You are invited to attend the fifty-third Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., Tuesday, December 3rd 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 | 9:00 a.m. to 11:00 a.m. | p.5  |
| Computer Science                  | D-202 | 9:00 a.m. to 11:30 a.m. | p.6  |
| Electrical and Computer Engineering| D-204 | 9:00 a.m. to 1:30 p.m.  | p.8  |
| Industrial and Manufacturing Engineering| D-201 | 8:00 a.m. to 3:00 p.m. | p.11 |
| Industrial and Entrepreneurial Engineering| D-210 | 8:30 a.m. to 8:55 a.m. | p 15 |
| Mechanical and Aerospace Engineering  | D-109 | 9:00 a.m. to 4:00 p.m. | p.16 |
| Chemical and Paper Engineering      | D-208 | 9:00 a.m. to 9:30 a.m. | p.21 |

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.htm
<table>
<thead>
<tr>
<th>TIME</th>
<th>ROOM/DEPARTMENT</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00</td>
<td>D-201 IME</td>
<td>Shell-Vacuum Metal Casting Process</td>
</tr>
<tr>
<td>8:30</td>
<td>D-201 IME</td>
<td>Shot Monitoring System for a Benchtop Die Casting Machine</td>
</tr>
<tr>
<td></td>
<td>D-210 IME</td>
<td>Facility Design of Banana Paper Manufacturing</td>
</tr>
<tr>
<td>9:00</td>
<td>D-115 CCE</td>
<td>Gas Station Site Redevelopment</td>
</tr>
<tr>
<td></td>
<td>D-202 CS</td>
<td>Role-Playing Game API</td>
</tr>
<tr>
<td></td>
<td>D-204/205 ECE</td>
<td>Induction Heating System</td>
</tr>
<tr>
<td></td>
<td>D-201 IME</td>
<td>Standardizing the Water Spider</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Front Suspension Design for WMU 2014 Sunseeker</td>
</tr>
<tr>
<td></td>
<td>D-208 ChP</td>
<td>Alternative Coating Clay Evaluation</td>
</tr>
<tr>
<td>9:30</td>
<td>D-115 CCE</td>
<td>Phase II Riverwalk Trail</td>
</tr>
<tr>
<td></td>
<td>D-202 CS</td>
<td>Web Portal and Report Delivery System</td>
</tr>
<tr>
<td></td>
<td>D-204/205 ECE</td>
<td>Amplitude Modulation Laboratory</td>
</tr>
<tr>
<td></td>
<td>D-201 IME</td>
<td>Experiment for Communications Systems</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Manufacturing Line’s Vision System</td>
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<tr>
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<td>“Recipe” Standardization</td>
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<tr>
<td></td>
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<td>Multifunctional Tank Design for Whiskey Distillation Process</td>
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<tr>
<td>10:00</td>
<td>D-115 CCE</td>
<td>I-96, Middlebelt Rd. Bridge Reconstruction</td>
</tr>
<tr>
<td></td>
<td>D-202 CS</td>
<td>Designing a Records Management System For the Kalamazoo Police</td>
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<td>D-204/205 ECE</td>
<td>Department</td>
</tr>
<tr>
<td></td>
<td>D-201 IME</td>
<td>Remote Force and Haptic Feedback For a Robotic Hand</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>WMU Flying Disc Mold</td>
</tr>
<tr>
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<td>Intraoperative Patient Normothermic Controller</td>
</tr>
<tr>
<td>10:30</td>
<td>D-202 CS</td>
<td>Asynchronous Realtime Multiplayer (ARM) Backend</td>
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<td></td>
<td>D-204/205 ECE</td>
<td>Water Cooling Tower Control and Monitoring System</td>
</tr>
<tr>
<td></td>
<td>D-201 IME</td>
<td>Velomobile Body Design</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Suborbital Vehicular Balloon Design For Atmospheric Data Collection</td>
</tr>
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<td>To Return To Launch Site</td>
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<td>11:00</td>
<td>D-202 CS</td>
<td>Crime Report Database Application</td>
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<td></td>
<td>D-204/205 ECE</td>
<td>Hybrid Curing Oven Control System</td>
</tr>
<tr>
<td></td>
<td>D-201 IME</td>
<td>Implementation of an Energy Management System</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Heat Reduction in the μ-LAM Laser Delivery System</td>
</tr>
<tr>
<td>11:30</td>
<td>D-204/205 ECE</td>
<td>Sunseeker Solar Car Driver Controls</td>
</tr>
<tr>
<td></td>
<td>D-201 IME</td>
<td>Application of Lean Concepts to Packaging and Kanban Systems</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Drag Reduction in Large Commercial Vehicles by the Use of Dimples</td>
</tr>
<tr>
<td>1:00</td>
<td>D-204/205 ECE</td>
<td>Particle Accelerator Vacuum Control System</td>
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<tr>
<td></td>
<td>D-201 IME</td>
<td>Grille Centering Tool for Use in Automotive Modular Assembly Industry</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Preliminary Design and Flight Testing of a UAV</td>
</tr>
<tr>
<td>1:30</td>
<td>D-201 IME</td>
<td>DFMA Analysis of a Cooling Tunnel Structure</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Green Alternative: Converting a Snow Gun to Wind Generator</td>
</tr>
<tr>
<td>2:00</td>
<td>D-201 IME</td>
<td>Dual-purpose Desktop Machine</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Design of a Lifecycle Test Procedure and Equipment</td>
</tr>
<tr>
<td>2:30</td>
<td>D-201 IME</td>
<td>Design of an Alternative Energy Go-Kart</td>
</tr>
<tr>
<td></td>
<td>D-109 MAE</td>
<td>Large-Scale, Modular and Tunable Mechanical Piano-Keyboard for the 2014 Gilmore International Keyboard Festival</td>
</tr>
<tr>
<td>3:00</td>
<td>D-109 MAE</td>
<td>Drag Reduction of Tractor Trailers by Active Flow Control</td>
</tr>
<tr>
<td>3:30</td>
<td>D-109 MAE</td>
<td>Optimization of A Drag Car Turbocharger System</td>
</tr>
</tbody>
</table>
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 December 2013. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

Action Mold and Machining
Banelino
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Force Engineering, LLC
Hill and Griffith Company
Irving S. Gilmore International Keyboard Festival
Kalamazoo Distilling Company Inc.
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Peloton, Inc.
Perrigo
Rapid-Line Inc.
Safari Circuits
Society of Plastics Engineers, West Michigan Section
Stryker Instruments
Tenneco Inc.
Township of Kalamazoo Police Department
µ-LAM Laser Delivery System
Verso Paper LLC.
VIRIDIS Design Group
Visi-Trak Worldwide, LLC
Wickeyware, LLC
GAS STATION SITE REDEVELOPMENT  
By: Matthew Lynch, Jordan Van Eerden, and Hua-Ming Wang  
Sponsor: Driesenga and Associates, Todd Batts  
Faculty Advisor: Yufeng Hu, Ph.D., P.E.  
9:00 a.m. – 9:25 a.m.  

A fuel service station located in Jackson, MI was in need of a full scale site redevelopment with the constraint of the existing convenience store remaining functional during construction. The redevelopment project included a reconfigured site layout, storm water management system, and building and fuel dispensary foundation designs. Several alternatives were considered for the storm water management system as well as the foundation designs. Detailed cost analysis as well as construction schedules were created for each alternative and used to determine the most cost-effective design.

PHASE II RIVERWALK TRAIL  
by: Shayne Giordano, Andrew Rudd, and Ibrahim Yakasai  
Sponsor: VIRIDIS Design Group, Timothy A. Britain and John W. McCann  
Faculty Advisor: Valerian Kwizigile, Ph.D., P.E.  
9:30 a.m. – 9:55 a.m.  

The Phase II Riverwalk Trail project involved the design, preparation of construction plans, specifications and cost estimates of the construction, located in the city of Hastings, MI. The Riverwalk Trail is a non-motorized pathway with approximately 120 linear feet of cantilevered overlook deck on the Thornapple River. The trail provided local residents with numerous connections to adjacent neighborhoods, as well as with the Hastings downtown area.

I-96, MIDDLEBELT RD. BRIDGE RECONSTRUCTION  
by: Kirk Habowski and Carl Montri  
Sponsor: Parsons Brinkerhoff, Matthew Oumedian  
Faculty Advisor: John S. Polasek, P.E.  
10:00 a.m. – 10:25 a.m.  

The Middlebelt Road bridge crossing over I-96 was in need of a complete reconstruction due to its long years of use. This required a complete removal and redesign of the bridge. After determining the best of three alternative beam designs, both the superstructure and substructure of the bridge were designed. Construction staging along with maintenance of traffic were conducted in order to smoothly direct the traffic through the construction areas. The Bridge Construction Manuel provided by MDOT was used to help redesign the bridge. Computer aided drafting programs provided the visuals of the design. The reconstructed Middlebelt Road overpass bridge allows for safer transportation across I-96.
ROLE-PLAYING GAME API  
by: Brandon Feldkamp, Andrew Ladd, and Donald Schram  
Sponsor: Red Button Games, Daniel Frandsen  
Faculty Advisor: John Kapenga, Ph.D.  
9:00 a.m. to 9:25 a.m.  

Role-playing games are very popular within the gaming industry; however these games take significant amounts of time to produce. An API was created with Libgdx, a popular cross-platform 2D framework, to provide useful functionality to speed up the production of 2D role-playing games. This API gives the developer flexibility to customize almost every aspect of their game and can be used to create fun, high-quality games without needing to worry about tedious low-level game elements.

WEB PORTAL AND REPORT DELIVERY SYSTEM  
by: Nick Breuer and Lars Hoffbeck  
Sponsor: Level Data Inc., Tim Webster  
Faculty Advisor: John Kapenga, Ph.D.  
9:30 a.m. to 9:55 a.m.  

For business today, it is extremely useful to have a company website that can provide tools and services to employees and clients. A web portal for delivering customizable core reports to clients was created using the Grails framework with an Atlassian Crowd backend. Clients are able to view reports by date range, or by searching past reports for instances of specific data. The web portal replaces the client’s former practice of providing lengthy reports via email. The project was created to be easily extensible so that additional tools and services may be added to it in the future.

DESIGNING A RECORDS MANAGEMENT SYSTEM FOR THE KALAMAZOO TOWNSHIP POLICE DEPARTMENT  
by: Jordan Barber, Stephen Castronovo, and Merrilee Miller  
Sponsor: Township of Kalamazoo Police Department, Sgt. Larry Haynor  
Faculty Advisor: John Kapenga, Ph.D.  
10:00 a.m. to 10:25 a.m.  

Obsolete software and hardware is often difficult to use, unreliable, and costly to maintain. A solution to migrate an existing records management system from a midrange IBM A/S400 hosting 20 years of criminal information to a new hardware and software platform provides an inexpensive option that allows non-technical personnel to access and maintain these critical records. The data from New World Systems’ Aegis was converted and placed onto a Microsoft SQL Server where it can be accessed through a custom interface, developed in Microsoft Visual Studio (C#).
ASYNCHRONOUS REALTIME MULTIPLAYER (ARM) BACKEND
by: Michael Wickey and Jeff Williams
Sponsor: Wickeyware, LLC
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. to 10:55 a.m.

In the mobile gaming industry there often arises the need to play games among many users on multiple platforms, i.e. Android versus IOS. This requires a server hosting a backend that can co-ordinate the necessary functionalities, such as registering users and pushing notifications of events to both IOS and Android. An ARM (Asynchronous Realtime Multiplayer) backend was written in Python using the Django framework hosted by Apache2 on a Rackspace server. This provides an efficient means for users to simultaneously connect and play each other, can scale up to a large number of users and is not limited by device-type.

CRIME REPORT DATABASE APPLICATION
by: Obed Ornelas, Zack Sharkey, and Andrew Woroniecki
Sponsor: Benton Charter Township Police Department, Carl DeLand
Faculty Advisor: John Kapenga, Ph.D.
11:00 a.m. to 11:25 a.m.

The use of a Microsoft Excel spreadsheet to store, manage, and sort records of crime report data can be problematic; it is inefficient as the volume becomes large, is subject to accidental data loss, and is prone to security vulnerabilities. A Windows Forms application, in conjunction with a MySQL database, was created to manage and store crime report data. The software allows more intuitive access to these records, greater security for the data itself, and provides authentication for user access.
ELECTRICAL AND COMPUTER ENGINEERING
Session Chair – Damon Miller
Room D-204/205

INDUCTION HEATING SYSTEM
by: Ryan Huber, Nathanael Noffsinger, and Cameron O’Brien
Sponsor: FEMA Corporation, Rory Adams
Faculty Advisors: Damon Miller, Ph.D. and John Stahl
9:00 a.m. – 9:25 a.m.

FEMA Corporation uses a conventional oven to cure a two-part silicone epoxy used in an electro-hydraulic solenoid valve. This process is a bottleneck on the assembly line and cost prohibitive. In order to combat this issue, FEMA Corporation has requested an induction heating system that is capable of heating the product from room temperature to 130 degrees C in 30 seconds. This is achieved by applying a square wave voltage to an amplifier that drives an induction coil. The output current is sinusoidal due to a resonant circuit, resulting in maximum efficiency.

AMPLITUDE MODULATION LABORATORY EXPERIMENT FOR COMMUNICATIONS SYSTEMS CLASS
by: Aaron Wilson
Sponsor: Safari Circuits, Jim Thompson
Faculty Advisor: Raghvendra Gejji, Ph.D.
9:30 a.m. – 9:55 a.m.

Lab experiments are needed to create a laboratory section for the ECE 4600 Communication Systems class. A discrete signal-multiplying analog circuit was designed, constructed, and translated into a laboratory experiment for students to learn about amplitude modulation. Existing laboratory equipment and components were used to minimize cost. A mobile version with equivalent functions was designed and fabricated, serving as a learning tool for electronics and communication systems, students, as well as potentially being integrated into future design projects.
REMOTE FORCE AND HAPTIC FEEDBACK FOR A ROBOTIC HAND
by: Anthony Serafano, John Stubbs, and Kyle Wroble
Sponsor: Western Michigan University, Pavel Ikonomov, Ph.D.
Faculty Advisor: Ralph Tanner, Ph.D.
10:00 a.m. – 10:25 a.m.

The medical field can greatly benefit from improvements to tactile feedback in remote surgery. The need for a sensor to detect force feedback is very important when attempting to implement this system into the medical field. The sensor has to be able to detect how hard or soft each point is pressing upon an object or the patient’s skin so that the doctor is able to operate with maximum precision. Remote control of a Novint Falcon controller affixed with a force sensor is used to simulate the remote operation of a surgical instrument.

WATER COOLING TOWER CONTROL AND MONITORING SYSTEM
by: Quinn Clifford, Daniel George, and Phillip Knight
Sponsor: Tenneco Inc., Jeff Decker and Mark Wallace
Faculty Advisor: Ikhlas Abdel-Qader, Ph.D.
10:30 a.m. – 10:55 a.m.

Tenneco, Inc. needs to monitor and control various aspects of a DAM water cooling tower including pressure, temperature, and water level. Currently there is no monitoring system in place and any downtime caused by the water tower can be devastating. These problems can be eliminated by installing sensors to monitor all of the variables using an Allen Bradley programmable logic controller (PLC). Values interpreted by the PLC will be displayed locally on a ten-inch touchscreen and globally at the central monitoring center located in the main office area.

HYBRID CURING OVEN CONTROL SYSTEM
by: Kyle Curtis and Linh Nguyen
Sponsor: Rapid-Line Inc, Mark Lindquist
Faculty Advisor: Damon Miller, Ph.D.
11:00 a.m. – 11:25 a.m.

Rapid-Line, Inc. uses infrared burners in a curing oven. Burner temperatures were automated to increase precision and reduce labor by design and implementation of an electronic control system. The system enables use of a handheld barcode scanner to input new jobs. This data is supplied to a dedicated PC station, which then uses ARM Cortex-M3 microcontrollers and analog circuitry to generate a control signal for the burner control boxes, automatically adjusting the desired temperature of the oven for different parts.
SUNSEEKER SOLAR CAR DRIVER CONTROLS
by: Loren Conlin, Michael Good, and Ryan Schwartz
Sponsor: Western Michigan University Sunseeker Solar Car Team, Bradley Bazuin, Ph.D.
Faculty Advisor: Bradley Bazuin, Ph.D.
11:30 a.m. – 11:55 a.m.

Competitive solar car designs rely on weight savings and power efficiency to achieve a competitive edge. A new Driver Control module (DC) has been developed and tested for WMU’s Sunseeker team that incorporates the functionality of the previous driver control module and CAN bridge module for displays. The DC provides switches and sensors for driver inputs such as turn signals, warning flashers, accelerator position and braking. It also provides electronic Controller Area Network communications to all vehicle modules. The new DC, based on an embedded MSP430 microcontroller with C language software, completed integration and testing on the Sunseeker CAN test bench, has achieved the desired size, weight and power reduction, and is awaiting installation in the new car under development.

PARTICLE ACCELERATOR VACUUM CONTROL SYSTEM
by: William G. Glover, Joshua Ickes, and Logan Lockwood
Sponsor: Western Michigan University Physics Department, Allan Kern
Faculty Advisor: Massood Atashbar, Ph.D.
1:00 p.m. – 1:25 p.m.

A vacuum control system was constructed to provide automation and protection for the vacuum pumps of a Van de Graaff particle accelerator. Automating the particle accelerator allows the system to monitor itself while the operator continues to prepare the accelerator for operation. Using an ARM microcontroller, thermocouple gauges are monitored to detect the pressure in the collision chamber down to $5 \times 10^{-6}$ Torr. If an abrupt change in pressure occurs, the system will close the electro-pneumatic valves in the system, thus preventing damage to the pumps. This design provides an option for future expansion to other areas of the particle accelerator.
The Shell-Vacuum metal casting process brings together two existing processes and combines the benefits of each. This process will allow for the production of molds with an indefinite shelf life. These molds can then be poured immediately or at a later date, at a different location. Process parameters were established to promote repeatability of the process. Patterns were developed to demonstrate the capabilities of this new process in a laboratory setting, and actual castings were produced.

Traditional die casting machines are too large and cost prohibitive to use in an educational setting. Using an existing bench top die casting machine created by a previous student team, a teaching tool for WMU and industry was developed. The existing machine was rebuilt, and new technology that allows the integration of shot monitoring was installed. The shot monitoring system allows real time changes to be captured via a computer software system attached to the machine. Testing and analysis using the shot monitoring system were performed while casting a small souvenir. The system is portable and can be brought into a teaching space for safe plug-and-play operation.

The job of the Water Spider—the human material handler—lacks standardization and therefore is not efficient or consistent across three continuous shifts. Using observations, work sampling, and time studies, the current processes of performing the assigned job duties were determined. The data collected was analyzed to identify the workload, production rates, efficiency rates, and wastes. Financial, trend, and statistical analyses were then performed to justify the recommendations to increase productivity. The recommendations for the position of the Water Spider will help to standardize the processes used to complete assigned duties, as well as help determine the appropriate staffing levels required under different production volumes.
MANUFACTURING LINE’S VISION SYSTEM “RECIPE” STANDARDIZATION
by: John Pringle, Remi Sanderford, and Derek Straub
Faculty Advisor: Larry Mallak, Ph.D.
9:30 a.m. to 9:55 a.m.

In retail pharmaceutical manufacturing, it is vital to have correct labeling on the bottle. Manufacturers often use vision systems to ensure the correct labels have been applied to the product packaging. The vision system uses “recipes” as the identifier to specify which bottles and labels to combine. Current information on the recipes for the vision system did not have a standardized terminology. Through observation and interviewing, detailed information was collected on the recipes. By in-depth analysis and consolidating recipes, a standardized terminology of recipes was developed. A cost analysis was conducted to show potential cost savings of using the new standardized system.

WMU FLYING DISC MOLD
by: Chelsea Briggs, Edward Cox, Chantalle Morency, and Dennis Williams
Sponsor: Society of Plastics Engineers, West Michigan Section
Action Mold and Machining
Faculty Advisors: Paul Engelmann, Ph.D. and Jay Shoemaker
10:00 a.m. to 10:25 a.m.

An injection mold was designed and manufactured to produce high-quality flying discs. 3-D CAD models of both disc and mold were created using parametric solid modeling software’s NX and Inventor. The finite element analysis software Moldflow was used to analyze the design to ensure a quality finished product. Process parameters, including machine settings and robotic interface, were optimized for use in WMU’s Plastics Lab. Hands-on experiences have been shown to be a key factor in causing students to consider STEM careers. The mold will provide an essential recruiting and learning tool, inspiring potential students to enroll in the College of Engineering and providing experience of the injection molding process for current students.

VELOMOBILE BODY DESIGN
by: Ashley Johnson, Eric Nederhoed, Mark Onderlinde, and David O’Hagan
Faculty Advisors: David Middleton and Pavel Ikonomov, Ph.D.
10:30 a.m. to 10:55 a.m.

Velomobiles are enclosed human powered and human/electric vehicles. These have helped reduce the dependence on automotive transportation but have often been unsuccessful in protecting the rider from adverse weather. For the WMU Velomobile, a lightweight, removable enclosure was designed and built to shelter the operator from rain, wind, snow, and debris. The design sought to improve aerodynamics, increase safety, and be comfortable while being inexpensive and easy to produce. Sketches and scale models were developed and Finite Element Analysis (FEA) was performed using Solidworks to evaluate structural integrity. The protective enclosure can serve as an example for the growing market of velomobiles and future lightweight transportation methods.
IMPLEMENTATION OF AN ENERGY MANAGEMENT SYSTEM
by: Rapheal Brown, John Ihling, and Devin Talcott
Sponsor: Landscape Forms, Inc.: Ken Slaughter, Kal Kalkowski
Faculty Advisor: Tarun Gupta, Ph.D.
11:00 a.m. to 11:25 a.m.

With global energy prices on the rise, industry leaders are taking actions toward more efficient energy consumption. One such way is through the implementation of an energy management system based on ISO 500001. This is a new standard published by ISO that is intended solely for the management of energy, and is based on continual improvement. During the process of implementing the system, a baseline of energy consumption is established, and Energy Conservation Opportunities, ECO’s, are identified during the energy audit. Once the ECO’s are corrected and the system is in place, the company should see significant reductions in energy consumption and greenhouse gas emissions.

APPLICATION OF LEAN CONCEPTS TO PACKAGING AND KANBAN SYSTEMS
by: Angela Davis, Brian Janego, David Janicki, and Tyler Queentry
Sponsor: Stryker Instruments, Travis Thorpe, Michael Anthony, and Gurdeep Singh
Faculty Advisor: David Lyth, Ph.D.
11:30 a.m. to 11:55 a.m.

Levelized production is a strategy to achieve lean manufacturing in an environment subject to unanticipated change. Re-engineering current component packaging and eliminating excess processes reduces waste, achieving a more efficient product flow. Value stream mapping, product flow mapping, and time studies resulted in more accurate forecasting and a proper use of KANBAN. Utilizing bin and lot sizing produced significant gains in time savings and storage space reduction. Working in a production facility offered hands-on experience with current industry tools and techniques, while enhancing the company’s focus toward lean manufacturing.

GRILLE CENTERING TOOL FOR USE IN AUTOMOTIVE MODULAR ASSEMBLY INDUSTRY
by: Joseph Behrens, Alex Hemker, Jeffery Ingold, and Arthur Kelsey
Sponsor: MAGNA International: AIM Systems- Warren
Faculty Advisor: Mitch Keil, Ph.D.
1:00 p.m. to 1:25 p.m.

A tool used to center a grille between headlamps was determined to be inconsistent based on a 30-piece study. From candidate designs, a foam prototype was created to show a possible solution. A 3D CAD model based on the foam prototype was created for further development and analysis. The new tool designed to improve the assembly process, while increasing the accuracy and repeatability.
DFMA ANALYSIS OF A COOLING TUNNEL STRUCTURE
by: Allison Buchholz, James Peters, Matthew Schultz, and Charles Washburn
Sponsor: Dimplex Thermal Solutions, Doug Mathews
Faculty Advisor: Mitchel Keil, Ph.D.
1:30 p.m. to 1:55 p.m.

A previous cooling tunnel design required excessive manufacturing hours and consisted of too many components. Alternative materials and assembly methods were studied. Design for Manufacture and Assembly (DFMA) was performed to analyze the frame components and verify their necessity. A design concept was modeled in Solid Edge CAD software. A cost analysis was performed to compare the previous and new frame designs. The new frame lowered costs, reduced the number of components while maintaining functionality, increased the rate of production, and ultimately increased profit margin.

DUAL-PURPOSE DESKTOP MACHINE
by: Miguel Acuña, Austin Grieve, and Kenneth Klingler
Faculty Advisor: Jorge Rodriguez, Ph.D.
2:00 p.m. to 2:25 p.m.

Desktop machines employing subtractive and additive manufacturing processes have become popular for use by hobbyists, but each process requires a separate machine. Following research on current industrial and personal machines, Creo CAD software was used to design a machine capable of 3D printing (additive) and milling (subtractive) in a 12’x12’x12’ working envelope. Components for motion, frame, 3D printing, milling, and controls were acquired; and assembly, fabrication, and testing were done in-house. This machine will introduce students to additive and subtractive manufacturing processes and will be used as a resource for classes and projects.

DESIGN OF AN ALTERNATIVE ENERGY GO-KART
by: Zach Johnson, Clifford Scott, and Damen Wolgamott
Sponsor: WMU Office for Sustainability
Faculty Advisor: Jorge Rodriguez, Ph.D.
2:30 p.m. to 2:55 p.m.

With the rising cost of fuel and the increasing availability of efficient and less expensive electric motors and batteries, an electric go-kart has the potential to be the future of backyard fun. Multiple go-kart designs were studied and analyzed to find the most suitable type for adaptation. Safety was an important consideration when determining weight and speed capabilities. Three-dimensional models of the proposed frame, electrical, and steering were created using Creo software. Based on these models, the kart was built from fabricated and purchased parts. The final kart allows for the testing and comparison of alternative energy versus standard gas engine.
FACILITY DESIGN OF BANANA PAPER MANUFACTURING
by: Lorena Pena Jimenez, Fainelys Encarnacion, and Austin Sievers
Sponsor: Banelino
Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.
8:30 a.m. to 8:55 a.m.

Dominican Republic is one of the biggest exporters of organic bananas in the world. When bananas are harvested the whole tree is cut down and the stalk of the tree is wasted. For this Senior Design Project, a process being used in Costa Rica was modified to use the banana tree stalks to make paper. After the process was identified, a location analysis, facility layout, and work station designs were completed. Cost analysis on this project includes payback period, return on investment, and rate of return for our sponsor.
MECHANICAL AND AEROSPACE ENGINEERING
Session Chair – Bade Shrestha, Ph.D.
Room D-109

FRONT SUSPENSION DESIGN FOR WESTERN MICHIGAN UNIVERSITY 2014 SUNSEEKER
by: Benjamien Brusselmans and Aaron Linden
Faculty Advisor: Sudhakar Medepalli, Ph.D.
9:00 a.m. – 9:25 a.m.

Western Michigan University Sunseeker team is developing a new solar powered vehicle for competition in the American Solar Challenge 2015 track race. A dynamic model of the future vehicle was developed using Mathcad mathematical processing software and a 3D model of the suspension was developed using Inventor solid modeling software. The coupled models allow for user-defined modifications to parameters important to vehicle stability, performance, and handling. Optimizing these parameters, a working front suspension was developed, designed, and built to provide superior cornering and handling ability in both road and track races.

MULTIFUNCTIONAL TANK DESIGN FOR WHISKEY DISTILLATION PROCESS
by: David Bellomy and Sarah Johnson
Sponsor: Kalamazoo Distilling Company, Inc., Grant Fletcher
Faculty Advisor: Javier M Montefort, Ph.D.
9:30 a.m. – 9:55 a.m.

Current whiskey distillation processes employ the use of two large tanks-one for mixing ingredients and another for heating the mixture to produce the final product. These two processes have been combined to take place in one multifunctional, steam-jacketed tank with an interchangeable lid system to allow for a more space efficient distillation process. Both the tank and two lids have been rendered using SolidWORKS modeling software, and a complete thermal analysis was done on the tank using Finite Element Analysis. The final design includes tank and lid specifications as well as recommended connection systems and operating parameters.
INTRAOPERATIVE PATIENT NORMOTHERMIC CONTROLLER (IPNC)
by: Christian Appold, David Miller, and Erik Blematl
Faculty Advisor: Christopher Cho, Ph.D.
10:00 a.m. – 10:25 a.m.

Surgical patients under general anesthesia cannot regulate their body temperature and surgeries lasting more than one hour require the patient to be warmed. Allowing a patient to become hypothermic increases infection rates, myocardial infarction rates, the need for transfusions, time in the ICU, and the need for assisted ventilation. The Intraoperative Patient Normothermic Controller (IPNC) uses controlled resistive heating to regulate a patient’s core body temperature by applying gentle heat to critical areas of blood flow. The IPNC is smaller, reduces infection risk, and is more cost effective than competitive equipment.

SUBORBITAL VEHICULAR BALLOON DESIGN FOR ATMOSPHERIC DATA COLLECTION TO RETURN TO LAUNCH SITE
by: Jacob Lefere and Sergio Pavan
Sponsor: Cindy Town, Tammy Miller, and Evelyn Winfield-Thomas
Faculty Advisor: Jennifer Hudson, Ph.D.
10:30 a.m. – 10:55 a.m.

Helium weather balloons are routinely launched into sub-orbital flight with radiosondes attached to them. These devices are used to record weather data through different altitudes of the atmosphere. Normally, the radiosondes end up over 60 miles away and can either be retrieved or remain uncollected. A suborbital vehicle was designed in order to return the instrumentation in the radiosonde back to the launch location. This enables the ability to include more sophisticated instruments for data collection and cuts out the time and cost of retrieval. This design was created using aircraft design techniques in MatLab and CAD software.

HEAT REDUCTION IN THE µ-LAM LASER DELIVERY SYSTEM
by: Hans Avildsen and Anthony Bootka
Sponsor: µ-LAM Technologies, Deepak Ravindra, Ph.D.
Faculty Advisor: John Patten, Ph.D.
11:00 a.m. – 11:25 a.m.

Machining materials such as ceramics and semiconductors with a diamond tip is currently a slow and expensive process. A prototype with new technology, µ-LAM, which couples a highly focused laser with the single point diamond turning process greatly increases efficiency while at the same time reducing tool wear. The alignment of this laser along with an optimized tool assembly is crucial to minimizing thermal expansion which can cause undesirable tolerances. A new tool was designed, fabricated, and tested to allow for consistent installation leading to less variability in laser alignment.
Semi-trailer trucks are often used for transporting large commercial and industrial goods. Due to their large size and shape, significant drag forces are created which results in an inefficient performance. It would be beneficial to increase the fuel economy of these transportation vehicles, by means of reducing aerodynamic drag. This design implements a passive flow control approach. By using the same idea behind dimpling golf balls, a dimpled diffuser was attached to the back of the model. The dimpling of golf balls reduced drag by creating a turbulent boundary layer which reduced the wake. Experimentation and computer simulation software were used to test the hypothesis. Experimentation was done in the wind tunnel at Western Michigan University aerodynamics laboratory. Computer simulation was performed using Fluent.

PRELIMINARY DESIGN AND FLIGHT TESTING OF A UAV
by: Adam Houtman and Jacob Maynard
Faculty Advisor: Peter Gustafson, Ph.D.
1:00 p.m. – 1:25 p.m.

A tail-less Unmanned Aerial Vehicle (UAV) was designed and fabricated to test a recently developed automated ground station. Driving the design were requirements of variable internal/external payload and multiple camera mounts, set by the American Institute of Aeronautics and Astronautics (AIAA). Flight dynamics and controls were modeled in a computational environment prior to design freeze. The test vehicle was created at a 1/3 scale using a combination of fiberglass composite and balsa wood construction. The vehicle will serve students in allowing immediate testing of Unmanned Aerial System (UAS) technology advancements.

GREEN ALTERNATIVE: CONVERTING A SNOW GUN TO WIND GENERATOR
by: Brian McWethy and Wayne Tremblay
Faculty Advisor: Bade Shrestha, Ph.D.
1:30 p.m.-1:55 p.m.

Green alternatives have been heavily sought over the last decades. Traditional solar cells and wind turbines currently used to collect the renewable natural resources have been relatively expensive to install. During the summer months, traditional snow guns/fans used on ski slopes to generate snow in ski seasons, sat idly. To harness the green energy from wind, the design changes were made to motor and existing structure to convert these snow guns into wind electricity generators when these were not in use to blow snow.
DESIGN OF A LIFECYCLE TEST PROCEDURE AND EQUIPMENT
by: Shane Rickert
Sponsor: Peloton, Inc. Levi Hunt, Nathan Hunt, and Travis Loofboro
Faculty Advisor: Judah Ari-Gur, Ph.D.
2:00 p.m.- 2:25 p.m.

Testing procedure and equipment was developed to benchmark deflection properties of the Peloton bearing assembly and telescoping extrusion alternative. Computer simulations validated by experimental data were used to analyze potential material choices. The resulting recommendations for a maintenance schedule of bearing components to optimize service life and deflection properties of the Peloton bearing assembly will aid Peloton, Inc. in their continual improvement process efforts.

LARGE-SCALE, MODULAR AND TUNABLE MECHANICAL PIANO-KEYBOARD FOR THE 2014 GILMORE INTERNATIONAL KEYBOARD FESTIVAL
by: Chad Hague and Michael Riley
Sponsor: Irving S. Gilmore International Keyboard Festival, Mary McCormick
Faculty Advisor: Koorosh Naghshineh, Ph.D.
2:30 p.m.- 2:55 p.m.

The Irving S. Gilmore International Keyboard Festival is widely known as the most prestigious piano festival in America. This festival is held every two years, with the next festival being held April 24th – May 10th 2014. Starting in 2012, The Gilmore creates a community outreach project to promote the festival to the public. For The Gilmore’s 2014 festival, we have designed a large-scale, modular, mechanical piano keyboard that is played by having a person step on the keys. When the key is depressed, an appropriately tuned note is played. This concept differs from current designs, which predominantly use electronics to produce sound. The keyboard has been constructed to allow prolonged exposure to the elements without damage. The design of this modular keyboard is such that its tuning may be easily altered and it can be combined with other modules to create a larger keyboard.

DRAG REDUCTION OF TRACTOR TRAILERS BY ACTIVE FLOW CONTROL
by: Clark Baker, Avin Castelino, and Joseph Karabatakis
Faculty Advisor: Javier Martin Montefort Sanchez, Ph.D.
3:00 p.m. – 3:25 p.m.

Semi-trucks play a major role in the delivery of goods, traveling billions of miles in the United States. Efforts to improve aerodynamics can have a significant impact in reducing fuel consumption and greenhouse gases. Due to the geometry at the rear of the trailer, the abrupt drop off creates low pressure resulting in increased drag. Computer simulations using FLUENT and experimental results from the Western Michigan University wind tunnel show that pressurizing the back of the trailer, by way of active flow control using the exhaust gas, the drag force will be reduced and ultimately reduce fuel consumption.
Turbocharging has been used to increase power output in combustion engines for almost a century. A systematic approach was used for optimizing the power output of a turbocharged drag car. The car was instrumented with sensors to analyze the turbocharging system. Mathematical models were created using fluid dynamics, heat transfer, and internal combustion engine theories. With a thorough understanding of the system, changes were made to improve power output.
ALTERNATIVE COATING CLAY EVALUATION
by: Kyle Caulkins
Sponsor: Verso Paper LLC. Mark Springer
Faculty Advisor: Said AbuBakr, Ph.D.
9:00 a.m. – 9:25 a.m.

Pigments are used in light-weight coated papers to improve the print quality of the final product. Gloss grades commonly use clay as a primary pigment to achieve smoothness and surface appearance after super calendaring. These grades have very large coat weights relative to total sheet weight; therefore, pigment changes have the potential to affect both optical and strength properties. For this study, a new clay product will be trialed on-machine and evaluated based on run ability, finished paper properties, and commercial print performance.
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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 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
- Interim Dean: Dr. Edmund Tsang
- 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 Industrial and Manufacturing Engineering: Dr. Steve Butt
- Chair of Manufacturing Engineering: Dr. John Patten
- Chair of Mechanical and Aerospace Engineering: Dr. Parviz Merati
- Chair of Chemical and Paper Engineering: Dr. Said AbuBakr

CEAS Data (Fall 2013)
- Bachelor’s Enrollment: 2220
- Master’s Enrollment: 362
- Number of Faculty: 100
- Number of Staff: 24

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