12-2008

43rd Conference on Senior Engineering Design

College of Engineering and Applied Sciences

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43rd Conference on Senior Engineering Design

Tuesday, December 2, 2008, 9 a.m. to 2 p.m.
College of Engineering and Applied Sciences
--Directions--

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

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

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

You are invited to attend the forty-third Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 2:00 p.m., **Tuesday, December 2, 2008** 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)

Teachers who cannot accompany their students to the conference may ask their students to sign in and out at the information table in the lobby on the first floor of the College. Sign-in sheets will be mailed to teachers the day after the conference.

**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 a.m. to 11 a.m. | p. 4 |
| Computer Science                  | D-204/5 | 9 a.m. to 11 a.m. | p. 5 |
| Electrical and Computer Engineering| D-208 | 9 a.m. to 1:30 p.m. | p. 6 |
| Industrial and Manufacturing Engineering| D-201 | 9 a.m. to 2 p.m. | p. 8 |
| Mechanical and Aeronautical Engineering A | D-109 | 9 a.m. to 2 p.m. | p. 11 |
| Mechanical and Aeronautical Engineering B | D-206 | 9 a.m. to 12 p.m. | p. 14 |

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.

CCE Civil and Construction Engineering  
CS Computer Science  
ECE Electrical and Computer Engineering  
IME Industrial and Manufacturing Engineering  
MAE Mechanical and Aeronautical Engineering
<table>
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<th>Time</th>
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<tr>
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<td>CCE</td>
<td>East Wing Addition to CEAS</td>
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<td>D-204/5</td>
<td>CS</td>
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<td>D-109</td>
<td>MAE A</td>
<td>Instrument Kit for Joint Surgeries</td>
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<td>D-206</td>
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<td>Advanced Design Wind Tunnel Data Acquisition</td>
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<td>10:00</td>
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<td>A Feasibility Study of Propeller Thrust Vectoring for a Small UAV</td>
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<td>Digital Speed Control of a Motor Via a GUI</td>
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<td>Simulink Modeling of a Compressed Air Energy Storage System</td>
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<td>Design of a Decision Support System, Forecasting Brewery Sales</td>
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<td>Ergonomic Chair with Real-time Electronic Feedback</td>
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<td>Alternative Humidity Control System Design</td>
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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 2008. 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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Frank’s Shoe Parlor
Kelen Sales Consulting, LLC
Parker Hannifin Corporation
Stryker Medical
Whirlpool Corporation
CIVIL AND CONSTRUCTION ENGINEERING
Session Chair – Hubo Cai
Room D-115

EAST WING ADDITION TO THE COLLEGE OF ENGINEERING AND APPLIED SCIENCES
by Jon Dyke, Ryan McGoff, and Dharmesh Valsadia
Faculty Advisor: Haluk Aktan
9:30 a.m. to 9:55 a.m., Room D-115

An engineering department has grown beyond expectations and will soon encounter problems due to space limitations. The solution is to expand the East Wing of the building it currently occupies. A two-story steel structure has been designed. The new addition will include a materials lab, structures lab, and computer lab, as well as classrooms and office space. The new facilities will attract incoming students, accelerate learning, and increase interest in the program by improving the college.

VALLEY ELEMENTARY SCHOOL
by Graham Blaxton, Stephanie Regis, and Tim Walsh
Faculty Advisors: Hubo Cai and Jun Seok Oh
10:00 a.m. to 10:25 a.m., Room D-115

The public school system has begun to expand since the Kalamazoo Promise was created. Infrastructure is demanded to accommodate future needs. The promise encourages students to finish high school and attend college by offering to pay the college tuition of the student. To accommodate this need, a K-6 elementary school was designed to be built off of 9th Street in Kalamazoo. The design was analyzed using ETABS and drawn in AutoCAD. Traffic analysis was done through the program Synchro. The new school lowered classroom size by giving students more one on one attention with faculty.

TWO STORY OFFICE BUILDING IN BTR PARK
by Travis Johnson, Matthew Menard, and Rebecca Mulholland
Faculty Advisors: Upul Attanayake and Jun Seok-Oh
10:30 a.m. to 10:55 a.m., Room D-115

There has been a steady increase in the demand for technology based business in the Kalamazoo, Michigan area. The creation of the Business, Technology, and Research (BTR) Park was developed to support this growth. A new two-story office building was designed for a vacant parcel within the BTR Park, to be occupied by an engineering or architectural firm. AutoCAD was used extensively throughout the design process, as well as the structural analysis program SAP2000. Syncro and SimTraffic were used to analyze the impact of a new building on the traffic flow in and around the BTR Park.
AMBULANCE MAINTENANCE SYSTEM
by Mike Davis, Christopher Marks, and Adam Riggs
Sponsors: Brian Balow and Shawn Oosterlinck, eInternet Design
Faculty Advisor: John Kapenga
9:00 a.m. to 9:25 a.m., Room D-204/205

Ambulance maintenance is critical when a patient’s life is involved. The Ambulance Maintenance System was implemented to update employees when repairs and upkeep are needed for emergency vehicles. PHP and SQL were used to dynamically allow employees and managers to edit and respond to maintenance alerts. Additionally, employees can create their own custom alerts and view the maintenance history of any ambulance.

COURSE ASSESSMENT SYSTEM
by Chris Anthony and Mark Yake
Faculty Advisors: Don Nelson and John Kapenga
9:30 a.m. to 9:55 a.m., Room D-204/205

A computer science department had been using a time consuming paper-based course assessment system. A new web-based system was developed to facilitate ease of use, flexibility, and extensibility. The system utilized PHP, mySQL, and the Apache web server to create a course assessment service similar to other services deployed by the department. The software will benefit many individuals including administrators, faculty, and the assessment committee.

ENVIRONMENT MONITORING WITH PROGRAMMABLE MICROCONTROLLER AND ZABBIX
by Michael Woods and Michael Yancon
Faculty Advisor: John Kapenga
10:00 a.m. to 10:25 a.m., D-204/205

Environmental conditions, particularly humidity and temperature, can have an adverse effect on the function and performance of mechanical and electrical equipment, which at high levels can cause rust, rot, decay, warping, and overheating. A solution was implemented that uses Texas Instruments’ eZ430-RF2500, which is a small, low powered, wireless, programmable microcontroller that was designed to locally monitor environmental conditions. These local systems are then monitored by Zabbix, an enterprise class, open source network monitoring system, which alerts appropriate personnel when variables are critical. This system can save valuable time, money, and equipment by ensuring appropriate conditions are always maintained.
JUST SWIPE – A STUDY TABLE TIME LOGGING SYSTEM
by Dustin Duclo and Brian Woodward
Faculty Advisor: John Kapenga
10:30 a.m. to 10:55 a.m., D-204/205

Student athletes are required to attend study table, a program helping aid athletes to meet academic requirements. Paper work and manually calculating logged minutes was time consuming for the academic advisors of study table. A C# program was designed which allows students to log in and out of study table by swiping their student ID’s. All information is recorded into a MySQL database. A website was built using HTML and PHP allowing advisors to view, change, or edit data and generate reports. With the “Just Swipe” application software, time logging is easier on both academic advisors and students.

ELECTRICAL AND COMPUTER ENGINEERING
Session Chair – John Gesink
Room D-208

LONG RANGE RADIO DATA TRANSMISSION
by Fady Abdel Messieh, Ahmad Khalis Ahmad Rosdan, and Joseph Siby
Sponsor: Diagnostic Systems Associates
Faculty Advisor: Ralph Tanner
9:00 a.m. to 9:25 a.m., D-208

Two Radio Frequency (RF) transceiver modules were designed to replace serial data transmission for commercial vehicles. The wireless modules were designed to operate in the Sub 1-GHz frequency range and extend over half a mile. A module was connected to a terminal computer and another module was placed in a commercial vehicle. The vehicle module will transmit data, gathered by an integrated circuit, to the terminal module for analysis.

PORTABLE RADIO FREQUENCY SPECTRUM ANALYZER
by Chris Brundage, Matthew Stack, and Justin Turner
Faculty Advisor: Bradley Bazuin
9:30 a.m. to 9:55 a.m., D-208

A low-cost, portable spectrum analyzer for Radio Frequency Identification (RFID) was designed and built for operation in the industrial, scientific, and medical band between 902 and 928 MHz. RFID is an automatic identification method that uses active RFID reader portals and passive RFID tags, or transponders, to track tagged items. To verify and monitor the proper installation of an RFID portal, a spectrum analyzer is needed to measure transmitted signal power levels and antenna beam pattern alignment. The spectrum analyzer uses an embedded microcontroller to scan an RF receiver across the ISM frequency band, digitizes and processes the downconverted signal, and displays the RF spectrum on an LCD display.
A radio-controlled model car company needed a dynamometer that had the capability to operate with both brushed and brushless DC motors. Their original dynamometer, which could only run with brushed DC motors, was redesigned. The redesigned dynamometer measures torque, RPM, and current. These measurements are used to compute the power of a radio-control motor. The new dynamometer includes a brushless DC motor controller, USB communication port, and an updated microcontroller. An external switch allows the user to switch between brushed and brushless mode.

A Graphical User Interface (GUI) is designed for a motor. The speed of the motor is controlled by a digital-based phase rectifier which is very efficient and also provides dynamic control. The speed control was achieved by using a semiconductor silicon controlled rectifier interface to a microcontroller through gate drivers.

Neurons are cells that process information by sending and receiving electrical signals. These signals are generated by the transfer of ions across neuron cell membranes. In 2007, a group of students began the development of a system for real-time feedback control of neuron cell culture electrical activity. Low noise stimulation and measurement instrumentation based on that initial work has been constructed and tested. Low noise design is a critical requirement since the neuron culture electrical signals are in the microvolt range.
ERGONOMIC CHAIR WITH REAL-TIME ELECTRONIC FEEDBACK
by Azhar Bramzakir Azwir, Ryan Birtles, and Frederick Skallos
Sponsor: Keith Ruckstuhl
Faculty Advisor: Janos Grantner
11:30 a.m. to 11:55 a.m., D-208

As office workers sit longer throughout the day, improper posture can lead to repetitive injuries. Behavior modification research has shown that people receiving real-time feedback can reduce or eliminate their bad habits. Using an array of electronic sensors, a modified chair has been built that detects sitting posture. The sensor data are gathered by a microcontroller mounted on the chair and fed to a PC, which in turn alerts the worker of improper posture via messages written on the PC’s screen.

VISUAL ALARM INTERFACE FOR THE HEARING IMPAIRED
by Ted Dey, Rachel Olson, and Matthew Romain
Faculty Advisor: Frank Severance
1:00 p.m. to 1:25 p.m., D-208

The hearing impaired face many difficulties in everyday life. Current commercial and residential fire alarm and smoke detector systems rely primarily on an audible alarm. The alarm interface analyzes the input from a small condenser microphone and detects an incoming alarm signal. Key components include a battery level detection circuit, false positive detection, automatic frequency analysis, and output triggering. The device alerts the user via visual and tactile stimuli.

INDUSTRIAL AND MANUFACTURING ENGINEERING
Session Chair – Betsy Aller
Room D-201

IMPROVING THE EFFICIENCY OF THE PRODUCT ENGINEERING LAB
by Eric Drzewicki, Keith Harger, Dennis Reedy, and Ryan Watson
Sponsor: Greg Kreczko, Parker Hannifin
Faculty Advisor: Joseph Petro
9:00 a.m. to 9:25 a.m., D-201

Testing of products must meet required standards set by the Department of Transportation (DOT) and Society of Automobile of Engineers (SAE). Problems in the lab at a local manufacturer included a lack of technology, layout of testing equipment/supplies, communications between technicians and engineers, and long set-up times. Time studies and flow process charts were among methods used to analyze product flow and to determine any correlation between testing results. A design layout was modeled and compared to the existing layout to determine if any improvements were made. The recommendations provided effective methods to improve the overall efficiency of production throughput.
NEW TECHNOLOGY FOR GREEN SAND TESTING  
by Ron Davis, Alex Hiday, and Mike Horvath  
Faculty Advisor: Sam Ramrattan  
9:30 a.m. to 9:55 a.m., D-201

Growing pressure to produce quality parts while maintaining efficiency in foundries has led the industry to require better control of their green sand systems. Current cone/jolt and friability tests neglect actual conditions the green sand molds are subjected to in a foundry. New test equipment and procedures were designed and tested, with results shared with industry advisors. This collaboration resulted in advanced cone/jolt toughness and thermal erosion tests, providing foundries with the ability to better control their green sand systems.

ENHANCING PERMANENT MOLD PREHEATING  
by Chris King, Jason Klein, and Adam Kraft  
Sponsor: Chris Lee, AC Foundry  
Faculty Advisor: Sam Ramrattan  
10:00 a.m. to 10:25 a.m., D-201

A local foundry was experiencing problems with bottlenecks in their permanent mold preheating process. The permanent mold process permits the casting of complex thin-walled shapes that are not practical by other means of production. This project utilized specialized technologies such as SolidCast, SolidWorks, thermal imaging, and Cosmos to improve the preheating process. Using the software, a new burner and mold preparation table were designed, built, and tested successfully. The permanent mold preheating process now yields a more uniform and efficient heat. Furthermore, the permanent mold area at the foundry was streamlined into a layout that minimized bottlenecks.

MECHANICAL SAND TESTING  
by Ryan Hoag and Alex Korkigian  
Faculty Advisor: Sam Ramrattan  
10:30 a.m. to 10:55 a.m., D-201

In green sand molding, the ability to control the sand system affects the final outcome of the metal casting. Existing test equipment was improved with the integration of computer technology and modified jigs, allowing users to obtain complete stress/strain data. These data illustrate the plastic deformation, modulus of elasticity, yield strength, and toughness of the mold sand. Comparison of obtained data yielded improved understanding and control of sand systems in order to produce a better product.
DESIGN OF A DECISION SUPPORT SYSTEM, FORECASTING BREWERY SALES
by Blaise Beltowski, Scott Jantz, and Ryan Stewart
Faculty Advisor: David Lyth
11:00 a.m. to 11:25 a.m., D-201

The growing demand for microbrewed beer, combined with increasing competition and rising material costs, has created the need for more accurate sales forecasting and production planning. The creation of a decision support system (DSS) will aid upper management at a local brewery in making decisions about brewing and bottling schedules. Two DSS models were created to aid production planning. The first DSS model predicts demand using time series analysis based on historical data. The second incorporates external economic factors. This decision support system predicts demand for each of the brewery’s products.

DESIGN OF A MOBILE SHOESHINE OPERATION
by Aaron Beattie, Andrew Dowdy, and Brad Tudor
Sponsor: Frank’s Shoe Parlor
Faculty Advisors: Betsy Aller and Fred Sitkins
11:30 a.m. to 11:55 a.m., D-201

Shoeshine stands today are typically bulky and lack the mobility necessary to allow shoeshine technicians to take their business to potential customers. A local shoeshine business sought an innovative design to address this problem. Following research on shoeshine history, current equipment, and anticipated markets, several designs were proposed and modeled in Pro/Engineer software. Using weighted criteria from all stakeholders, a final design was selected and tested for safety, functionality, and durability using finite element analysis (FEA) and physical testing. The new chair will allow shoeshine technicians to expand their customer base.

POWER SLIDER ASSEMBLY DESIGN VALIDATION
by Andrew Gautraud, Matt Ostrowski, and Yogesh Patel
Faculty Advisor: Jorge Rodriguez
1:00 p.m. to 1:25 p.m., D-201

Efficient manufacturing in today’s competitive automotive industry requires reduced cycle times and the fewest number of parts. A local automotive supplier proposed design changes to make their truck’s power sliding rear window assembly more efficient. That proposed design was validated using computer aided engineering (CAE) tools. Variations of the proposed design were analyzed using Finite Element Analysis (FEA), and prototypes were tested to the highest industry standards. A final design was defined, and cost savings in terms of cycle time and materials used were calculated. This new design will be applied to other projects at the company, greatly increasing their efficiency and profits.
CUSTOMER REQUESTED MODIFICATION SYSTEM ANALYSIS
by Eric Blasky, Chris Groff, and Vikram Hemanathan
Sponsor: Stryker Medical
Advisor: Nolan Akerman
1:30 p.m. to 1:55 p.m., D-201

Organizations in today’s global market must prevail over competitors by offering superior service. Customers demand increased personalization and customization of products. The customer requested modification (CRM) process at a local manufacturer was evaluated as a whole in order to create an alternate systems-based approach to customization. Value stream mapping, statistical analysis, interviews, and research in mass customization led to suggestions for improvement of the current process. The company will use the information to help redesign the IT and ordering systems in order to maximize both profit and customer satisfaction.

MECHANICAL AND AERONAUTICAL ENGINEERING - A
Session Chairs – Rameshwar Sharma and Pnina Ari-Gur
Room D-109

INSTRUMENT KIT FOR JOINT SURGERIES
by Greg Giarmo, Casey Tubergan, Ted Uphues, and David Wright-Huynh
Sponsor: Adam Keilen, Kelen Sales Consulting, LLC
Faculty Advisor: Judah Ari-Gur
9:00 a.m. to 9:25 a.m., D-109

Arthrodesis surgeries (joint surgeries) are increasingly common among the aging population. A new set of tools were developed with the focus of allowing surgeons to perform Arthrodesis surgeries faster and with higher quality than what is possible today. This kit includes a bone distraction and compression tool, a soft tissue spreader, and multiple interchangeable tips. All components were designed with Solid Works and Pro/ENGINEER and analyzed with COSMOSXpress and Mechanica for structural and kinematic characteristics.

REDESIGN OF MEDICAL CRUTCH
by Ryan Gill and Jordan Hull
Faculty Advisor: Daniel Kujawski
9:30 a.m. to 9:55 a.m., D-109

Modern medical crutches lack the necessity of user comfort. Current crutches can bring back preexisting injuries and also slow the healing process. A crutch was designed using solid modeling software. Finite Element Analysis was used to determine stresses within the frame. A dampening mechanism was introduced into the crutch, as well as redesigned handle and pad placement to reduce jolting and user fatigue. The new crutch will aid in the healing process of users with faster healing times, less discomfort, and greater ease of use.
HYDROGEN TRANSIT VEHICLE FUEL STATION
by Ryan Chapman, Adam Gelfand, and Alec West
Faculty Advisor: Bade Shrestha
10:00 a.m. to 10:25 a.m., D-109

With the rising cost of oil and the growing concern over environmental consequences of fossil fuels, development and implementation of energy sources that are low cost, renewable, and environmentally friendly have become important. Wind turbines and solar panels are used to power a campus hydrogen fuel station, with a two stage storage system that will be continually filled by an electrolysis machine. The station will produce and provide hydrogen to fuel the busses of a transit system. This will save the transit system money on fuel and could be attractive to students interested in the field of alternative energy.

SIMULINK MODELING OF A COMPRESSED AIR ENERGY STORAGE SYSTEM
by Jack Hein and Andrew Pike
Faculty Advisor: James Kamman
10:30 a.m. to 10:55 a.m., D-109

Compressed air energy storage systems are becoming frequently used in industry as a means of back-up power and off-peak energy storage. A software tool was designed that creates a modular framework using Matlab and Simulink to simulate these types of systems and give quantitative results. The models were verified by comparing the results generated to data gathered from currently operating systems.

OPTIMIZED ADJUSTABLE OVEN RACK
by Steven Burkhardt, Kyle Lambright, and Brian Snyder
Sponsor: Dan Diebolt, Whirlpool Corporation
Faculty Advisor: Judah Ari-Gur
11:00 a.m. to 11:25 a.m., D-109

The useable volume within an oven cavity has become a key feature that current consumers look for when purchasing ovens. The oven rack positions within an oven cavity determine its usable volume. Most available consumer grade ovens are equipped with three to five rack positions that are designed into the oven cavity itself. In order to optimize the useable volume within the oven cavity, the rack system was redesigned to eliminate the discrete positioning constraints and allow for continuous positioning. CAD/3-D modeling, Finite Element Analysis (FEA) software, and concept prototyping were used in the development, optimization, and verification of the proposed new design. The infinitely adjustable oven rack maximizes the available cavity volume of the oven without compromising the key consumer needs, such as ability to clean and ease of removal.
CHOPPER SYSTEM REDESIGN FOR DISHWASHERS
by Mallory Good, Joseph Seeger, and Gregory Ward
Sponsor: Steve Balinski, Whirlpool Corporation
Faculty Advisor: Iskender Sahin
11:30 a.m. to 11:55 a.m., D-109

Chopper systems are commonly utilized in the sump system of dishwashers to chop soil particles and prevent clogging in the spray arms. While choppers provide many advantages, such as eliminating the need for manual cleaning, they also require high power and are inefficient. In order to improve current chopping methods, several new chopper designs were developed and tested. Solid modeling and fluid FEA were used to test design concepts, from there functional prototypes were created and physically tested to determine the optimal design. The recommended chopper design successfully requires less power and increases the overall efficiency compared to conventional chopping systems.

REDESIGN OF A TENSILE TEST MACHINE FOR SPECIALIZED APPLICATIONS
by John Albrecht, Philip Cataldo, and Sean Curtis
Faculty Advisor: Daniel Kujawski
1:00 p.m. to 1:25 p.m., D-109

Knowledge of material properties is essential to ensuring the quality of production parts and material stock, especially in the area of high-performance automobile racing. A tensile test machine was redesigned using LabVIEW software, data acquisition hardware, and appropriate transducers in order to implement graphical representations of load and displacement values. Adapting the testing machine for special use was accomplished by designing and building an extensometer capable of use with various test specimens of the company’s choosing. The machine was also retrofitted for computer controlled displacement. Redesign of the tensile test machine provides a higher ease of use, more accurate test data for specific parts, and graphical representation of data collected.

ALTERNATIVE HUMIDITY CONTROL SYSTEM DESIGN
by Gregory Adamczyk, Robert Miller, and Ryan Patterson
Faculty Advisor: Ho Sung Lee
1:30 p.m. to 1:55 p.m., D-109

Condensation on the automobiles has been a concern within a car museum’s historic barns for many years. By collecting humidity and temperature data from within the barns, an understanding has been established on how these factors are related, and models were formed to predict future conditions. A system was then designed in order to significantly reduce the number of hours per year that these classic cars have to be exposed to undesirable conditions. This will help to preserve the classic car collection housed in these barns for future generations.
ADVANCED DESIGN WIND TUNNEL DATA ACQUISITION
by Kelly Ohrtman and Myles Cooley
Faculty Advisor: Tianshu Liu
9:00 a.m. to 9:25 a.m., D-206

A new LabVIEW 8.2 program was designed to replace the existing, outdated program used to acquire data from an advanced design wind tunnel. This program is used to display values for lift, drag, side force, moment, and pressure. This program was designed for simplicity and ease of use, and will save valuable time when running tests in the wind tunnel.

WIND TUNNEL DESIGN AND PROPELLER EFFICIENCY ANALYSIS
by Joseph Dyer and Jacob Puente
Faculty Advisor: Kapseong Ro
9:30 a.m. to 9:55 a.m., D-206

A propeller thrust efficiency test bench is in use by students of a mechanical and aeronautical engineering department. Phase II involved designing and constructing a modification for the test bench in order to obtain propeller efficiency and thrust measurement in a free stream testing environment. Additions to the test bench included installation of a fan and new instrumentation, resulting in an operational wind tunnel environment. The control and data software LabVIEW was used to create an interface between the test bench and the user. MATLAB was used to validate the experimental results.

A FEASIBILITY STUDY OF PROPELLER THRUST VECTORING FOR A SMALL UNMANNED AERIAL VEHICLE
by Travis Iott and Curtis Trinkle
Faculty Advisor: Kapseong Ro
10:00 a.m. to 10:25 a.m., D-206

The widespread use of unmanned aircraft suggests a need for innovative approaches to improve takeoff and landing distances. An articulating motor mount was designed, and optimized using solid modeling and finite element analysis software. A resulting prototype was used to modify an unmanned aerial vehicle to test the effects of thrust vectoring on takeoff distances. With the use of a telemetry system, takeoff distances and other performance variable were recorded and evaluated for several different motor angles and compared to theoretical data. Unmanned aerial vehicles may consider using articulating motors to decrease required areas for ground operations.
REDESIGN OF HEAVY DUTY MEDIUM STUB TOWER ASSEMBLY
by David Markle and Cedrick Shelton
Sponsor: Stewart Gulliver, Eaton Corporation
Faculty Advisor: Koorosh Naghshineh
10:30 a.m. to 10:55 a.m., D-206

The medium height heavy duty stub tower assembly was redesigned to reduce cost and weight, integrate components, and improve functionality. The stub tower assembly is attached atop the shift bar housing, which houses the shift blocks on a heavy duty transmission. The lower portion stub lever or finger is connected to the shift blocks (in order to change gear ratios) and the upper portion is attached to the shift lever, which extends into the cab. In the prior design, the housing accounted for the vast majority of the weight, leading to the exploration of alternate materials. Given the production volumes, a more efficient manufacturing process was desired. Pro/Engineer Wildfire 2.0 was used, along with ANSYS 11.0, to create a 3D-model of the design and perform a finite element analysis. The geometry and material was then adjusted to find an optimum design and a prototype of the design was built.

DESIGN OF A RACE CAR CALIBRATION SYSTEM
by Paul Mavrikos and Justin Ruster
Faculty Advisor: Richard Hathaway
11:00 a.m. to 11:25 a.m., D-206

Steering system geometry and configuration are vital to the overall performance capabilities of any race vehicle. A manual system for characterizing the geometric relationships is currently available on the market for race car steering preparation. This system was redesigned to interface with a data acquisition system to eliminate the need for manual measurements. Modeling for the redesign was done through SolidWorks, 3-dimensional solid modeling software, and the data logging programming was achieved through WinDAQ, an object oriented programming code. The utilization of the upgraded design and software will enable race teams to tune the steering system more efficiently and effortlessly.

SUSPENDED ARMATURE
by Cody Sturgill and Anthony Walker
Sponsor: Rory Adams, FEMA Corporation
Faculty Advisor: Judah Ari-Gur
11:30 a.m. to 11:55 a.m., D-206

A solenoid consisting of a suspended (frictionless) or reduced friction armature possesses desirable characteristics for use in the electro hydraulic valve market. The current suspended armature design is limited to 0.010 inch of stroke (armature movement). Finite element analysis, magnetic modeling, and drafting software were used to go beyond the current design and create a nearly frictionless armature assembly that is capable of 0.100 inch of stroke. A new magnetic circuit was also designed to accommodate the innovative armature assembly. The final design allows for more precise and repeatable control than what is currently on the market.
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