

Conference on Senior Engineering Design Project



You are invited to attend the forty-ninth Conference on Senior Engineering Design Projects. The conference will be held from 9:00 a.m. to 3:30 p.m., **Tuesday, Dec. 6th** 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 2:30 p.m.	p.9
Industrial and Manufacturing Engineering	D-201	9:00 a.m. to 3:30 p.m.	p.12
Mechanical and Aeronautical Engineering	D-109	8:00 a.m. to 4:00 p.m.	p.16
Paper Eng., Chemical Eng., and Imaging	D-208	9:00 a.m. to 10:00 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>

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
8:00	D-109 MAE	External Hydraulic Cooling System For Reciprocating Pump
8:30	D-109 MAE	Industrial Foil Pleating Machine
9:00	D-115 CCE D-202 CS D-204/205 ECE D-201 IME D-109 MAE D-208 PCI	Centre Meadows Senior Living Facility Remote Sensing Satellite Receiving Station 3D Stereoscopic Shutter Glasses Optimizing Die Casting Parameters to Reduce Defects Hybrid Airship Design Laboratory Scale Medium Consistency Oxygen Delignification
9:30	D-115 CCE D-202 CS D-204/5 ECE D-201 IME D-109 MAE D-208 PCI	US-131 and Centre Ave Interchange Improvement CAE Center Web Add on DC Motor Speed Controller Optimizing the Production Process of Pressure Gravity Valves for the Bottling Industry Renewable Energy HVAC System A Study Into Chemical Treatment For The Absorption Of Algae Onto Pulp Fiber
10:00	D-115 CCE D-202 CS D-204/205 ECE D-201 IME D-109 MAE	Bridge Scour Monitoring Wireless Temperature and Humidity Environment Monitoring System Sensor System with a Mobile Interface BroncoBot: Multi-tool Additive Manufacturing System Redesign of Musical Instrument Key Soldering Fixture
10:30	D-202 CS D-204/205 ECE D-201 IME D-109 MAE	Battery Module Tester Universal PC Interface Bernhard Center Dish Room Redesign Real Time Evaluation of PEM Fuel Cell Membrane

11:00	D-202 CS D-204/205 ECE D-201 IME D-109 MAE	Tool and Die Inventory Database Transient Power Test System 5S Decision Support System and Implementation Plan Redesign of a Lockable Telescoping Cane
11:30	D-204/205 ECE D-201 IME D-109 MAE	Temperature Controlled Home Theater Enclosure Foundry Equipment and Process Optimization Geodesic Pool Dome Cover
1:00	D-204/205 ECE D-201 IME D-109 MAE	Three-Phase Electric Motor Dynamometer Modernization of the Great Lakes Biplane Wing Spar Optimizing the Composition of NiMnGa
1:30	D-204/205 ECE D-201 IME D-109 MAE	Solar Heat and Daylight Harvester System Controllers Three-Wheel Urban Vehicle Frame Design and Build Mack Bull Gear Gage Station Design
2:00	D-204/205 ECE D-201 IME D-109 MAE	Hollow Core Wind Turbine Generator Urban Electric Three-Wheel Vehicle Body Design & Build Hydraulic System Attenuator
2:30	D-201 IME D-109 MAE	Snow Gun Deployment and Leak Detection/Cost Heating and Ventilation Energy Recovery System
3:00	D-201 IME D-109 MAE	Design and Build of a Lightweight, Packable Treestand An Innovative Optical System For Automotive Combustion Chamber Imaging Studies
3:30	D-109 MAE	Geb-6 (Glide Cordless Blower)

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 2011. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

American Axle and Manufacturing
Bittersweet Ski Resort
Conn Selmer, Inc. Musical Instruments
CLYDEUNION Pumps
CRDF Global
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WMU Department of Blindness and Low Vision Studies
WMU Dining Services
WMU Engineering and Maintenance Services
White Pine Tool



CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – John Polasek

Room D-115

CENTRE MEADOWS SENIOR LIVING FACILITY

by Said Mzee, Austin Pritchard and Tyler Walls

Faculty Advisor: Yufeng Hu

Sponsor: Tim Woodhams, Fleis and Vandenbrink Engineering, Inc.

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

The city of Portage has a lack of quality senior living facilities. The need for a senior living facility along with the parcel of open land near the Lover's Lane and Centre Street intersection provided the opportunity for such a facility to be created. In preparation for the new building, a site design and analysis, including geotechnical analysis, storm water design, pavement design, and foundation design, was performed. A site layout plan was proposed for the building, the parking layout, utilities, and drainage and retention ponds. With the completion of this site layout design, the facility is ready to be constructed and bring benefits to the city of Portage.

US-131 AND CENTRE AVE INTERCHANGE IMPROVEMENT

by Alexander Frazier, Aaron Reed and Branden Slagle

Faculty Advisors: Jun-Seok Oh and Valerian Kwigizile

Sponsor: Michelle O'Neil, Michigan Department of Transportation

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

The US-131 Centre Avenue Interchange was identified by the Michigan Department of Transportation as an area to be studied for improvement. During peak hours in the morning and the evening, this interchange, including the 12th street and Angling Road intersections with Centre Avenue, have experienced high congestion. This high congestion has caused problems for motorists, specifically those exiting US-131 South who are trying to head south on 12th Street. Alternative solutions were designed and analyzed using Synchro 7, a traffic modeling software. The costs of these solutions were estimated and the feasibility analyses were conducted. A final design was proposed to be used for future implementation if funds become available.

BRIDGE SCOUR MONITORING

by Ashok Balakrishnan, Steve Houren, and Zach Gardner

Faculty Advisor: Pingbo Tang

Sponsor: Janine Cooper, Michigan Department of Transportation

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

Sixty-six Michigan Department of Transportation bridges in the southwest region have been categorized as being susceptible to scour. A scour analysis on one of the critical bridges as well as a cost-efficiency study of currently used scour monitoring systems was completed. A best fit relationship was utilized to correlate which scour monitoring system should be implemented at each bridge. A management plan was devised for MDOT to monitor these scour critical bridges in a fashion that fulfills the Federal Highway Administration specifications in a cost effective manner.

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

REMOTE SENSING SATELLITE RECEIVING STATION

by Jacob Comer, Travis Thompson and Dylan Weber

Faculty Advisor: John Kapenga

Sponsor: Earth Sciences Remote Sensing Lab

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

Scientists use remote sensing to acquire real time imagery and data from various orbiting satellites to help them better understand global warming and climate change. Terascan, a satellite imagery receiving and processing program, is used to download and then take images and add post capture meta data such as borders and tags. These images are then cataloged and put into an ArcGIS database for later review and research. A combination of automation, streamlining, and back-end optimizations will allow research to continue with the best available data which will help us better understand the effects of climate change.

CAE CENTER WEB ADDON

by Ross Chambers and Constantine de Castro

Faculty Advisor: John Kapenga

Sponsors: Jason Johnson and Karlis Kaugars, CAE Center

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

The CAE center currently has no centralized location for managing and organizing employees. A web-based employee management suite was created in order to fill this void. The website was created entirely using open web standards; HTML, JavaScript, and PHP backend that leverage a MySQL database storing all relevant data. The web site, database, and all relevant information are stored securely on a server that is backed up on a daily basis. This website is accessible to any employee with an internet connection and will be capable of such tasks as timesheet generation, clocking in/out, scheduling and more.

WIRELESS TEMPERATURE AND HUMIDITY ENVIRONMENT MONITORING SYSTEM

by Christopher Atkinson, Kevin Blasko and Emily Schneider

Faculty Advisor: John Kapenga

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

Cigar shops require properly monitored humidors otherwise the cigars can dry out, go sour, or mildew. A wireless sensor system which monitors fluctuations in temperature and humidity was created using Arduino circuit boards, xBee communication hardware, and combination temperature/humidity sensors. The sensor data is stored in a MySQL database on a GoDaddy web server where the data can be viewed. The server sends out an alert when a sensor reports a dangerous temperature or humidity reading. The completed system prevents the loss of sellable product by allowing for automated monitoring of temperature humidity.

BATTERY MODULE TESTER

by Robert Buelke, Luke Quigley and David Risch

Faculty Advisor: John Kapenga

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

To run an electric vehicle, one must use limited resources and ensure safety of the driver. With Battery Module Tester testing software, built with electronic vehicles in mind, one is able to gather information from lithium ion batteries. The software, written in Java, is connected to a load tester and power supply to gather the data. Recorded information will be useful to detect aged or dying batteries and develop an optimized configuration and will also provide safety to operators and individuals involved with development. Altogether, the software will provide a better use of power and a faster, more competitive vehicle.

TOOL AND DIE INVENTORY DATABASE

by Simranjit Singh and Cameron Sehlke

Faculty Advisor: John Kapenga

Sponsor: Terry Sehlke, White Pine Tool

11:00 a.m. to 11:25 a.m., D-202

A lack of an inventory management system made it difficult to keep track of the current quantity of items in a tool and die shop. A database was created to allow customers to view the real-time available inventory over the internet. An ASP.NET web application, with a Microsoft SQL Server database, was created to solve the issue. A means for customers to email requests for quotes (RFQs), view current inventory, and easily find directions to the shop were also provided. An administrator can also securely login to the page to alter the inventory as necessary.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink

Room D-204/205

3D STEREOSCOPIC SHUTTER GLASSES

by Erik Boettcher, Nick Dipisa, and Luis Lorenzo

Faculty Advisor: Dean Johnson

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

An inexpensive 3D system consisting of a sync capture device and 3D glasses were designed to work with existing conventional displays. The 3D glasses were designed and built to actively “close” and “open” each eye rapidly, which allowed the host computer to deliver separate images to each eye in order to create the illusion of 3D. The sync capture device was designed to extract video signal information to tell the 3D glasses when to switch. The circuit boards for each of these devices were designed in Altium and gEDA, and based around Texas Instruments MSP430 microcontrollers. High speed Pi-cell liquid crystal shutters from Liquid Crystal Technologies combined with these inexpensive microcontrollers yielded an inexpensive solution to making a 3D system.

DC MOTOR SPEED CONTROLLER

by Ali Albaghly, Erwin Wong, and Lin Yang

Faculty Advisor: Ralph Tanner

Sponsor: Dr. Richard Hathaway

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

Speed controller technology has been used in many fields, particularly in the automotive industry. A simple and easy-to-use speed controller was created by using a logic inverter chip as a main component and an interface with other electronic components. The speed controller allows users to control speed using Pulse Width Modulation (PWM) implemented with a logic inverter chip and simulated using SPICE analog circuit and digital logic simulation software. The controller can be used to control and display the speed of the motor within certain limits. The completed system will be useful for future studies requiring the speed measurements of DC motors.

SENSOR SYSTEM WITH A MOBILE INTERFACE

by Khalid Al Hadad, Frantz Morisseau, and Akliseya Nahusenaye

Faculty Advisor: Massood Atashbar

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

A portable multi-sensing system was designed and built to measure the concentration of specific gases in the atmosphere. The device houses two gas sensors (Carbon Monoxide and Oxygen) that are read by a microcontroller. The user sends signals to the microcontroller through a custom application designed for smart phones that run on the Android operating system. Within the application, the user is able to select which sensor output to view either in analog or digital format. If abnormal levels of gases are detected, the application delivers a warning message to the user.

UNIVERSAL PC INTERFACE

by Lyth Alobiedat, John Stanny, and Cory Welch

Faculty Advisor: Janos Grantner

Sponsor: Stryker Instruments

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

Electronic companies often use multiple I/O interfaces within their products. Interfacing these products to a PC is a requirement for these companies for testing and troubleshooting purposes. Due to the different I/O interfaces, multiple devices are needed to interface a PC to these different products. Creating a common interfacing device for multiple products creates simplicity, allows for expansion and minimizes overhead time when configuring hardware and software. Using a field-programmable gate array on a customized printed circuit board assembly, a universal data interface is created to link a wide array of products to a computer using the common USB interface.

TRANSIENT POWER TEST SYSTEM

by Raed Alkhamis, Abdulmajeed Alshaalan, and Moadth Ba-Sulouh

Faculty Advisor: Ikhlas Abdel-Qader and Damon Miller

Sponsor: Brian G. Krug, Parker Hannifin Corporation

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

The transient power test system is connected between a power supply and a device under test that may be sensitive to power supply transients. The system uses a microcontroller to vary the device power supply inputs. The user interface enables the user to set the number of voltage pulses, the pulse width and the time between each pulse by using rotary switches. The settings are presented on microcontroller driven alpha-numeric displays.

TEMPERATURE CONTROLLED HOME THEATER ENCLOSURE

by Hussain Alsheikhahmed, Jeffrey Morgan, and Jacob Van Dam III

Faculty Advisor: Bradley Bazuin

11:30 a.m. to 11:55 a.m., D-204/205

Home theater electronic devices are becoming increasingly more heat intensive, especially when it comes to video game systems. Device performance can be improved with a controlled environment. A temperature controlled chamber was created using peltier units, heat sinks, fans, and temperature monitoring devices to keep the device in the chamber operating within a specified temperature range. The temperature controlled chamber allows the systems contained to run flawlessly in a controlled environment using a microcontroller that reacts to changes in the temperature. The chamber can be used to increase reliability, longevity, and performance of the devices contained.

THREE-PHASE ELECTRIC MOTOR DYNAMOMETER

by Patrick Morefield, Jonathan Roos, and Nicole Wrubel

Faculty Advisor: Johnson Asumadu

Sponsor: Jeff Schroeder, Fantom Racing

1:00 p.m. to 1:25 p.m., D-204/205

In Remote Control (RC) racing it is desirable of miniature model cars to have the electric motor's torque and power tuned with a dynamometer specifically for each RC race track in order to gain advantage over the competition. A DC dynamometer has been modified to automatically calculate, store and compare the parameters torque, horsepower, voltage, current, and rpm of model car three-phase AC motors. The parameters are presented in tabular and graphical format allowing users to easily compare multiple dynamometer tests.

SOLAR HEAT AND DAYLIGHT HARVESTER SYSTEM CONTROLLERS

by Tyler Gravlin, Michael Serota, and Mark Valzonis

Faculty Advisor: Raghvendra Gejji

Sponsor: Ed Winegar, The Masonic Temple Finance Corp.

1:30 p.m. to 1:55 p.m., D-204/205

Rising energy costs have caused many companies to look for energy saving methods. By controlling the amount of ambient light in a room, through a process called daylight harvesting, one can eliminate the use of artificial lighting during daytime hours. A sensor was built to monitor the number of lumens in an area. These readings are sent to a data acquisition unit (DAQ) for processing. In addition, a control unit is operating a solar array on the roof. The solar array uses solar energy to heat water, and then redirects the water through the building, thereby heating it. Since the addition of these control systems, the building has become more energy efficient.

HOLLOW CORE WIND TURBINE GENERATOR WITH A CIRCUMNAVIGATING ROTOR.

by Neil Hurley, Matthew Olson, and Cong Yang

Faculty Advisor: Ikhlas Abdel-Qader

2:00 p.m. to 2:25 p.m., D-204/205

The hollow core wind turbine generator allows for versatile mounting of the wind turbine onto existing structures. The wind driven rotor of the generator circumnavigates the stationary base containing inverted induction stator coils and a hollow center core, to allow mounting around an existing structure. The transposing of the rotor and stator locations also allows for a larger electrical output from a small generator size due to the increased inductive path achieved. A neodymium magnet rotor is used to induce current. Electrical output testing and analysis were performed to monitor power levels, efficiency, and physical resistance from the electromagnetic fields.

INDUSTRIAL AND MANUFACTURING ENGINEERING

Session Chair – Betsy Aller

Room D-201

OPTIMIZING DIE CASTING PARAMETERS TO REDUCE DEFECTS

by Evan Maltas and Dustin Youtsey

Faculty Advisor: Sam Ramrattan and Azim Houshyar

Sponsor: Christopher Whetstone, Michigan Automotive Compressor Inc.

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

In manufacturing automotive compressors, die casting defects can reduce the performance of certain parts. A design of experiments was used to test many different shot parameters and their effect on the casted parts. Probability and statistics were used to summarize the data. Operations research was then used to analyze different constraints and their impact on the system. These tools helped to determine the optimum parameter settings of the die casting machine. The new optimum settings helped reduce the defect rate, which saved the company both time and money.

OPTIMIZING THE PRODUCTION PROCESS OF PRESSURE GRAVITY VALVES FOR THE BOTTLING INDUSTRY

by Salman Abukabbus, Matthew Byrem, Meng Chan, and Jithin Nair

Faculty Advisor: Azim Houshyar and Bob White

Sponsor: Joe Stroup, Ryan Fritz FBN Sales, Inc.

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

The bottling industry requires several highly specialized pieces of equipment. Filling valves are one of the more complex pieces, undergoing multiple production processes and a demanding assembly process. Using time studies and process flow charts, a standard operating procedure was developed to identify and reduce non-valve added costs in the production phase. Additionally, a fixture was designed using AutoCAD, a 3-D modeling program, to aid in the assembly process and promote ergonomically correct movements. The implementation of these developments will result in increased throughput, quality, and profit margin.

BRONCOBOT: MULTI-TOOL ADDITIVE MANUFACTURING SYSTEM

by Bailey Cupp, Bryan Stolla, Tipu Sultan, and Andrew Tucker

Faculty Advisor: Jorge Rodriguez and Pavel Ikonomov

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

The ability to rapidly manufacture an object is an extremely valuable tool in reducing costs and saving time, in industry and at WMU. Functionality, size and accuracy of current desktop additive manufacturing systems were evaluated, with a focus on supporting the design of a new system. A concept machine was designed using ProEngineer 3D CAD software followed by fabrication. The machine was integrated with electrical components to operate by use of a desktop computer, and was

tested and evaluated for optimization. This system will be implemented in the Computer Integrated Design (CID) lab for prototyping and design purposes by students and faculty.

BERNHARD CENTER DISH ROOM REDESIGN

by Matthew Clark, Doug Harding, and Michael Van De Velde

Faculty Advisor: Kailash Bafna

Sponsor: WMU Dining Services

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

Effectiveness and efficiency of a facility is directly related to the layout and utilization of equipment. The current layout of the Bernhard Center Dish Room is out-of-date and inefficient. Using ergonomic studies, cost analyses, and flow pattern analysis, several bottlenecks within the facility were identified. Three alternative dish room layouts were then designed, ranging from relocating only some of the equipment, to a completely remodeled area with all new equipment. Budgets for the three optional layouts varied from \$25,000 to \$3,000,000. The chosen layout will maximize efficiency, streamline operations, and reduce operational costs of the Bernhard Center Dish Room.

5S DECISION SUPPORT SYSTEM AND IMPLEMENTATION PLAN

by Austin Dery, Eric Patzer, and Brittany Saddler

Faculty Advisor: David Lyth and Betsy Aller

Sponsor: John Barnes, Sterling Industries

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

As manufacturing industries grow, organization becomes increasingly vital. A widely accepted lean manufacturing tool, known as 5S, was used to organize the tools and storage of materials throughout the plant, optimizing available space. Using Visual Basic Analysis (VBA) and Macro programming in Excel, a decision support system was developed to use when implementing 5S. Cost analyses determined the payback period and rate of return on these changes. Results included a reduction in time to complete tasks and in physical strain on employees, laying the groundwork for the efficient addition of new customers and processes.

FOUNDRY EQUIPMENT AND PROCESS OPTIMIZATION

by David Bent and Robert Caswell

Faculty Advisor: Sam Ramrattan

Sponsor: Metal Technologies: Three Rivers Gray Iron

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

Research and educational foundries are limited greatly by the amount of molten metal that can be continuously poured into a mold. A system to effectively increase the amount of molten metal available was designed, fabricated, and implemented. The molding and pouring processes was analyzed using from-to-charts and work studies. All equipment implemented in the design was modeled and tested via Finite Element Analysis (FEA), using Creo parametric modeling software. The improvements made increased the capabilities in an educational setting.

MODERNIZATION OF THE GREAT LAKES BIPLANE WING SPAR

by Hadi Alawami, Sabrina Moore, Patrick Retzer and Paul Van Ooy

Faculty Advisor: Larry Mallak

Sponsor: Rich Hunter, WACO Classic Aircraft Corporation

1:00 p.m. to 1:25 p.m., D-201

There is a strong desire for the modernization of historical aircraft while keeping the original integrity of the design. Investigation and simulation were conducted on materials such as aluminum, spruce wood, and carbon rod as alternative material choices to the classic wooden wing spar found in the latest incarnation of the Great Lakes Biplane. The material was tested using Finite Element Analysis (FEA). A cost analysis was performed and a sample test plan was developed for future use by the sponsor.

THREE-WHEEL URBAN VEHICLE FRAME DESIGN AND BUILD

by Adrian Jee, Chris Longrey, Sean Wabeke and Jacob Wentink

Faculty Advisor: Pavel Ikononov and David Middleton

1:30 p.m. to 1:55 p.m., D-201

Efficiency of conventional vehicles decreases when operating in an urban environment. A compact and lightweight vehicle incorporating the use of renewable energy was explored as a viable solution. The three-wheeled vehicle frame design was established through research on currently available electric vehicles. Integration of a golf cart frame and the rear end of a motorcycle met design criteria. This system was analyzed with SolidWorks 3D modeling software using Finite Element Analysis (FEA) for structural integrity. The vehicle incorporates an electric motor, nickel metal hydride batteries, and an economical design. The three-wheeled vehicle will lower costs for personal transportation and reduce carbon emissions in an urban environment.

URBAN ELECTRIC THREE-WHEEL VEHICLE BODY DESIGN & BUILD

by Jennifer Day, Wendell Mansfield and Tom Olech

Faculty Advisor: Pavel Ikononov and David Middleton

Sponsors: Michael Day, MLAJ Consulting

2:00 p.m. to 2:25 p.m., D-201

Electric vehicles are becoming increasingly popular in society. History has shown that electric vehicles can be manufactured while remaining safe and light-weight. Using 3D Studio Max, a modeling, animation, and rendering software package, a vehicle design was first created. A scaled model was then formed using a Computer Numerical Control machine (CNC). Finally, the manufacturing design process was used to build the actual vehicle. The final vehicle resulted in reduced weight.

SNOW GUN DEPLOYMENT AND LEAK DETECTION/COST

by Kaleb Brown, Dave Heath, Fred Roderick and John Van Wagner

Faculty Advisor: Tarun Gupta and Betsy Aller

Sponsors: Victor Gayhard and Nick Ross, Bittersweet Ski Resort

2:30 p.m. to 2:55 p.m., D-201

Snow making is a costly process for ski/snowboard resorts. Leaks and wasted resources can be a financial burden on any resort. Fluid mechanics modeling determined optimal snow gun deployment and configuration. On-site field testing was conducted to validate the resulting model by grantifying line pressures and flow rates. Cost analysis of identified leaks was used to determine money lost. Continuous improvement and leak management will result in savings of resources for years to come.

DESIGN AND BUILD OF A LIGHTWEIGHT, PACKABLE TREESTAND

by Justin Dragicevich, Andrew Machacek, Joseph Miller and Timothy Witherow

Faculty Advisor: Frederick Sitkins

3:00 p.m. to 3:25p.m., D-201

For those involved in wilderness search and rescue, there is a need for a treestand that is more lightweight and packable than what is available in the market today. Multiple designs were brainstormed and compared against criteria, and best designs were conceptualized using Pro/Engineer and SolidWorks software. Working prototypes were then user tested in real world settings. The final design was tested using Finite Element Analysis (FEA) and was evaluated for manufacturability. The resulting lightweight and packable treestand will allow search and rescue teams to accomplish their duties more effectively.

MECHANICAL AND AERONAUTICAL ENGINEERING A

Session Chair – Jerry Hamelink

Room D-109

EXTERNAL HYDRAULIC COOLING SYSTEM FOR RECIPROCATING PUMP

by Jeffrey Mierau and John Stscherban

Faculty Advisor: Daniel Kujawski

Sponsors: Michael Elliger and Tom Verbeek, CLYDEUNION Pumps

8:00 a.m. to 8:25 a.m., D-109

An external cooling system was required for the lubricant of a TX-350 model positive displacement reciprocating pump. A mathematical model was created, using the engineering calculation software MathCAD, to analyze the thermal conditions of the lubricant. A 3D model was also constructed using the ANSYS-Fluent flow modeling simulation software package to accurately predict the operational behavior of the cooling system. These models were then used to determine operating requirements of the cooling system, enabling the selection of components that would optimize performance with respect to cost.

INDUSTRIAL FOIL PLEATING MACHINE

by Noah Riojas and Austin Schrotenboer

Faculty Advisor: Judah Ari-Gur

Sponsor: Plascore Inc.

8:30 a.m. to 8:55 a.m., D-109

A machine was designed that is capable of performing an uneven pleating operation on aluminum alloy foil of varying widths. The pleated aluminum foil is used as a disposable tool to aid in the expansion of an aramid fiber honeycomb block. The designed machine was modeled using Solidworks 3D software. Various components were optimized using finite element analysis and prototype testing. Using a machine to complete this process would reduce the need for labor and generate a more uniform pleat, thereby increasing savings and precision.

HYBRID AIRSHIP DESIGN

by Ryan Burlager, Kyle Soffin, and Jeff Woodside

Faculty Advisor: Tianshu Liu

Sponsor: Department of Aeronautical Engineering

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

Recent interest in an aircraft with capabilities beyond existing state of the art designs have led some in the aviation community to propose a new class of aircraft known as hybrid airships. A Hybrid airship prototype was designed and built to produce lift from both a buoyant lifting body and a conventional aircraft wing to carry a specified payload. To determine optimum performance and sizing, mathematical calculations, computer-aided design and analysis software, and test flights were performed.

RENEWABLE ENERGY HVAC SYSTEM

by Tyler Bays, David Morreale, and Chris Sliney

Faculty Advisor: Ho Sung Lee

Sponsor: Ed Winegar, Masonic Temple Finance Corp.

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

Building owners wish to lower their current utility costs by replacing its outdated boiler heating system with a modern system powered by renewable energy. The new HVAC system consist of solar heat exchangers, ground source heat pumps, and a radiant cooling system. A three-dimensional computer model was created in Ecotect to calculate the required thermal loads of the system. The piping and ductwork network of the system was simulated using McQuay Energy Analyzer. The completed model provides an eco-friendly system that will set a good example for other neighboring buildings to emulate.

REDESIGN OF MUSICAL INSTRUMENT KEY SOLDERING FIXTURE

by Frederic Oehmke and Michael Severns

Faculty Advisor: Koorosh Naghshineh

Sponsor: John Thomas, Conn-Selmer, Inc.

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

Keys on musical instruments, such as saxophones, clarinets and flutes, are machined into multiple pieces and hand soldered. A variance of greater than 0.040 can result in a defective product. Conn-Selmer Inc. has encountered such variance and attributed a major portion of it to thermal expansion during the soldering process. New materials were considered and selected based on thermal qualities and durability. A new soldering fixture was designed with few fastening points. This fixture experiences reduced thermal expansion through the soldering process which resulted in less manufacturing variance.

REAL TIME EVALUATION OF PEM FUEL CELL MEMBRANE

by Kok Seong Foo, Adrian Yen-Yue Tok, Ewing Shan-Hong Tiong, Sean Lwe Leslie Weera

Faculty Advisors: Bade Shrestha, Muralidhar Ghantasala, and Valery Bliznyuk

Sponsor: Western Michigan University

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

Several new high performance membranes for Proton Exchange Membrane (PEM) Fuel Cells have emerged in the market and required extensive testing. A lab-scale fuel cell was designed to house new types of membranes while being able to perform real time data acquisition under different operational conditions. The internal geometry of the fuel cell was designed using SolidWorks to make in situ monitoring of the device operation while providing unobstructed flow to reactants. The results obtained were used to evaluate the performance of the fuel cell based on several newly developed hybrid polymer-inorganic membranes.

REDESIGN OF A LOCKABLE TELESCOPING CANE FOR THE VISUALLY IMPAIRED

by Ahmad Alghamdi, Mitchell Button, and Torri Garland

Faculty Advisor: Koorosh Naghshineh

Sponsor: Michael McCarthy, Department of Blindness and Low Vision Studies, WMU

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

A white cane is utilized by many people who are visually impaired or blind as a mobility tool. A telescoping cane is desirable for some users because of its portability. Currently such products are non-compact and have a tendency to break or collapse as the result of impact with hard objects. A new design for a lockable, telescoping white cane was developed. Models of the redesign were created in SolidWorks then evaluated using finite element analysis in order to determine the mechanical properties of the system. A prototype was then fabricated and tested in order to determine the basic functionality of the new design. The final design provides improved reliability in a small, light weight package.

GEODESIC POOL DOME COVER

by Shelby Gilson

Faculty Advisor: Dennis VandenBrink

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

In order to prevent debris and precipitation from collecting on top of an above ground pool in the winter months, a geodesic dome cover was designed that could withstand wind and snow loads while also making dewinterizing easier. The design used light weight poles constructed into triangles to form a dome that covers a 24" diameter pool. Finite Element Analysis was used to ensure the dome was structurally sound for winter in Michigan.

OPTIMIZING THE COMPOSITION OF NiMnGa FOR BEST MAGNETIC SHAPE MEMORY BEHAVIOR

by Hussain Al-Khuder and Matthew Funk

Faculty Advisor: Pnina Ari-Gur

Sponsor: CRDF Global

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

Alloys comprised of nickel, manganese, and gallium exhibit magnetic shape memory properties under an applied magnetic field. The NiMnGa alloys have applications ranging from aerospace to medical. However, when the composition of the alloy is in perfect stoichiometry (Ni₂MnGa), the desired magnetic shape memory properties are observed at temperatures too low to be practical. To make this material useful at ambient temperatures and beyond, promising compositions of the alloy were cast, and evaluated.

MACK BULL GEAR GAGE STATION DESIGN

by Mitchell Vorick and Mark Wenstrup

Faculty Advisor: James Kamman

Sponsor: American Axle and Manufacturing

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

American Axle and Manufacturing currently uses hand micrometers to measure the physical dimensions of Mack Bull Gears, helical gears found in front and rear differentials. These measurements are often inaccurate and vary significantly between operators. A new system for making accurate measurements has been designed. The new system eliminates the inconsistency by having a fixed plane at which the pitch diameter measurements are taken. The system includes; detailed drawings of the work station, digital micrometer setup, and track system setup.

HYDRAULIC SYSTEM ATTENUATOR

by Chris Duda, Ryan LaPorte, and Nicholas Larsen

Faculty Advisor: James Kamman

Sponsor: Nicole Obrieht, Parker Hannifin Corporation-Aerospace Group

2:00 p.m. to 2:25 p.m., D-109

Aircraft hydraulic systems produce unwanted fluid pressure fluctuations which induce structural vibrations during normal operation. These vibrations increase the fatigue loading on structural components leading to shortened life cycles and possibly catastrophic failure. In conjunction with Parker Hannifin-Hydraulic Systems Division, a pressure attenuator was designed to reduce pressure fluctuations in aircraft hydraulic lines and hence reduce their negative impact on hydraulic and structural components.

HEATING AND VENTILATION ENERGY RECOVERY SYSTEM

by Seth Berger and Shedrick Harrell

Faculty Advisor: Christopher Cho

Sponsor: Anand Sankey, WMU Director of Operations and Engineering

2:30 p.m. to 2:55 p.m., D-109

Companies are looking for ways to minimize operating costs, and one proven way to do this is to improve operating efficiencies of their existing buildings. By recovering wasted energy, heating and cooling costs can be significantly reduced. Various methods of energy recovery were considered for Lawson Ice Arena, and from those calculations, a final system design was optimized in an effort to minimize the operating costs. This optimal system design can be implemented for other existing buildings, in an effort to improve sustainability and reduce operating costs.

AN INNOVATIVE OPTICAL SYSTEM FOR AUTOMOTIVE COMBUSTION CHAMBER IMAGING STUDIES

by Patrick Kreun and Trevor Lambert

Faculty Advisor: Claudia Fajardo-Hansford

3:00 p.m. to 3:25 p.m., D-109

In modern automotive design and research, the need often arises to gather information from the combustion chamber of a running internal combustion engine without significantly altering the process being studied. A minimally invasive image acquisition system was designed for implementation in production engines using a CMOS micro-camera. The design integrates a novel cooling system to protect the camera from the harsh environment of the combustion chamber. The system enables the acquisition of experimental data to generate an improved understanding of in-cylinder processes and validate existing Computational Fluid Dynamics models. These are critical steps for the development of more efficient and environmentally friendly internal combustion engines.

Gcb-6 (GLIDE CORDLESS BLOWER)

by Kevin Henneman and Jeffrey Williams

Faculty Advisor: Christopher Cho

Sponsor: Stryker Medical

3:30 p.m. to 3:55 p.m., D-109

The GCB (Glide Cordless Blower) provides a portable alternative to the current 120AC blower of the Glide System. This system includes a docking station cradle, two interchangeable battery packs, and a small cordless DC powered blower. The purpose of the docking station is to recharge the batteries. During operation the blower unit, when coupled with the glide mat, allows sufficient pressure and CFM (cubic feet per minute) to safely transfer the patient. The technology of the GCB allows patients weighing up to 1,000 lbs to be moved safely and easily.

PAPER ENGINEERING, CHEMICAL ENGINEERING, AND IMAGING

Session Chair – Andrew Kline

Room D-208

LABORATORY SCALE MEDIUM CONSISTENCY OXYGEN DELIGNIFICATION OPTIMIZATION

by William Norton

Faculty Advisor: John Cameron

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

Oxygen delignification of pulp is a process used in industry that can improve the bleaching process. Experiments were conducted to determine optimum operating parameters for a laboratory scale oxygen delignification reactor. Pulp properties after delignification were measured to determine the efficacy of reactor operating parameters. The establishment of an oxygen delignification reactor at WMU will aid future research and student education at the university.

A STUDY INTO CHEMICAL TREATMENT FOR THE ABSORPTION OF ALGAE ONTO PULP FIBER

by Casey F. Kick

Faculty Advisor: Raja Aravamuthan

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

Lake Apopka is Florida's fourth largest lake, and currently has one of the largest eutrophication problems in the U.S. This project explored a variety of natural and synthetic chemical treatment options to achieve maximum absorption of algae particles onto a cellulose fiber medium for intended use in the paper making process. Using the most economic means of chemical treatment, the goal was to reduce the concentration of algae and significantly reduce the lake's phosphorus component. Since algae particles carry a net negative particle charge, this research investigated various cationic polymers and emulsions to successfully coagulate the algae particles for their capture in the paper making process. The results and procedures used in this project could be applicable in cleaning up other eutrophic bodies of water.



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Information about the College of Engineering and Applied Sciences at Western Michigan University

CEAS Mission

To educate our learning community for life-long excellence in responsible professional leadership. To increase knowledge through collaborative discovery, integration, application, and teaching. To serve as a resource and partner to our constituents. To prepare job-ready graduates for the global market.

CEAS Vision

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

CEAS Four Cornerstones

- Engagement: Produce job ready graduates with the ability to grow in their profession and are life long learners
- Innovation: Move the profession and society forward by providing engineers, scientists, and technologists with new capabilities
- Leadership: To graduate engineers, technologists, and applied scientists who are and will continue to be leaders in their profession and community
- Globalization: Our graduates must be prepared to work in a global engineering and applied sciences industry

CEAS Administration

- Dean: Dr. Anthony J. Vizzini, Ph.D., PE
- Associate Dean of Undergraduate Studies: Dr. Edmund Tsang
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- Chair of Paper Engineering, Chemical Engineering, and Imaging: Dr. Said AbuBakr

CEAS Data (Fall 2009)

- Bachelor's Enrollment: 2185
- Master's Enrollment: 293
- Ph.D. Enrollment: 78
- Number of Faculty: 94
- Number of Staff: 28

CEAS Contact Information

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- CEAS Dean's Office: (269) 276-3253
- CEAS Student Outreach and Recruitment Coordinator: Scot Conant – (269) 276-3272
- CEAS Cooperative Education and Internships: Fred Sitkins – (269) 276-3261
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