating specific compounds from a given substance that is organic compatible. Viability was measured in terms of separation efficiency and financial analyses of the process economics. Separation efficiency was tested based on a percent of product separated to a given purity over an expected residence time. From these pilot studies, efforts were made to design cost effective processes which would operate on an industrial scale. Once implemented, this new design would operate more efficiently and produce a purer product.

OPTIMIZATION OF DEHYDRATION OF CARROT CUBES
by: Nathan Campbell, Brett Cassady, Justin Gugala, and Brendan Schwalm
Sponsor: Kalsec Incorporated, Dave Gordon and Jarrod Chestnut
Faculty Advisor: Andrew Kline, Ph.D.
10:00 a.m. – 10:25 a.m.

The color quality of a baked good, cereal or snack is an indicator to consumers of freshness and quality. Retaining the color quality of extracts that are used as coloring agents in other products is of great importance in the food industry. For this project, optimum processing equipment and conditions for the dehydration of carrots will be determined by conducting experiments regarding the retention of coloring agents and the effects of their exposure to osmotic solutions. An economic analysis will be used as a tool to help compare processes and make final recommendations.

OPTIMIZATION OF A MINT EXTRACT DISTILLATION PROCESS
by: Gabriel Cole, Kevin Cooper, Keith Douglass, and Davis Mulder
Sponsors: A.M. Todd, A Division of Wild Flavors, Inc., Jim Cain and Jesse Hochstedler
Faculty Advisor: Andrew Kline, Ph.D.
10:30 a.m. – 10:55 a.m.

Distillation columns are commonly used in industry to separate multicomponent liquids into discrete components. This process requires substantial energy input, much of which can be wasted if not managed properly. An energy audit was conducted on a distillation process used to refine mint oil. The current process was studied and modeled, and opportunities to recover wasted energy to reduce energy input were explored. If implemented, these opportunities could reduce the required energy consumption and lower operating costs.

ALTERNATIVE PESTICIDE REMOVAL METHODS FOR MINT OIL PRODUCTS
by: Brian Ausberger, Jordan Johnson, Nicholas King, and Kylie Oldenburg
Sponsors: A.M. Todd, A Division of Wild Flavors, Inc., Jim Cain and Jesse Hochstedler
Faculty Advisor: Andrew Kline, Ph.D.
11:00 a.m. – 11:25 a.m.

As people become more environmentally and health conscious, the demand for pesticide free products increases. Moreover, A.M. Todd, division of Wild Flavors, Inc. is trying to develop new ways to rid mint oil of pesticides, searching for new and innovative ideas that will be more efficient, save money, and promote sustainability. In this project, new ideas and concepts for pesticide removal will be evaluated to replace the current distillation method and reduce the overall product loss in the refining process. These methods will be evaluated based on their feasibility and economic impact to A.M. Todd.

EVALUATION OF OVEN EXHAUST MITIGATION TECHNOLOGY
by: Adam Bognar, Trevor Dalton, Jeffrey Katz, and Jeffrey Lockwood
Faculty Advisor: Andrew Kline, Ph.D.
11:30 a.m. – 11:55 a.m.

Effective treatment of oven exhaust is a regulated process of commercial baking. The project scope was evaluating the treatment of toxic emissions created during the baking process to meet environmental regulations. The exhausting component of interest was ammonia generated from baking ammonium bicarbonate, a commonly used leavening agent in commercial cracker baking. The amount of ammonia exhausted to the environment must be controlled through exhaust emissions removal technology. The outcome was a detailed investigation of emerging and existing technologies used for removing toxic emissions. Economic analysis, equipment capability, and ability to meet process demands were used to determine the technology recommended.

COATING TO ADVANCE THE VIABILITY OF NANO-SILVER FLEXOGRAPHIC PRINTED SMART LABELS
by: Kevin Bussa
Faculty Advisor: Margaret Joyce, Ph.D.
1:00 p.m. – 1:25 p.m.

Printed electronics are becoming more prevalent as their potential is realized in several sectors. One of the major barriers to its use as a Smart label is cost. The ability to directly print to a package, or cellulosic label would reduce product costs. A UV curable primer coating was created to enhance the properties of label paper for using is such applications. Use of this coating eliminates the need to use more expensive film substrates which are less environmentally friendly.

DESIGN OF A CENTRALIZED IRON REMOVAL SYSTEM
by: Jesse Harroun, Philip LaCharite, Angela Segura, and Blaine Stressman
Sponsor: USG Otsego Paper, Inc. Henry Krell and Mike Lahti
Faculty Advisor: Peter Parker, Ph.D.
1:30 p.m. – 1:55 p.m.

Iron accumulation in industrial processes can lead to significant mechanical damage and production downtime losses. Several technologies for particulate filtration were analyzed to determine the most cost-effective method for reducing the iron concentration in plant water streams. A centralized filtration system utilizing a series of filtration devices was designed to significantly reduce iron levels in the water streams entering into plant processes. The installation of this system will greatly reduce maintenance costs associated with iron accumulation and extend equipment life.

MANAGING BIOCHEMICAL OXYGEN DEMAND IN PAPER MILL WATER STREAMS
by: Abigail Cameron, Nicole Seymour, and Matthew Wheaton
Faculty Advisor: Peter Parker, Ph.D.
2:00 p.m. – 2:25 p.m.

Over the past year, the biochemical oxygen demand (BOD) of the water discharged from a local paper mill has increased. A portion of the water is sent to the city to be processed and is tested for BOD. Therefore, the increase in BOD resulted in an increase in cost to the company. In order to reduce the cost of wastewater treatment, the water systems of the mill have been analyzed to determine the source of increase. A new system has been suggested to monitor this increase and potentially save the company money by reducing BOD released to the environment.

CHILLED WATER BIOBURDEN TREATMENT SYSTEM UPGRADE
by: Aric Beikmann, Maggie Michalak, Ron Shattuck, and Derek Simpson
Faculty Advisor: Andrew Kline, Ph.D.
2:30 p.m. – 2:55 p.m.

Organic material often referred to as "bio burden," can accumulate in chilled water systems when left untreated, which can cause severe scaling and blockages in pipelines and heat exchangers. The company's current method for bio burden control uses a chlorine dioxide treatment, but due to its reactivity, it can only be shipped at low concentrations, making it expensive. A list of alternatives were compiled, tested, and analyzed, which included generating chlorine dioxide on site and using other water purification chemicals such as ozone and hydrogen peroxide. Finding an effective alternative will have long term financial and site infrastructure benefits.

SUBSTANTIATE PERCENT YIELD WITHIN AEROSOL PERSONAL CARE PLANT
by: Alec Anderson, Gregory Maxwell, and Seth Vincent
Sponsors: Amway Corporation, Bret Nordland, Mark Carlson, Bernie Howard, and Nancy Beard
Faculty Advisor: Andrew Kline, Ph.D.
3:00 p.m. – 3:25 p.m.

The project identified losses of bulk product throughout the mix and packaging process substantiating percent yield. Support data for yield calculations was found by mapping multiple equipment trains, collecting and weighing samples, tracking waste streams, and executing engineering studies. The completed studies identified and verified product loss ensuring the accuracy of yield calculations. This project identified potential cost savings to the facilities.

LASER MARKER DEVELOPMENT FOR THE PRODUCTION OF SURGICAL INSTRUMENTS

by: Jeffrey Timmer
Sponsors: Stryker Instruments, Jeff Holdwick and Joshua Wiese
Faculty Advisor: Andrew Kline, Ph.D.
3:30 p.m. – 3:55 p.m.

Applying clear, enduring marks onto stainless steel surgical instruments is a significant challenge for medical device manufacturers. Only recently, laser markers have been developed to apply crisp, corrosion resistant marks through a process called annealing. New FDA requirements for Unique Device Identification (UDI) only further this demand for laser markers. A new laser marking system was developed with a focus on surgical drill cables. The system was designed with the ability to hold, rotate, and laser mark multiple cable nuts at a time. This laser marker provides great improvements to product flow and ensures capacity for future products.

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