



47TH CONFERENCE ON SENIOR ENGINEERING DESIGN

**Tuesday, December 7th, 8:30 a.m. to 2 p.m.
College of Engineering and Applied Sciences**



WESTERN MICHIGAN UNIVERSITY

Conference on Senior Engineering Design Project



You are invited to attend the forty-seventh Conference on Senior Engineering Design Projects. The conference will be held from 8:30 a.m. to 2:00 p.m., **Tuesday, December 7th** 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 11:30 a.m.	p.5
Computer Science	D-202	9:00 a.m. to 10:30 a.m.	p.6
Electrical and Computer Engineering	D-204	9:00 a.m. to 11:30 a.m.	p.8
Industrial and Manufacturing Engineering	D-201	8:30 a.m. to 11:30 a.m.	p.9
Mechanical and Aeronautical Engineering	D-109	9:00 a.m. to 2:00 p.m.	p.12
Mechanical and Aeronautical Engineering	D-208	10:30 a.m. to 2:00 p.m.	p.14
Paper Eng., Chemical Eng., and Imaging	D-208	9:00 a.m. to 10:30 a.m.	p.16

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>

CCE Civil and Construction Engineering
CS Computer Science
ECE Electrical and Computer Engineering
IME Industrial and Manufacturing Engineering
MAE Mechanical and Aeronautical Engineering
PCI Paper Engineering, Chemical Engineering, and Imaging

TIME	ROOM/DEPARTMENT	TOPIC
8:30	D-201 IME	Re-design of a modern fuel system on a classic-inspired Chevy
9:00	D-115 CCE D-202 CS D-204/205 ECE D-201 IME D-109 MAE D-208 PCI	Finkbeiner Road Over Thornapple River CAEsKed – A Class Scheduling Web Application DC Motor Testing System Improving Core Making Technology Autonomous Robotics Chassis Design The Effects of Clear Toner on the Color Gamut
9:30	D-115 CCE D-202 CS D-204/5 ECE D-201 IME D-109 MAE D-208 PCI	I-94 BL Stadium/Howard St. Intersection Interactive Walker Assistant Sensor-Based Music Controller Increasing engagement between healthcare and IT systems Automobile Mass Distribution Analyzer Oxygen Pretreatment of Cellulose to Improve Enzymatic Hydrolysis Biomass
10:00	D-115 CCE D-202 CS D-204/205 ECE D-201 IME D-109 MAE D-208 PCI	Kalamazoo River Valley Trail Academy St to Kal-Haven Trail Behavior Modification in a Learning Environment Using Embedded Systems Control System Experiment Suite Modular Hydraulic System Test Bench All Terrain Vehicle Hydraulic Drive Train Design The Consequence of Calendaring Various Perfluoro Treated Paper
10:30	D-115 CCE D-202 CS D-204/205 ECE D-201 IME D-109 MAE	M-43, 12th Ave, 72nd St six way intersection, Van Buren Athletic Inventory Management System Wireless GPS Data Transmitter Receiver System A Greener Kalamazoo Rubber Fatigue Testing Apparatus

	D-208 MAE	Design of a Near-Constant Force Spring for Orthopedic Implants
11:00	D-115 CCE D-204/205 ECE D-201 IME D-109 MAE D-208 MAE	Rosa Parks Transportation Center Temperature Control of a Thermoelectric Cooler Reducing Production Cycle Time for Mining Vehicles High Precision Spring Rate Tester Latching Pneumatic Valve
11:30	D-201 IME D-109 MAE D-208 MAE	Manufacturing Process Management: WACO YMF-5 Fuel Tank Racecar Multi-Element Rear Wing Design Optimization of an Electro-Hydraulic Valve
1:00	D-109 MAE D-208 MAE	Detergent Limiting System for Washer Biofuel Micro Turbine Engine Test Cell Design and Operation
1:30	D-109 MAE D-208 MAE	Characterization of Aerospace Grade Hydraulic Hoses Development of a Fuel Delivery System for a Single Cylinder Gasoline Direct Injection Engine

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 2010. 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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CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – John Polasek

Room D-115

FINKBEINER ROAD OVER THORNAPPLE RIVER

by Chelsea Griffith, Omar Kanaan, and Vishal Patel

Sponsor: Wilcox Professional Services

Faculty Advisor: Yufeng Hu

9:00 a.m. to 9:25 a.m., D-115

In response to residential and commercial growth seen in Middleville, MI, a two-span bridge joining Finkbeiner and Crane Road over Thornapple River was proposed to accommodate the projected AADT of 10,000 vehicles per day by 2020. A structural study compared the feasibility of two girder options: reinforced pre-stressed concrete and steel, per AASHTO LRFD Bridge Design Specifications. A hydraulic model demonstrating the impacts of water surface elevations and floodplain limits was prepared in Hydraulic Engineering Centers River Analysis System (HEC-RAS) software. Based on a 100 year runoff event, foundation depth, geometry and placement were determined by a scour analysis, also in HEC-RAS. An optimal bridge design was presented, ultimately reducing commuter travel time and opening up commerce within local communities.

I-94 BL (STADIUM DR.) AND HOWARD ST. INTERSECTION IMPROVEMENT

by Bradley Gerbasich, Christopher Sawyer, and David Schmidt

Sponsor: Michelle O'Neill, Michigan Department of Transportation

Faculty Advisor: Jun-Seok Oh

9:30 a.m. to 9:55 a.m., D-115

The intersection of I-94 Business Loop (Stadium Drive) and Howard Street is a major intersection which has reached its traffic capacity and is listed on the state of Michigan's high crash list for intersections. The intersection improvements considered the nearby railroad crossing, as well as flood plain site conditions. The recommendations for improvements were based on an analysis of the current operating level of service, as well as an inspection of intersection crash data. Complete plan sheets as well as maintenance of traffic sheets were created based on the improvement recommendations.

KALAMAZOO RIVER VALLEY TRAIL ACADEMY ST TO KAL-HAVEN TRAIL

by Adam Eaton, Matthew Maluchnik, and Nathan Raburn

Sponsor: Fred Nagler, City of Kalamazoo

Faculty Advisor: John Polasek

10:00 a.m. to 10:25 a.m., D-115

As more emphasis is being placed on using alternative modes of transportation, non-motorized paths and trails will become increasingly significant. Connecting the existing path systems of WMU and Kalamazoo College with the end of the Kal-Haven Trail, and eventually the rest of the Kalamazoo River Valley Trail system, will foster increased use of the trails, as well as providing an attractive bike and pedestrian route into downtown. Alignments and typical cross sections, as well as project schedule and detailed quantity estimate, were created in order to provide the city with a comprehensive plan for this new trail segment.

M-43, 12TH AVE, 72ND ST SIX WAY INTERSECTION, VAN BUREN COUNTY

by Matt Bishop, Ryan Russell, and Brice Wandyg

Sponsor: Wes Butch, DLZ

Faculty Advisor: Richard Rhodes

10:30 a.m. to 10:55 a.m., D-115

Six way intersections are not a common occurrence for the average commuter. As a result, such intersections can be viewed as intimidating and often confusing at times of high traffic volume. To avoid letting this confusion raise the number of vehicle accidents, completely different intersection geometry was designed based on previous traffic data. A three dimensional working model of the new intersection was created in traffic simulation software, as well as a fly by view of the new geometry in AutoCAD. This new model will improve safety at an otherwise difficult intersection.

ROSA PARKS TRANSPORTATION CENTER

by Bradley Ade, James Haley, and Kristin Karasch

Sponsor: Parsons Brinckerhoff Michigan, Inc.

Faculty Advisor: Irfan Ahmed, P.E.

11:00 a.m. to 11:25 a.m., D-115

Detroit was in need of an international, intermodal transit center to organize and effectively move people in and around Detroit and across the border to Canada. A tedious Work Break Down structure was developed to determine the number of individual activities in the project. A cost estimate and schedule posed their own challenges, but these challenges were overcome and both were created to decide the duration and cost of the project. Now that the Rosa Parks Transit Center is complete people are able to navigate Detroit from a central location.

COMPUTER SCIENCE

Session Chair – John Kapenga

Room – D-202

CAESked – A CLASS SCHEDULING WEB APPLICATION

by Chris Fruin and Jerry Grochowski

Faculty Advisor: John Kapenga and Karlis Kaugars

9:00 a.m. to 9:25 a.m., D-202

Scheduling classes is a tedious process for WMU students. CAESked, a class scheduling web application, was created to ease this process. The programming languages PHP, JavaScript, and Perl were used to build a solution which integrates WMU data for upcoming courses into a web application. With features including a weekly calendar, a campus map, and class information all in one place, CAESked provides students with an easy to use tool for adding classes to their schedule.

INTERACTIVE WALKER ASSISTANT

by Brandon Andrews and Steve Stockall

Sponsor: Gail Sulkey, Personal Assistive Device Inc.

Faculty Advisors: John Kapenga

9:30 a.m. to 9:55 a.m., D-202

Many surgeries require the use of a walker for the rehabilitation process. Patients with normal cognitive function can use a walker by themselves, but for patients with problems like short term memory loss, a live-in assistant is needed. After modifying a walker with visual and audio prompts, a patient receives the same reminders they would from an assistant. Sensors to detect foot position further help patients since restricting range of motion is often necessary. Powered by a Beagle Board, a single-board computer, the walker will give patients independence while helping prevent re-injury.

BEHAVIOR MODIFICATION IN A LEARNING ENVIRONMENT USING EMBEDDED SYSTEMS

by Muhammad Alwashmi, David Morhovich, and Tim Van Prooyen

Sponsor: Dr. Lynne Snyder

Faculty Advisor: Robert Trenary and John Kapenga

10:00 a.m. to 10:25 a.m., D-202

In a classroom setting it is advantageous to record the frequency, intensity, and duration of a student's unwanted behavior for external modification. This information is currently recorded with a manual process, and instead could be automated with electronic tabulation. In addition, it is hypothesized that if a student is able to self-monitor inappropriate conduct, the undesirable behavior will be curtailed to a greater extent than using external regulation. An inexpensive, programmable, off-the-shelf device with wireless capabilities would provide solutions to both objectives, and allow for the straightforward addition of multiple devices to the scope of the project in later iterations. Software will be developed to communicate with the device, provide analysis of the collected data, and suggest statistical correlations. The encompassing solution that fits the clients' needs will be produced using the agile methodology.

ATHLETIC INVENTORY MANAGEMENT SYSTEM

by Kevin Heeringa, Kimberly Mueller, and Jarrod Seccombe

Sponsor: Joe Armstrong, Read Fieldhouse Business Office

Faculty Advisor: John Kapenga

10:30 a.m. to 10:55 a.m., D-202

Sports teams require a large amount of athletic equipment that needs to be inventoried. An ASP.Net web application in conjunction with a MySQL database backend was made to integrate all sports inventories and team rosters into one central location, accessible from anywhere. The application allows authorized personnel to remotely access the system, add and remove athletes and equipment to the database, and assign equipment to athletes. The system also supports report generation and keeps a record of all changes to the database. This is a more convenient and time efficient way to manage inventory.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink

Room D-204/204

DC MOTOR TESTING SYSTEM

by Nicholas Cross, Michael O’keefe, and Glen Robertson

Sponsor: Jeff Schroeder, Fantom Racing

Faculty Advisor: Johnson Asumadu

9:00 a.m. to 9:25 a.m., D-204/205

A DC motor test and analysis was developed. It allows the user to adjust for optimal motor performance. The system measures the performance characteristics of the motor and graphically displays the results on a user’s PC. A printed circuit board was developed, which incorporates a ATMega 328 microprocessor, a serial-to-USB interface, and multiple measuring devices.

SENSOR-BASED MUSIC CONTROLLER

by Linjia Jiang, Yinchong Han, Tze Kang Ng, and Sau Fung Chan

Faculty Advisor: Dean Johnson

9:30 a.m. to 9:55 a.m., D-204/205

A sensor-based hand held, multifunction music controller has been designed, built and tested as an alternative to a laptop computer to perform music in a KLOrk (Kalamazoo Laptop Orchestra) concert. This multifunctional controller, smaller than a laptop, detects movements, finger-touch, and combinations of postural maneuvers by users. Raw analog and digital data sent wirelessly via a Bluetooth line to a computer to generate music; this is made possible by electronic sensors, a programmable driver, and a compatible Bluetooth module. This device ensures power efficiency and portability.

CONTROL SYSTEM EXPERIMENT SUITE

by Malath Almutairy, Austin Forrest, and Tiffany Gach

Faculty Advisor: Massood Atashbar

10:00 a.m. to 10:25 a.m., D-204/205

Western Michigan courses ECE 3710 and ECE 4700 now have a prototype lab to stimulate in-class theories on a hardware system. The laboratory experiment was designed to give students a more hands-on approach to learning the material in these courses. Students will be able to test and analyze sampled data or a linear feedback control system. This prototype will expand the student's knowledge and experience of the characteristics of closed-loop control systems.

WIRELESS GPS DATA TRANSMITTER RECEIVER SYSTEM

by Michael Czarnecki, Cory Hamlin, and Michael Long

Faculty Advisor: John Gesink

10:30 a.m. to 10:55 a.m., D-204/205

Research is attempting to quantify the effects of quieter vehicles on the mobility of people with visual impairment. To aid current research, a transmitter and receiver system has been designed to wirelessly transmit GPS data in real time from a moving vehicle to a stationary laptop computer. Using the Control Area Network output of the GPS system and a microcontroller, the GPS output is converted to an analog format and sent via radio signals to the laptop. This laptop is also the collector station for other gathered test data such as the ambient sound level and subject recognition of vehicles events. The final product saves time and money by eliminating the time consuming manual data manipulation that was previously required.

TEMPERATURE CONTROL OF A THERMOELECTRIC COOLER

by Michael Blackmond, Alexander Bodurka, and Gregory Inglett

Faculty Advisor: Frank Severance

11:00 a.m. to 11:25 a.m., D-204/205

Time is everything in the medical field. If a paramedic can perform some tasks, such as take blood to diagnose, or cool down an overheated patient with a cool IV, then the time could help save lives. A Thermoelectric cooler (TEC) will be implemented to heat and cool different substances to desired temperatures. A control system that utilizes the coupling of proportional control and pulse width modulation (PWM) will be applied. Employing a temperature control system will allow for the most efficient use of power while heating or cooling in an appropriate time for respective purposes.

INDUSTRIAL AND MANUFACTURING ENGINEERING

Session Chair – Betsy Aller

Room D-201

RE-DESIGN OF A MODERN FUEL SYSTEM ON A CLASSIC-INSPIRED CHEVY

by Christopher Markee and Alan Szu Yang

Faculty Advisor: Fred Sitkins
8:30 a.m. to 8:55 a.m., D-201

A multi-phase student designed “street rod” which illustrates reverse engineering concepts was updated to improve the fuel and air delivery system. The new system results in safer and more reliable operation with less noise pollution. In addition, a safer hood opening mechanism was modeled after current industry standards, fabricated, and installed. This modern hood lift system compliments the classic look of the truck.

IMPROVING CORE MAKING TECHNOLOGY

by Jason Bolek and Curtis Kniffin

Faculty Advisor: Sam Ramrattan

9:00 a.m. to 9:25 a.m., D-201

Current trends in manufacturing put pressure on the U.S. foundry industry to produce ever more intricate and complex castings. Aeration technologies have proven to be a quiet, clean, and economical means of mold production. A prototype aeration system used for green sand molding was retrofitted for production of shell sand cores. Modifications included the design of a sand shutoff plate, a sand delivery runner system, and some mold modifications. A casting trial compared cores made using aeration to those made using conventional high pressure blow and gravity fill methods. Application of the aeration system to core making allows for production of more intricate core shapes.

INCREASING ENGAGEMENT BETWEEN HEALTHCARE AND IT SYSTEMS

by Andrew Crowe, Brittany Roye, and Andrew Simmons

Sponsors: Chad Dunlap, Kyle Washburn, Chris Lininger, Borgess Medical Center

Faculty Advisors: Nolen Akerman and Larry Mallak

9:30 a.m. to 9:55 a.m., D-201

Information Technology (IT) in health care settings is a growing field that can critically affect patient care. A thoroughly planned staffing model and availability of IT specialists to handle issues that occur is key in building a quality system that meets the needs of the hospital. Statistical analysis of current ticket data resulted in information to properly staff certain areas of the hospital at certain times. Surveys provided information as to the type of problems each area of the hospital experienced. Application of these findings provided a better staffing model, improved feedback method, and improved communication between health care and IT employees.

MODULAR HYDRAULIC SYSTEM TEST BENCH

by Jeffrey Herman, Joseph Mydosh, Jason Shane, and Brian Sommer

Sponsor: Tony Lorentz, Parker Hannifin-Hydraulic Division

Faculty Advisors: Alamgir Choudhury and Jorge Rodriguez

10:00 a.m. to 10:25 a.m., D-201

Understanding low pressure characteristics of hydraulic systems and components is vital to create improved hydraulic systems. A three-piece modular hydraulic system test bench was designed and fabricated with mobility and adaptability requirements in mind. A final design that employed detachable hydraulic modules was chosen using several design concepts and Pugh matrices. Three-dimensional models of the bench and hydraulic circuits were created using Pro/Engineer. Using on-board sensors, DAQ, and LabVIEW, data of components' characteristics can be acquired and analyzed, allowing for future design improvements of hydraulic systems and components.

A GREENER KALAMAZOO

by Matt Boardman, Corwin Furrow, Justin Grumbir and Luis Hernandez

Sponsor: Steve Deisler, Bob Miller, and Brian Persky, Downtown Kalamazoo Incorporated (DKI)

Faculty Advisors: Betsy Aller and Paul Engelmann

10:30 a.m. to 10:55 a.m., D-201

Recycling is essential for making Kalamazoo a clean and sustainable place for future generations. Downtown Kalamazoo required a convenient place for pedestrians to discard refuse on the mall. The new recycling/trash station was created using Pro/Engineer and Solid Edge, both parametric modeling software programs, and a prototype was fabricated. A new recycling station was designed to use newspaper dispensers previously located on the mall. User needs were assessed using surveys, VOC, user testing, and ergonomics. The new recycling station will aid in making Kalamazoo a greener city for years to come.

REDUCING PRODUCTION CYCLE TIME FOR MINING VEHICLES

by Cory Barber, Darrel Bruzewski, Brandon Gorton, and Tim Kooiker

Sponsor: Erik VanAllen, Getman Corporation

Faculty Advisor: Kailash Bafna

11:00 a.m. to 11:25 a.m., D-201

In order for a mining operation to be successful, it is imperative to use dependable support vehicles capable of fueling, transporting, or powering various facets of the operation. In response to this demand, the warehouse and tank manufacturing cell of a mining support vehicle manufacturing plant was renovated. Route sheets and flow process charts were analyzed and a time study conducted. Applying these techniques resulted in a reduction of cycle time to enhance industry operations despite the uncompromisingly harsh conditions of today's mines.

MANUFACTURING PROCESS MANAGEMENT: WACO YMF-5 FUEL TANK

by Craig DuBay, Jason LaDuke, and Tyler Mayer

Sponsor: Rich Hunter, WACO Classic Aircraft Corporation

Faculty Advisor: Larry Mallak

11:30 a.m. to 11:55 a.m., D-201

Recreational aviation is a highly specialized market in which the manufacturing process is time consuming and costly. A local manufacturer of aircrafts required more cost effective methods of creating fuel tanks for their classic replica. The current flow process chart was examined to identify potential improvements in the fuel tank manufacturing process. This more efficient method resulted in reduction of labor and manufacturing costs.

MECHANICAL AND AERONAUTICAL ENGINEERING A

Session Chair – Richard Hathaway

Room D-109

AUTONOMOUS ROBOTICS CHASSIS DESIGN

by Rayford Chew, Daniel Hirvela, and Gary Nola

Faculty Advisor: James Kamman

9:00 a.m. to 9:25 a.m., D-109

An autonomous robotics chassis for a mobile medical-waste cart is presented. The new robotic chassis reduces the need for human interaction with the cart. A scaled model that demonstrates motor and sensor control of the chassis was developed using a robotics prototyping kit. Further conceptual designs demonstrate the ability to apply robotics programming to the full-sized vehicle.

AUTOMOBILE MASS DISTRIBUTION ANALYZER

by Garrett Beulle, Donald Ragatz, and Eric Rifel

Sponsor: Richard Hathaway

Faculty Advisor: James Kamman

9:30 a.m. to 9:55 a.m., D-109

A device was designed and constructed to accurately measure the moments of inertia and center of gravity of passenger vehicles. These properties are important to accurately simulate vehicle performance, making the device of particular interest to vehicle enthusiasts. The design was optimized with the use of solid modeling and finite element analysis software to minimize cost and space requirements of the device.

ALL TERRAIN VEHICLE HYDRAULIC DRIVE TRAIN DESIGN

by Christopher Akiyama, Derek Hagan, and Michael Tartaglia

Faculty Advisor: Richard Hathaway

10:00 a.m. to 10:25 a.m., D-109

The demand for increased performance of all-terrain vehicles has lead to increased engine size. These vehicles also experience torque and power losses due to their use of mechanical transmissions. Hydrostatic drive systems offer infinitely variable gearing and the possibility of improved fuel economy for these same vehicles. Design and analysis of the hydraulic drive system was completed using

mathematical software and solid modeling. This unique drive system has the potential to increase rider safety and fuel economy and, the analysis performed herein, can serve as a benchmark for research into passenger vehicle applications.

RUBBER FATIGUE TESTING APPARATUS

by Sam Mensch and Nicholas Pohl

Faculty Advisor: Daniel Kujawski

10:30 a.m. to 10:55 a.m., D-109

Rubber treads, which are used on many all-terrain vehicles, have a shorter filed life than desired. Prior to new rubber compounds being put into full production the material must be tested. Full scale testing at proving grounds is prohibitively expensive and other testing methods fail to accurately simulate fatigue conditions experienced in the field. The design of a new testing apparatus was done using solid modeling software. The design was validated using finite element analysis software. The final design resulted in the construction of a testing apparatus capable of providing a timely and cost effective means to test and validate new rubber compounds while accurately replicating the failure mode.

HIGH PRECISION SPRING RATE TESTER

by Shawn Avery, Adam Dally, and Stephen Sakata

Sponsor: Sweet Manufacturing

Faculty Advisor: Dennis VandenBrink

11:00 a.m. to 11:25 a.m., D-109

Advancements in racecar dynamics require a high accuracy, high precision evaluation of spring rates. A system was designed using solid modeling software and tested using finite element analysis software to precisely measure coil spring characteristics. A data acquisition program was created to collect spring performance data and display load vs. displacement curves. The completed design helps in the optimization of suspension systems, increasing racecar performance.

RACECAR MULTI-ELEMENT REAR WING DESIGN

by Azukaego Okei-Nwabuokei and Adarsh Anand

Sponsor: Richard Hathaway

Faculty Advisor: Tianshu Liu

11:30 a.m. to 11:55 a.m., D-109

A three-element rear wing was created to produce maximum downforce for a super modified race car. The wing was design by first benchmarking previous models. The flow patterns and efficiencies of the different designs were assessed. Solid modeling software was applied to create a prototype used in wind tunnel testing. The wing was properly optimized from the results obtained through testing and simulations.

DETERGENT LIMITING SYSTEM FOR WASHER

by Kenneth Bowers, David Klein, and Derek McFall

Sponsor: Whirlpool Corporation

Faculty Advisor: Muralidhar Ghantasala

1:00 p.m. to 1:25 p.m., D-109

A device was designed, for a front loading clothes washing unit, to measure and deliver a precise amount of detergent during the wash cycle. Without a limiting system, overfilling is common which results in excessive suds, elongated cycle times, and possible bearing failure. The current design was re-engineered and 3-D solid models were created using computer aided design software followed by finite element analysis. A working prototype, which met all the design parameters and constraints, was manufactured using 3-D printing to verify functionality.

CHARACTERIZATION OF AEROSPACE GRADE HYDRAULIC HOSES

by Andrew Oman, Travis Thorpe, and Andrew Woods

Sponsor: Parker Hannifin, Aerospace Group, and Hydraulic Systems Division

Faculty Advisor: Koorosh Naghshineh

1:30 p.m. to 1:55 p.m., D-109

The goal of this project is to experimentally characterize the dynamic properties of hydraulic hoses used in aerospace applications. This will be accomplished through the design and fabrication of the necessary test fixtures that would replicate operating conditions (i.e., pressurized hoses). The results obtained from measurements conducted using this test fixture will be compared to a finite element model in order to accurately predict structural dynamic characteristic of current and future aerospace hydraulic systems. Currently, to validate a hydraulic system, testing is done on large and expensive test rigs or in flight testing. The use of the above test system would eliminate such expensive techniques.

MECHANICAL AND AERONAUTICAL ENGINEERING B

Session Chair – Richard Hathaway

Room D-208

DESIGN OF A NEAR-CONSTANT FORCE SPRING FOR ORTHOPEDIC IMPLANTS

by Christopher Hartman and Paul Rotarius

Sponsor: Nicholas Horsmon, PMI Development Engineer, Biomet Orthopedics

Faculty Advisor: Peter Gustafson

10:30 a.m. to 10:55 a.m., D-208

The design and testing of a spring assembly for the attachment of an orthopedic implant to a human femur bone is presented. The design will supply a near-constant compressive force at the bone-implant interface. This constant force promotes in-growth of bone tissue at the implant surface while reducing deviations in compression forces during implantation in the body. The design was modeled using analytical computer programs, solid-modeling software, and a finite element analysis (FEA) software. The final design was validated by the construction of a prototype and correlated physical testing.

LATCHING PNEUMATIC VALVE

by Timothy P. Meyer

Sponsor: Tim Tinholt, Humphrey Products

Faculty Advisor: Iskender Sahin

11:00 a.m. to 11:25 a.m., D-208

A latching pneumatic valve was designed to require less power resulting in a lower temperature rise than an existing valve. The new design modifies an existing valve design and uses a neodymium magnet to hold the valve in the actuated position instead of an electrically powered coil. This attribute greatly reduces the electrical power requirement saving energy and reducing the temperature rise of the coil. The newly designed valve will be used in low frequency applications where the valve is required to be actuated for longer periods of time than the existing valve.

OPTIMIZATION OF AN ELECTRO-HYDRAULIC VALVE

by Eric Bouman and Michael Gruizinga

Sponsor: Jerry Boza and Rory Adams, FEMA Corporation

Faculty Advisor: Dennis VandenBrink

11:30 a.m. to 11:55 a.m., D-208

A proportional electro-hydraulic valve was redesigned to increase manufacturability and reduce performance shift. Re-design focused on solenoid flatsprings to integrate and eliminate valve components contributing to performance shifts. Thermal cycling and durability testing was used to verify the design. Lower manufacturing costs and increased throughput was achieved by a reconfigured assembly line. The re-designed valve costs less and provides consistent long term performance.

BIOFUEL MICRO TURBINE ENGINE TEST CELL DESIGN AND OPERATION

by Syafwan Ismail and Ing Huang (Edmond) Tan

Faculty Advisors: William Liou and Javier Montefort

1:00 p.m. to 1:25 p.m., D-208

Due to the increasing popularity and emphasis on green energy, a fully functional experimental lab capable of allowing experiments on a bio-fueled micro turbine engine was designed. The designed laboratory can be used for pioneering research into the application of bio fuels for turbine applications. The system, along with appropriate data acquisition, was designed to operate the engine and measure the

thrust, exhaust gas temperature, fuel flow rate, engine revolution per minute and other critical parameters. LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) is used for the data acquisition.

DEVELOPMENT OF A FUEL DELIVERY SYSTEM FOR A SINGLE CYLINDER GASOLINE DIRECT INJECTION ENGINE

by Adam Bolen, Daren DiStefano, and Brad Mathis

Faculty Advisor: Claudia Fajardo

1:30 p.m. to 1:55 p.m., D-208

In a world on the verge of an energy crisis, maximum fuel efficiency for any vehicle is paramount. In response to this problem, a high pressure fuel delivery system was developed for a four-stroke gasoline direct injection engine. Utilizing fluid analysis software programs, 3-D software programs, in conjunction with bench-top testing, an optimal design was derived. This fuel system is essential for the development of a direct injection four-stroke engine. This fuel system will drastically improve four-stroke engine performance and fuel economy.

PAPER ENGINEERING, CHEMICAL ENGINEERING, AND IMAGING

Session Chair – Peter Parker

Room D-208

THE EFFECTS OF CLEAR TONER ON THE COLOR GAMUT

by Robert Grotans

Faculty Advisor: Paul Fleming

9:00 a.m. to 9:25 a.m., D-208

The Canon imagePRESS C1 + is a digital press capable of printing four-color process toner, as well as a special clear toner. When printing this clear toner over other colors, it is imperative to understand how it will affect their color gamut because it can change how an image looks. To determine how clear toner affects the color gamut, this research compared color charts printed on multiple substrates with and without clear toner. From each of these charts, color measurements were taken and compiled. The results are summarized and help to model how clear toner affects color.

OXYGEN PRETREATMENT OF CELLULOSE TO IMPROVE ENZYMATIC HYDROLYSIS OF BIOMASS

by Louden Cox

Faculty Advisor: John Cameron

9:30 a.m. to 9:55 a.m., D-208

Pretreatment of biomass affects glucose yields for enzymatic hydrolysis. Desirable pretreatment schemes are cost effective, easy to operate, solubilize hemicelluloses and lignin, and work on a variety of different biomass species. Wood is very accessible and contains a high content of cellulose. Solubilizing hemicelluloses and lignin and exposing/increasing cellulose after pretreatment could increase glucose yields during enzymatic hydrolysis. In an effort to produce an efficient and cost effective pretreatment scheme, an experiment treating a hardwood species using oxygen and a metal catalyst inside a laboratory minidigester were conducted.

THE CONSEQUENCE OF CALENDARING VARIOUS PERFLUORO TREATED PAPER

by Andrew Loveland

Faculty Advisor: Margaret Joyce

10:00 a.m. to 10:25 a.m., D-208

Conventionally, paper and paperboard are surface treated for water repellency, oil repellency or hydrophylicity in order to prevent the penetration of oils or water. Several perfluoro-based polymers are used for this purpose. Due to differences in chemical structures; the calendaring response of these materials may vary. A comprehensive calendaring has not yet been reported. This study compared the surface energy of treated papers under varying calendaring conditions. The results were related to the differences in chemical structure. A better understanding of calendaring conditions on surface activity and how it relates to differences in perfluoro chemical structure was obtained.



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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.

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

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- Ph.D. Enrollment: 78
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