You are invited to attend the fifty-first Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., Tuesday, December 4th 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 Map: 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 10:30 a.m. | p.5 |
| Computer Science                   | D-202 | 9:00 a.m. to 11:30 a.m. | p.7 |
| Electrical and Computer Engineering| D-204 | 9:00 a.m. to 12:00 p.m. | p.9 |
| Industrial and Manufacturing Engineering | D-201 | 8:00 a.m. to 3:00 p.m. | p.11 |
| Industrial and Manufacturing Engineering | D-210 | 11:00 a.m. to 12:00 p.m. | p.16 |
| Mechanical and Aeronautical Engineering | D-109 | 9:00 a.m. to 4:00 p.m. | p.17 |
| Paper Eng., Chemical Eng., and Imaging | D-208 | 9:00 a.m. to 10:30 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
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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 2012. 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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SPX Clyde Union Pumps
Stryker Global Quality & Operations
Western Michigan University Office of Sustainability
Western Michigan University Dining Services
ARCADIA CREEK SEWER RELIEF  
by: Nicole Clement, Allison Doty, Tyler McMillin and Thomas Niksich  
Sponsor: Paul Romano, Jones & Henry Engineers, Ltd.  
Faculty Advisor: Richard Edwards  
9:00 a.m. to 9:25 a.m., D-115

In order to reduce the stress of the sanitary sewer pipes along Stadium Drive, Kalamazoo Mi, a relief system needed to be created. Model of the system were created in EPA’s Storm Water Management Model (SWMM), and were used to evaluate the flows of the wastewater. Communications with the City of Kalamazoo, Michigan Department of Transportation (MDOT), and utility companies were all accomplished. The project was completed by designing a set of construction plans, estimates & quantities, and maintenance of traffic plan. The construction of this relief pipe will greatly improve the efficiency of the entire city sewer system.

CHEVROLET DEALERSHIP IN SCHOOLCRAFT  
by: Brian Curtis, Eric Lee, and Pablo Olivarez  
Sponsor: Todd Hurley, Hurley & Stewart, LLC  
Faculty Advisor: Yufeng Hu  
9:30 a.m. to 9:55 a.m., D-115

A site development was needed for a new Chevrolet car dealership in Schoolcraft, Michigan along US-131. The 20,000-sqft structure that includes a carwash, offices, and a mechanic shop requires large amounts of excavation due to the unusual depth of poor soil. The site layout and grading was designed and the excavation and embankment amounts were calculated. Storm water calculations and design were performed. Shallow foundations for the structure were designed. The site development design satisfied the requirements of functionally and visibility of the dealership from US-131.
By analyzing I-94 Business Loop (Skyline Drive) and exploring the different methods used to rehabilitate road pavement, several alternatives were evaluated to determine the most cost-effective. These alternatives included full removal and replacement of the pavement and sub grades, or applying a multicourse overlay on top of the existing pavement. Other design tasks that were undertaken include replacement of existing culverts, guardrails, signs and clearing tree growth from the area around the road to maintain proper distance for safety concerns.
ANDROID INVENTORY
by: Raldin Dilone Hidalgo Tirado and ClasSara Yvette Morris
Sponsor: Dale Anderson, Confections with Convictions
Faculty Advisor: John Kapenga
9:00 a.m. to 9:25 a.m., D-202

An inventory is the method that companies use to keep track of every item they own. The Android inventory was created to give the company the ability to add the quantity of products by its type into a database, allowing the company to know how much it should produce per day. It also allows the owner to mark which products will be shown on the main page that are available for sale. The Android inventory will only be accessible to the company owner in order for him to add and edit the product details.

BATON
by: Matthew David Knewtson, Andrew Stratton, and Timothy Weidner
Faculty Advisor: John Kapenga
9:30 a.m. to 9:55 a.m., D-202

The Kalamazoo Laptop Orchestra at Western Michigan University needed a better way to incorporate iPads, iPhones, and iPods into their performance pieces. The previous implementation put too much stress on the network and sent out much more data than was needed. A new app was designed for the mobile devices to provide the same functionally as the one previously used but without the significant network saturation. The new solution allows the Laptop Orchestra to continue performing their pieces without having to upgrade their networking hardware. It also allows for more expansion with the current hardware in place.

PIZZERIA POINT OF SALES SYSTEM
by: Gabriel Casella and Scott Klassen
Sponsor: Francesca Impellizzeri, Franco’s Sub-Station & Italian Pizzeria
Faculty Advisor: John Kapenga
10:00 a.m. to 10:25 a.m., D-202

In today’s world technology is being integrated everywhere possible. This holds true in the restaurant industry, where companies are implementing computer-based point of sales systems for customer transactions. These points of sales system are designed and installed to replace dated cash registers and automating pricing. This reduces errors and increases throughput by finishing sales faster. Designing a point of sales system required three main components: designing a database, creating and programming a user-friendly interface, and lastly, selecting and installing the necessary hardware to run both the database and the interface.
PARKVIEW CAMPUS TOUCH SCREEN KIOSK
by: Bryan Ford, Michael Guzior, and Alan Pfeiffer
Sponsor: Christopher Rand, Western Michigan University
Faculty Advisor: John Kapenga
10:30 a.m. to 10:55 a.m., D-202

Touch screen kiosks at universities often provide useful services to both visitors and students. The kiosks within the lobby of the CEAS campus were without services targeted towards visitors and new students. A graphical interface was created using Windows Presentation Foundation, an IDE within Visual Studio, to provide such services. The main services included a campus map, contact info for staff, and campus events. The kiosks will help provide answers to common questions asked by visitors and students new to the campus.

INVENTORY CONTROL WEB APPLICATION
by: David Barnes, Carleton Oldham, and Benjamin Vronko
Sponsor: Christopher Rand, Western Michigan University
Faculty Advisor: John Kapenga
11:00 a.m. to 11:25 a.m., D-202

Accurate inventory control in a computer lab is vital in ensuring that day to day operations run smoothly. A web application was developed to aid in the process of maintaining accurate inventory control. The application was built using current web standards including HTML5, JavaScript, database driven backend, coded in PHP. The application allows for the addition and the removal of items. This is a simple way to use interface for adjusting quantities, as well as email notification for items with low inventory stock. The completed application ensures that computer labs will never endure down time due to depleted inventory.
BATTERY PROTECTION SYSTEM FOR SOLAR CAR
by: Jason Faulconer, Nicholas Gillette, and Byron Izenbaard
Faculty Advisor: Bradley Bazuin
9:00 a.m. to 9:25 a.m., D-204/205

A battery protection system (BPS) has been developed for the WMU Sunseeker solar car to monitor the lithium polymer battery and protect the car and battery from operating in potentially dangerous conditions. The BPS operates by periodically measuring individual cell voltages and cell temperatures as well as the total battery charging or discharging current. When initially turned on, the BPS uses an external auxiliary battery to determine if the voltages, temperature and current are within defined safety limits. If correct, the BPS allows the battery to connect to the primary power distribution and to power the BPS. During normal operation, if any parameter moves outside the safe operating range, the BPS will disconnect the battery pack from the solar car and return to external battery power while maintaining information on the battery fault. In addition to monitoring and protection, the BPS performs the pre-charging of the two main motor controller capacitors and communicates battery status information via the CAN bus to the telemetry subsystem. The BPS was successfully demonstrated in this year’s American Solar Challenge 2012 track and cross-country “rayces”.

WIRELESS RACE CAR TIMING DEVICE
by: Keith Martinez, Spencer Oonk, and Eric Wilkins
Faculty Advisor: Janos Grantner
9:30 a.m. to 9:55 a.m., D-204/205

Accurately measuring the lap time for a high-velocity race is an extremely difficult task. A Global Positioning System module and an accelerometer within the transmitting module work together to determine the position of the car on the track with respect to a user-chosen starting point. The lap time information is sent wirelessly to a handheld device for display to the user. Additionally, each lap time will be saved to an external storage device for later evaluation. The completed system provides lap times accurate to one one-hundreth of a second while allowing the user to concentrate on other important tasks around the track.
SMART TOASTER
by: Llemss de la Rosa and Silvio Martinez
Faculty Advisor: Dean Johnson
10:00 a.m. to 10:25 a.m., D-204/205

Conventional toasters use an open loop control system of time and temperature to accomplish their process of toasting bread without considering factors like color, moisture, and size. A smart toaster using a closed loop feedback system has been designed to improve the toasting process. The smart toaster has three settings: light, golden, and dark brown. It employs thermocouple sensors to provide feedback to a microcontroller to determine when to end the toasting process for each of the settings.

AUTONOMOUS MOBILE ROBOT
by: David Waithaka and Welby Seely
Faculty Advisors: Hanyi Dai and Frank Severance
10:30 a.m. to 10:55 a.m., D-204/205

This Autonomous Mobile Robot is a small, inexpensive three wheel robot with the primary purpose of target acquisition. Using a variety of sensors, the robot’s mission is to seek out a target, indicate acquisition success, and returns to base. The target, an infrared LED, is hidden in a room full of obstructions. The robot has to navigate this gauntlet of obstructions to achieve its goal.

SUPPLEMENTING AC GRID POWER USING BATTERIES
by: Matthew Kubacki, Mohammed Mousa, and Steven Ryder
Sponsor: Alternative and Renewable Energy Research and Laboratories
Faculty Advisor: Damon Miller
11:00 a.m. to 11:25 a.m., D-204/205

A system was developed to transfer energy stored in battery cells to a low voltage AC power grid. Energy transfer is accomplished by stepping up the battery voltage followed by conversion to a potential compatible with the grid. This demonstrates key aspects of a system that stores and retrieves energy from retired electric car batteries.

A PRE-HEATING SYSTEM FOR PLUG-IN-HYBRID ELECTRIC VEHICLES
by: Paul Nicholson, Hetal Patel, and Shane Scott
Sponsor: Denso Corporation
Faculty Advisors: Johnson Asumadu and John Patten
11:30 a.m. to 11:55 a.m., D-204/205

A system was developed that uses external electricity to pre-heat the cabin, coolant, battery, catalytic converter, and oil pan of a Plug-in-Hybrid Electric Vehicle (PHEV) in cold weather. The pre-warming of the PHEV eliminates the need to pre-run the internal combustion engine and thus increases the apparent overall efficiency (measured in miles per gallon (MPG)) of the PHEV in cold conditions.
PNEUMATIC SHOCK DYNAMOMETER
by: Jerry Andrews II, Tom Casperson, and Trent Heithoff
Sponsor: Humphrey Products Company
Faculty Advisor: Jorge Rodriquez
8:00 a.m. to 8:25 a.m., D-201

Within the racing community, the right choice of shock absorbers is often the difference between winning and losing, causing more racers to want to know how their shock absorbers are performing. An innovative, portable, and price competitive pneumatic shock dynamometer was designed, built, and tested, as an alternative to mechanically-driven commercial ones. The frame and components were designed and laid out using computer-aided design (CAD) software. The testing cycle is fully automated and emulates accepted practices. The designed dynamometer is capable of testing a variety of shocks, and test results compare very well to ones from testing bureaus.

BENCH TOP DIE CAST MACHINE
by: Matthew Goerlich, Lawrence Hengesbach, Gregory Lindow, and Michael Saldana
Faculty Advisor: Sam Ramrattan
8:30 a.m. to 8:55 a.m., D-201

Die casting, a specialized manufacturing technique, involves forcing non-ferrous molten metal into a mold cavity. Machines that perform this process are large and require a long setup time, making them unrealistic for a lab setting. A fully functioning, eighth-scale die cast machine, based on an eight ton press was designed and built to be used as a teaching tool. Solidworks, a computer aided engineering software, was used to create the 3D machine model. The final bench top die cast machine will provide valuable learning tool for university students and industry training.

INFORMATION SYSTEM DEVELOPMENT AND PRODUCT TRACEABILITY
by: Michael Gianunzio, Bryant Powers, Tim Schultes, and Kenneth White
Faculty Advisor: Larry Mallak
9:00 a.m. to 9:25 a.m., D-201

The food development production process requires adhering to FDA regulations and complying with the Bioterrorism Act of 2002 for food safety and traceability. A key project identifier for the pilot plant test plan was created to trace all production information electronically. Data flow diagrams, process leader input, job shadowing, and cost benefit analysis were used to improve product traceability and the ease of information sharing. The integration of the key project identifier with the centralized SharePoint system will allow for easy electronic traceability and the reduction of manual information input.
HYBRID SOLAR UPDRAFT TOWER
by: Adam Haslinger, Josef Imesch, and Andrew Pherson
Sponsor: Bas Blankenstijn and Jeffrey Spoelstra, Western Michigan University Office of Sustainability
Faculty Advisor: Jorge Rodriguez
Graduate Advisor: Sean Derrick
9:30 a.m. to 9:55 a.m., D-201

The motivation to improve efficiency in self-sustainable energy resources continues to grow at a great pace. Solar updraft towers have become a prevalent alternative energy source; however, power producing efficiency of the towers is limited by their dimensional requirements, roughly 12.8 acres per megawatt. CAD software was used to design and implement a hybrid system of lenses and mirrors to improve the tower’s efficiency. Material options were tested and compared in order to maximize efficiency in the tower before the hybrid system was added. A model was constructed, providing an opportunity to compare statistics before and after the hybrid system to observe efficiency improvements.

CONTINUOUS IMPROVEMENT FOR LEAN MANUFACTURING
by: Courtney Burnett, Andrew Dreikosen Jr., Brendan Klok, and Grant Miller
Sponsor: Gurdeep Singh, Stryker Global Quality & Operations
Faculty Advisors: David Lyth and Betsy Aller
10:00 a.m. to 10:25 a.m., D-201

Rapidly growing companies frequently struggle when expanding product lines due to the constraint of manufacturing space within their current facilities. Through the use of the Plan, Do, Check, Act (PDCA) approach, significant floor space was freed up through the elimination of batch building and separating subassembly processes. While redesigning the floor plan, detailed analyses were performed to improve ergonomics, material handling, process flow, and to reduce the seven wastes defined in lean manufacturing. Templates to replicate the same line improvements were provided to enable the further reduction of floor space and help drive the facility toward becoming a leaner manufacturer.
USING INJECTION MOLDING SIMULATION TO DETERMINE REALISTIC PLASTIC TOLERANCES
by: Nathan St. Amour and Jacob Williams
Sponsor: David Okonski, General Motors
Jay Shoemaker, Autodesk, Inc
Faculty Advisor: Jay Shoemaker
10:30 a.m. to 10:55 a.m., D-201

The tolerance(s) required of plastic parts are affected by material shrinkage and can limit the dimensional stability of a final product. Incorporating simulation molding into the design and manufacturing process allows companies to better determine the dimensional changes that occur due to molding. Moldflow, an injection molding simulation program, was used to import CAD geometry and select processing conditions to predict part shrinkage. These shrinkage results were compared to molded parts that were laser scanned to determine dimensions. By understanding the correlation between processing conditions and molded part dimensions, manufacturers can control the sensitivity of the molding process and the ability to maintain products within specifications.

HUMANOID ROBOTICS CASE STUDY: THE REBIRTH OF ROBO-BRONCO
by: Michael Biro, Millet Mello, and Ross Snyder
Faculty Advisor: Tarun Gupta
11:00 a.m. to 11:25 a.m., D-201

Robo-Bronco, first developed in 2003 to serve as a recruitment tool for Western Michigan University, needed extensive updating in mechanical and interface systems. Existing mechanical constraints were addressed and redesigned to bring the technology up to date. Additional ranges of motion were introduced in the legs, giving the robot more humanoid qualities. The overall structural design was lightened, improving stability by lowering the center of gravity. Programming and interface were improved through the addition of an Arduino microcontroller. Extensive research on humanoid robotics, 3D modeling, and testing of new modifications brought Robo-Bronco new life as WMU’s robotics case study and publicity robot.

IMPROVEMENTS FOR PARKVIEW CAFÉ
by: Karol Kret, Trent Palmer Vance, and James V. Street
Sponsor: Judy Gipper, Western Michigan University Dining Services
Faculty Advisor: Kailash Bafna
11:30 a.m. to 11:55 a.m., D-201

With increased usage of the Parkview Café, its current design and menu offerings are inadequate to accommodate a growth in demand. An analysis was done for three levels of growth in clientele and different amounts of capital investments. Various techniques such as user surveys, cost analysis, and CAD drawings were used for the analysis. Recommendations were made for each level of growth and include increased menu variety, small layout changes to the current design, as well as an expansion utilizing new space adjacent to the café.
HIGH-END CAMERA CRANE FOR ENTRY-LEVEL FILMMAKERS
by: Tony Bienz, Zachary McDonnell, Benjamin Schmitt, and Joe Staperfenne
Faculty Advisors: Joseph Petro and Betsy Aller
1:00 p.m. to 1:25p.m., D-201

Camera cranes are powerful tools in filmmaking, but those currently available are not affordable to students and amateurs or usable without extensive training. A fully-functional crane was designed and built to be low-cost, easy to use, modular, and portable. It features a rotatable camera mount, a simple controller, and a modular boom. Designs were modeled and analyzed with computer-aided engineering software such as Creo, and the chosen design was fabricated using computer numerical control (CNC) machining and various welding processes. The completed crane fills a need in the market for students and amateurs.

POWER DOCK: A REDESIGNED CHARGING STATION FOR ELECTRONIC DEVICES
by: Joseph Dyer, Ethan Heiden, and Tristan Roeda
Faculty Advisor: David Middleton
1:30 p.m. to 1:55 p.m., D-201

Parkview’s classroom and lecture hall desks are outfitted with power and Ethernet ports for the students’ convenience. However, in the years since their installation, these ports have failed and deteriorated. Through sketch modeling, user surveys, and 3D modeling (using Creo software), an alternative was designed. Outdated technologies, such as Ethernet ports, were replaced with universal serial bus (USB) power ports. Multiple failure analysis tests of the existing terminal were compared to the alternative Power Dock using finite element analysis (FEA). Rapid prototypes were created using stereolithography (SLA) and fused deposition modeling (FDM), and were tested in-place by typical users. Power Dock will be more useful to users and will last significantly longer in a classroom environment.

DESIGN AND CREATION OF THE MOTOPIPE
by: Rob Belinc, Tony Lo, and Sean Pachuta
Faculty Advisor: Frederick Sitkins
2:00 p.m. to 2:25 p.m., D-201

Since the invention of the bicycle, children have enjoyed adding accessories such as bells, baskets, and other items. The “Motopipe” accessory gives the impression that the child is riding a motorcycle without the bicycle being motorized. The exhaust pipe was designed using the computer-aided engineering (CAE) software Creo; the design contains a throttle, which activates the light and sound. The prototype was fabricated and tested. The product will provide a more enjoyable experience for any child who wants to upgrade their bicycle.
The Automotive Systems Laboratory at WMU had an Engine Dynamometer Lab in need of an updated control system. A new throttle control and data acquisition system was installed on the supercharged Nissan engine. The setup included OBD II data logging for the engine measurements, along with PWM (pulse width modulation) throttle control that allows students to see engine measurements at the crankshaft and ECU (engine control unit). Scan XL Pro was used to display engine measurements, and Microsoft Visio was used for a layout of the setup. The adaptation of this economical control system has simplified the current over-engineered industrial settings and will support students in the Automotive Systems minor.
INDUSTRIAL AND MANUFACTURING ENGINEERING
Session Chair – Bob White
Room D-210

SHIPPING AND RECEIVING COST REDUCTION
by: Zachary Fillmore, Joseph Fodo, and Yaris Recio
Faculty Advisors: Azim Houshyar and Bob White
11:00 a.m. to 11:25 a.m., D-210

In manufacturing facilities worldwide, a goal to becoming world class includes the reduction and control of inventory. Using facility layout techniques; statistical analysis; and ProModel, a discrete event simulator, an optimized layout and flow of material became visible. Inventory control became a focus to define bin storage and utilization within the facility. Using these engineering tools, reductions of cost and inventory were attained to increase available space and operating profit.

SYSTEMS ANALYSIS OF DISCHARGE INFORMATION FLOW
by: Jozef Aniszczycyk, Yolanda Bautista Garcia, and Lynnette Neil
Sponsors: Marla Atkinson and Betsy McGraw, Bronson Methodist Hospital
Vani Sabesan, Kalamazoo Center for Medical Studies
Faculty Advisors: Laila Cure and Tycho Fredericks
11:30 a.m. to 11:55 a.m., D-210

Information flow is a necessary requirement for the safe and timely discharge of patients from a hospital. Process mapping was used to understand and describe the patient flow and the information flow throughout the unit, and root cause analysis was used to identify potential information bottlenecks throughout these flows. These tools aided in the analysis of a discharge dashboard to be used by an interdisciplinary healthcare team. The information gained from this study could potentially be used in the design and evaluation of alternative strategies to facilitate the flow of information within the different areas of a healthcare environment.
HINGE INSTALLATION FIXTURE FOR AUTOMOTIVE ASSEMBLY
by: James Langhart and Andrew Vos
Sponsors: James E. Schleben, General Motors and Ryan P. Fogg, Shoreline Manufacturing
Faculty Advisor: James Kamman
9:00 a.m. to 9:25 a.m., D-109

A major automotive manufacturer uses a large mechanical fixture to install door hinges on automobile bodies as they move along an assembly line. The current fixtures occasionally fail during the assembly process due to repeated use and loading. To prevent assembly line downtime handheld backup fixtures were designed using 3D solid modeling software. The fixtures were then built and tested for reliability.

VIBRATION REDUCTION OF A CARDBOARD MANUFACTURING MACHINE
by: Chris Henegar, John Kalbfell, Anthony Konesni, and Greg Morgan
Sponsor: Matt Kerr, Hexacomb Corporation
Faculty Advisor: Koorosh Naghshineh
9:30 a.m. to 9:55 a.m., D-109

Cardboard packaging is used to safely ship a wide range of products. A machine that is used to produce honeycomb patterned cardboard structures exhibits excessive vibrations. This limits the rate at which packaging material can be produced. Pro/ENGINEER and SimMechanics were used to investigate treating the vibrations at the source by balancing the cutting action of the machine. ANSYS and Mathcad were used to simulate the effects of applying vibration absorbers as well as adding stiffeners on the structure of the cardboard processing machine. Using these models, studies were done to come up with the best selection of dimensions, materials, and mounting locations for each vibration reduction technique. Prototypes were fabricated and tested.

EXPERIMENTAL VALIDATION OF COMPUTATIONAL FLUID DYNAMICS MODEL
by: William Dekam and James Martlew
Sponsor: Mark Lindquist, Rapid-Line
Faculty Advisor: Claudia Fajardo
10:00 a.m. to 10:25 a.m., D-109

Industrial paint curing ovens are used across many industries and, due to their open-ended design, can be very energy intensive. To prevent heat loss and improve efficiency, air seal jets are often fitted to blow across the openings and separate internal air from the atmosphere. In support of an ongoing graduate research project, which aims to optimize the air system of an industrial partner, validation work was conducted to establish temperature, velocity and turbulence boundary conditions for an ANSYS Fluent model. Experimental techniques included thermocouple and anemometer testing, along with extensive work in the field of particle image velocimetry.
DESIGN, ANALYSIS, AND TESTING OF A WASTE CONTAINER WHEEL
by: Paul Clark and Josh Peters
Sponsor: Jordan Avery, Sturgis Molded Products
Faculty Advisor: James Kamman
10:30 a.m. to 10:55 a.m., D-109

There is a demand in the market of plastic injection molded parts for an eight inch diameter curbside waste container wheel. A three-dimensional model of the design of the wheel was created in SolidWorks. FEA and mold flow analysis were critical steps in the design process in order to create a mold design and a prototype of the part. The prototype was then tested to ensure it agreed with design requirements set by Sturgis Molded Products. The new wheel design is expected to be used on waste containers throughout the nation as a durable, lightweight alternative to current wheel standards.

DEVELOPMENT AND ANALYSIS OF A 1.4L TURBO LIQUID COOLED CAC AND AC CONDENSER SYSTEM
by: Matt Cutler and Mitch Zajac
Sponsors: Dan Hornback and Kevin Laboe, Chrysler Group, LLC
Faculty Advisor: HoSung Lee
11:00 a.m. to 11:25 a.m., D-109

With the recent competition among automotive manufactures to produce more fuel efficient vehicles, many techniques have been investigated, including reduction of power consumption within the power train cooling system. A dual radiator system design (one high temperature and one low temperature) with certain liquid cooled components is sought over the conventional single radiator design. Analysis of each system based on performance, power consumption (fuel economy), and packaging space was investigated. This type of decrease in power consumption in the power train cooling system led to improved fuel efficiency of the vehicle, making it a more attractive option for the consumer.

AUTOMOTIVE EXHAUST DRIVEN TURBINE ALTERNATOR
by: Garrick Eccles and Chris Engler
Faculty Advisor: Bade Shrestha
11:30 a.m. to 11:55 a.m., D-109

Automobiles today feature increasing numbers of electrical components and systems that have previously been mechanical. These systems tend to be more efficient but also require a larger supply of electrical power. In order to meet these larger power demands, a turbine alternator has been modeled and analyzed that will recuperate waste exhaust heat in the form of electrical power. A prototype was built for experimental data collection and proof of concept. The exhaust driven turbine alternator will reduce emissions while increasing fuel economy in automotive applications.
DESIGN VALIDATION OF A HYBRID AIRSHIP THROUGH FLIGHT TESTING
by: Nathan Hamilton and Nicholas Konkle
Sponsor: Southern Balloon Works
Faculty Advisor: Tianshu Liu
1:00 p.m. to 1:25 p.m., D-109

As today’s aircraft push the limits of available technology, hybrid flight platforms need to be developed which combine current technology in ways to provide superior performance in flight regimes unreachable by configurations of the time. The ground work for this project, completed in December of 2011, was evaluated to improve the flexibility of its design and overall flight performance. Computer-aided design and simulation, using AutoCAD and MATLAB, was performed to facilitate analysis of the hybrid configuration to determine the best solution to the problem set. Validation of this design provides solutions to the problems of personal, high-altitude, and planetary flight.

WELD INSPECTION TABLE FOR CATALYTIC CONVERTER
by: Peter Stelwagen and Chengjie Tian
Sponsor: Jeremy Jones, Eberspaecher North America
Faculty Advisor: Judah Ari-Gur
1:30 p.m. to 1:55 p.m., D-109

The visual inspection of welds is one significant step in the production of catalytic converter canisters. However, an unaided inspection of the welds can be inaccurate, and non-ergonomic. An inspection table, with a V-shaped platform, built-in-lights, height adjustment, and information display area, was constructed. The table allows for a major improvement in the inspection process. This table is more accurate, and more user friendly, than the current method. The inspection table provides a tool that produces better quality catalytic converter canisters while reducing cost.

REDUCE SETUP TIME FOR TEST PUMP DISCHARGE SYSTEM
by: Jasen Ratajczak and Eric Townsend
Sponsor: Bryan Leslie, SPX Clyde Union Pumps
Faculty Advisor: Javier Montefort
2:00 p.m. to 2:25 p.m., D-109

Testing industrial pumps requires various intake and discharge set-ups depending on the type and size of the pump. A three-dimensional model of a universal discharge pipe system was created using SolidWorks, a parametric solid modeling program. The model was then used in a Finite Element Analysis program to ensure it would be able to handle the expected loads without falling and be safe in the work environment. The model of the completed system shows a solution to reducing the set-up time of pumps, thus improving the testing capacity of the facilities.
In recent years military use of electrical weapon accessories has become increasingly common. An electrical generator was designed using thermoelectric modules to convert excess waste heat from an M-4 rifle barrel into electrical energy to power sights, lasers, and other equipment. It is contained within the rail mounting system on the weapon itself. A model was designed and tested using SolidWorks cad software, ANSYS fluid and heat transfer simulation software, and MathCAD engineering calculations software. This generator can be used to help ensure that military accessories do not fail from lack of electrical energy in the field.

To further research and develop Western Michigan University’s alternative energies research, a hydrogen fuel-cell-electric vehicle was recreated. SolidWorks software and finite element analysis (FEA) were used in the designing of new components. Parts were fabricated using computer numerical controlled (CNC) and manual machining and forming tools. Tests were run on the completed vehicle to compute the efficiency and performance of the battery and hydrogen fuel-cell. The data and vehicle are being used to prove and expand upon hydrogen fuel cells as a feasible alternative energy.

Metal casting is a $40 billion industry in the United States. The quality of the casting and final product depend on the characteristics of green sand used in the casting mold. The quality of the sand can be improved by a process called aeration. To determine the cause for property enhancement from aeration, samples of aerated and non-aerated green sand were analyzed using x-ray diffraction. The findings were evaluated using the ICDD database and a PowderCell simulation of the material was created to identify and utilize the improved characteristics of the green sand.
EFFECT OF ANTHRAQUINONE (AQ) IN OXYGEN DELIGNIFICATION OF PULP
by: Ryan Adidharma Audwinto
Faculty Advisor: John Cameron
9:00 a.m. to 9:25 a.m., D-208

Oxygen delignification is considered as an intermediate step between kraft pulping and bleaching since up to about 50% of the residual lignin in kraft pulp can be removed at this stage. The process of oxygen delignification was done in lab using the lab size O2 reactor. The chips preparation and cooking with the AQ had already been done before the pulp entered the reactor. The complete analysis of product was produced to provide significant information to aid in future research of oxygen delignification.

DESIGN AND MANUFACTURE OF SPECIALTY GRADE ART PAPER
by: Phil Slesinski
Faculty Advisor: John Cameron
9:30 a.m. to 9:55 a.m., D-208

Paper pilot plant operations at Western Michigan University may have the capabilities to support the manufacture of a specialty grade paper used in the aquatint hand engraved print process. Aquatint printing is a variant of the intaglio etching method used by art professionals, scholars, and hobbyists. Baseline physical properties and chemical composition were determined from an existing sample, and the pilot machine was configured to produce a nearly exact replication. Cost analysis was performed on the energy, raw materials, and labor to determine if the production of aquatint paper is a profitable business venture for the pilot plant operations at WMU.

IDENTIFICATION OF A FURNISH AND PROPERTIES OF A LAYFLAT POLY EXTRUSION BASE SHEET
by: Liz Bishop
Sponsors: Jeff Armstrong, Dan Thompson, Loparex LLC
Faculty Advisor: Jan Pekarovic
10:00 a.m. to 10:25 a.m., D-208

The dimensional stability of a base sheet is critical when applying a polyethylene or polypropylene application. Currently eucalyptus fiber base sheets provide the dimensional stability characteristics that are required, but with a higher price tag. The purpose of this research is to determine alternates, if any exist, and/or additional fiber sources for the development of a premium layflat liner other than eucalyptus fiber. A variety of paper properties of 10 different base sheets currently used in the industry were measured and compared to the currently preferred eucalyptus.
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