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Senior Engineering Design Conference

College of Engineering and Applied Sciences

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4-2009

## 44th Conference on Senior Engineering Design

College of Engineering and Applied Sciences

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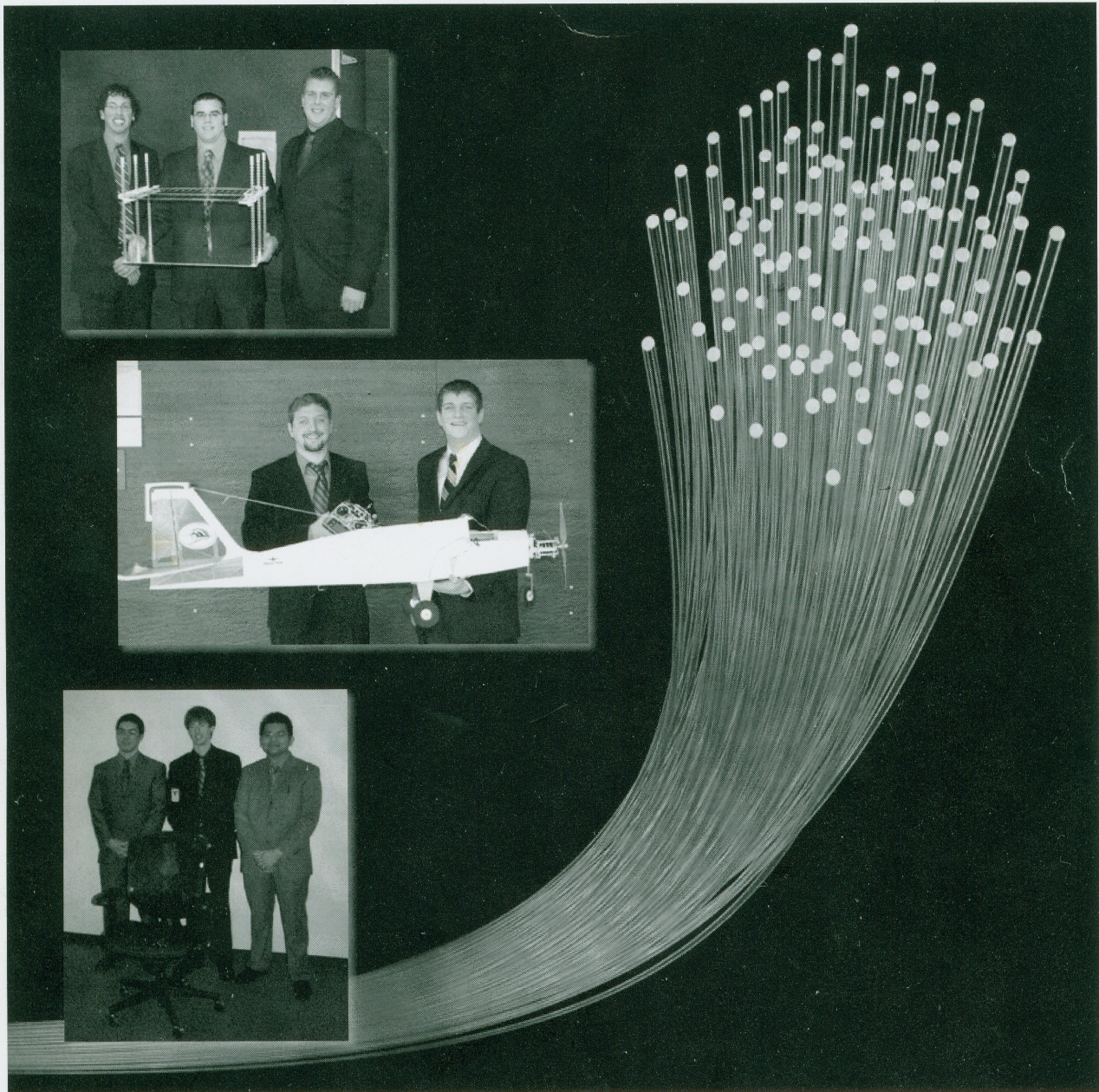
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# 44<sup>th</sup> Conference on Senior Engineering Design



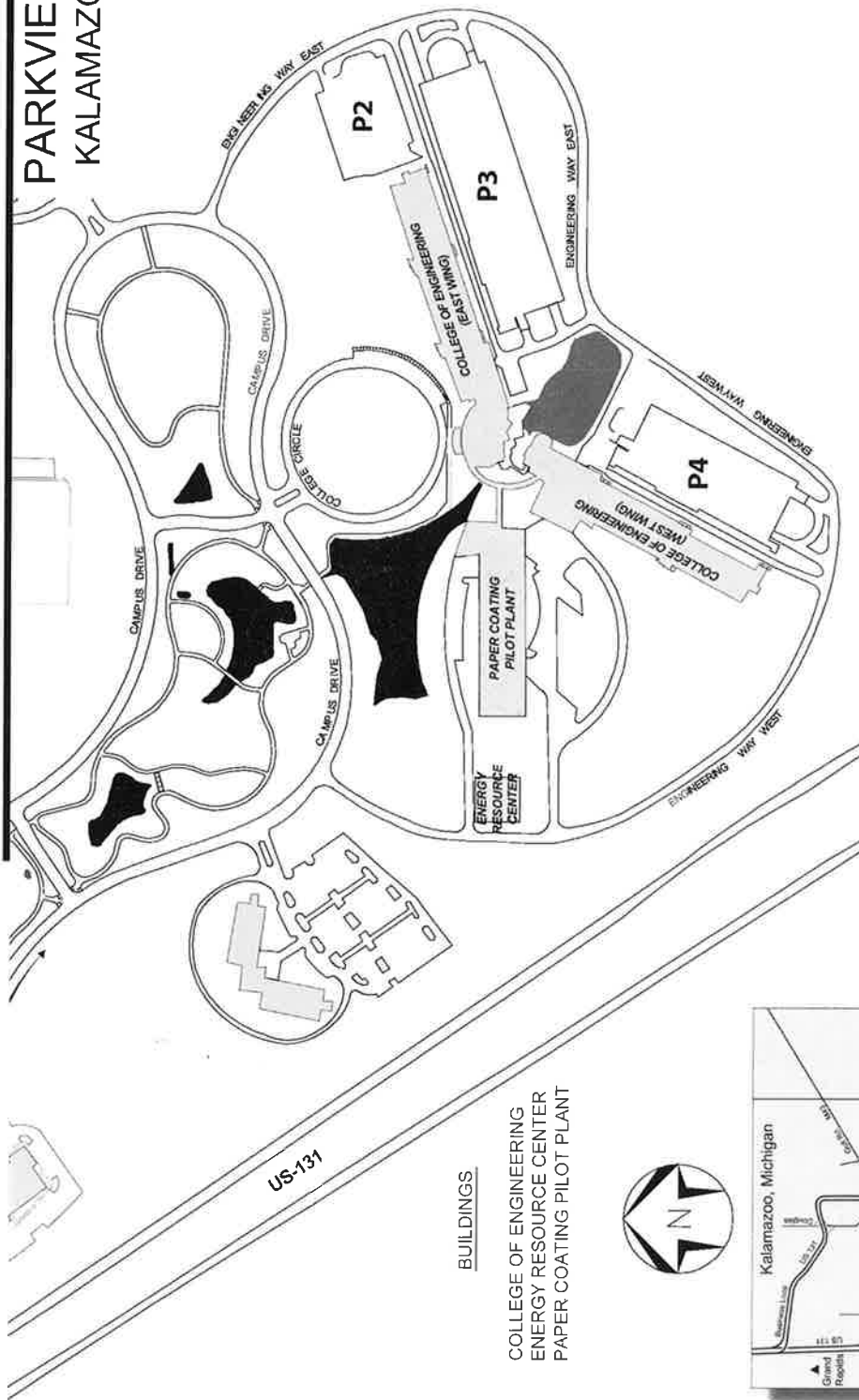
**Tuesday, April 14, 2009, 8 a.m. to 4:30 p.m.**  
**College of Engineering and Applied Sciences**



**WESTERN MICHIGAN UNIVERSITY**  
College of Engineering and Applied Sciences

# WESTERN MICHIGAN UNIVERSITY

PARKVIEW CAMPUS  
KALAMAZOO, MICHIGAN



## --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.



SCALE IN FEET

## Conference on Senior Engineering Design Projects

You are invited to attend the forty-fourth Conference on Senior Engineering Design Projects. The conference will be held from 8 a.m. to 4:30 p.m., **Tuesday, April 14<sup>th</sup>, 2009** 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-204/5	9 a.m. to 3 p.m.	p. 5
Computer Science	D-210	9 a.m. to 12 p.m.	p. 8
Electrical and Computer Engineering	D-208	8:30 a.m. to 12 p.m.	p. 10
Industrial Design	D-115	8:30 a.m. to 4:30 p.m.	p. 12
Industrial and Manufacturing Engineering	D-201	8 a.m. to 2 p.m.	p. 17
Mechanical and Aeronautical Engineering A	D-109	9 a.m. to 2:30 p.m.	p. 20
Mechanical and Aeronautical Engineering B	D-212	9 a.m. to 3 p.m.	p. 23
Paper Eng., Chemical Eng., and Imaging	D-208	1 p.m. to 4 p.m.	p. 26

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

**ID** Industrial Design

**IME** Industrial and Manufacturing Engineering

**MAE** Mechanical and Aeronautical Engineering

**PCI** Paper Engineering, Chemical Engineering, and Imaging

<b>Time</b>	<b>Room</b>	<b>Dept.</b>	<b>Topic</b>
8:00	D-201	IME	Process Design and Documentation of ISO 9000 Standards
8:30	D-208	ECE	Controller-Area Network (CAN) Test Bench
	D-115	ID	Math through Art
	D-201	IME	V-Process for Rapid Prototyping
9:00	D-204/5	CCE	Optimized Winter Operations
	D-210	CS	Distributed Network Monitoring
	D-208	ECE	Solar Cell Characterization System
	D-115	ID	Honeycomb Dog Kennel
	D-201	IME	Cost Model Construction for Product Families
	D-109	MAE A	Design of Formula SAE Frame and Suspension
	D-212	MAE B	Classic Aircraft Windscreen and Canopy Design
9:30	D-204/5	CCE	12 <sup>th</sup> Street Elementary – Portage Public Schools
	D-210	CS	Modification of Room Reservation Website and Room Wizards©
	D-208	ECE	Audio Signal Quality Monitor
	D-115	ID	Hygiene Pack
	D-201	IME	Design and Manufacturing of a Three-Wheeled Electric Vehicle
	D-109	MAE A	Redesign of a Solar Car Suspension and Steering
	D-212	MAE B	Multi-Element Wing Design
10:00	D-204/5	CCE	Bridge Load Rating Analysis
	D-210	CS	Making an Xbox 360 Game
	D-208	ECE	CAN-Bus Based Vehicle Telemetry System
	D-115	ID	Kalamazoo Capsule Shelter
	D-201	IME	Modeling a Heavy Truck for Rollover Stability
	D-109	MAE A	Aero Body Development for Formula SAE Race Car
	D-212	MAE B	Pneumatic Quick Jack
10:30	D-204/5	CCE	Gusset Plate Analysis for Steel Truss Bridges
	D-210	CS	Materials Science Virtual Lab
	D-208	ECE	Rugged Mobile Data Acquisition Unit
	D-115	ID	ZAK: An Educational Handheld Tool
	D-201	IME	Determining Energy Savings using a “Green” Refrigeration Product
	D-109	MAE A	House Geometry Optimization for Wind/Solar Energy Generation
	D-212	MAE B	Design and Optimization of Piping System for Water Heating Package
11:00	D-204/5	CCE	Steel Frame Retrofit of a Hospital
	D-210	CS	E-Commerce Gift Card Web Application
	D-208	ECE	Pneumatic Proportional Control System
	D-115	ID	Mobile Showering Unit
	D-201	IME	Total Productive Maintenance Cuts Costs and Enhances Quality

	D-109 MAE A	Flow-Conditioning for a Vertical Axis Wind Turbine
	D-212 MAE B	Analysis and Improvement of a Biomedical Implant
11:30	D-204/5 CCE	Design of Hawkins Road Bridge over I-94
	D-210 CS	Solar Car Simulator
	D-208 ECE	Peltier Countertop Heating/Cooling System
	D-115 ID	Total Health Hygiene Pack
	D-201 IME	Redesign Assembly Line through Inventory Optimization
	D-109 MAE A	Hybrid PV/T Solar Collection System
1:00	D-204/5 CCE	Construction Documents and Schedule for a Vehicle Facility
	D-115 ID	Helping Hand
	D-201 IME	Optimizing Shipments to Customers from Plants/Distribution Centers
	D-109 MAE A	Design of Pneumatic Fitting Assembly Machine
	D-208 PCI	ERIC Measurement by Ingede 11 and a NIR Spectrometer
1:30	D-204/5 CCE	Olivet College Cutler Events Center
	D-115 ID	The Nocturnal
	D-201 IME	Evaluation of a PRT System Around WMU Campus
	D-109 MAE A	eyeBOT: Robotic Performance Vehicle
	D-208 PCI	Reducing Fresh Water Usage in a Paper Mill
2:00	D-204/5 CCE	Parkview Bridge Overpass US-131
	D-115 ID	Terra Trike Fairing
	D-109 MAE A	Aircraft Rotary Actuator Testing Station Design
	D-212 MAE B	Design and Construction of an Experimental Submarine Propulsion
	D-208 PCI	Compound Coating Cost Savings Opportunity
2:30	D-204/5 CCE	Evaluation and Repair of the Jennings Drain Culvert
	D-115 ID	The K Guide
	D-212 MAE B	Assessment and Treatment of Poor Acoustics in a Classroom
	D-208 PCI	Baking Oven Exhaust Heat Reclamation
3:00	D-115 ID	The "Eco Essentials" Pak
	D-208 PCI	Methanol Waste Distillation Optimization from Manufacturing Biodiesel
3:30	D-115 ID	H-Pack: A Mobile Storage Shelter
	D-208 PCI	The Affects of Gray Component Replacement on Color Gamut Volume
4:00	D-115 ID	Sculprate: The Hydrating Art

## **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 April 2009. 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 & Manufacturing**  
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## **CIVIL AND CONSTRUCTION ENGINEERING**

**Session Chair – Hubo Cai**

**Room D-204/205**

### **OPTIMIZED WINTER OPERATIONS**

by David Bonamy, Griffin Enyart, and Kyle Ghastin

Sponsor: Mia Silver - Michigan Department of Transportation

Faculty Advisors: Hubo Cai and Jun-Seok Oh

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

In the northern parts of the country snow and ice are a common problem that not only affects the safety of motorist but also a state's budget. A system has been developed using ArcGIS, a geographical information system software used to generate optimized water plans. These plans allow for snow and ice to be removed from state roadways in a timely and economical manner. The plan contains prioritized plow routes, current and alternative de-icing techniques and strategic garage locations. This optimized snow and ice removal system will minimize the use of materials while keeping roads safe.

### **12<sup>TH</sup> STREET ELEMENTARY – PORTAGE PUBLIC SCHOOLS**

by Mark Crider, Jackie Kawa, and Marianne Zenz

Faculty Advisors: Jun-Seok Oh and Upul Attanayake

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

This fall, the Portage Public School District will be opening a two-story elementary school on 12<sup>th</sup> Street that shall accommodate 3,800 students. The project will total about 15 million dollars. Structural analysis and design of this 72,000 square foot structure was performed in accordance with the national and local codes and specifications. Traffic analysis was performed considering the Safe Route to School concept. Both the structural and transportation components were analyzed using basic theory of structural and traffic engineering in conjunction with state-of-the-art computer technology.

### **BRIDGE LOAD RATING ANALYSIS**

by Ryan Forgey, Logan Lockman, and Ryan Wurtz

Faculty Advisor: Haluk Aktan

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

Heavy loads and equipment need to be transported periodically on the highway system. Vehicles loaded beyond legal limits need to apply for a permit. Highway agency reviews the route including capacity assessment of bridges among other issues in order to issue the permit. An analysis was done on a bridge in Southwest Michigan in response to a permit application. The bridge analysis under load was studied using SAP2000. From the generated computer models and member capacity calculations, bridge safe load capacity was obtained. The permit analysis also includes a traffic study and geotechnical investigation.



## **GUSSET PLATE ANALYSIS FOR STEEL TRUSS BRIDGES**

by Paulette BeVier, Megan Montgomery, Frank Rodriguez, and Evan Selahowski

Faculty Advisor: Yufeng Hu

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

The gusset plate failure of the Minnesota 1-35 Bridge led the FHWA to recommend that steel truss bridges be evaluated for similar flaws. Implementing the mathematic analysis software MathCAD, a general template was developed to check the adequacy of gusset plate designs. This template will be an efficient tool in the analysis and design of gusset plates on various existing truss bridges. In the case of inadequate design, a steel connection retrofit plan was developed. Because of a possible need for upgrades, a construction traffic plan was proposed. This was accomplished using the traffic simulation software Synchro.

## **STEEL FRAME RETROFIT OF A HOSPITAL**

by Andrew Grimes, Alberto Landa, and Michael Peake

Faculty Advisor: Xiaoyun Shao

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

Over the past half decade, buildings in the United States have been lacking proper earthquake design and construction regulations. More recently, the Federal Emergency Management Agency (FEMA) has created present criteria for the design and construction of structures to resist earthquake ground motions. The “NEHRP (National Earthquake Hazards Reductions Program) Recommended Provisions for Seismic Regulations for New Buildings and Other Structures” provides minimum design criteria applicable to withstand earthquake ground motion. SAP2000 was used to model a theoretical, four-story steel frame hospital located in southern California. Using basic dynamic and nonlinear static analysis in SAP 2000, the steel frame hospital was retrofitted to meet all of the design provisions recommended by NEHRP. The retrofitted model can serve as an example for future rehabilitation or construction of similar steel frame buildings that require retrofitting due to seismic activity.

## **DESIGN OF HAWKINS ROAD BRIDGE OVER I-94**

by Nick Francis, Joshua Glowski, Dan Robinson, and Amanda Rossman

Faculty Advisor: Upul Attanayake

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

The Hawkins Road Bridge over I-94 deteriorated over time and required replacement considering current traffic demands and relevant design standards and specifications. The bridge clearance was a controlling factor for the new design as well as removing two piers to change the bridge from a four-span bridge to a two-span bridge. The challenge in redesigning the bridge was to increase the clearance and remove the piers while maintaining strength requirements. This challenge was addressed by choosing a beam design that met necessary requirements and altering any necessary earthwork. A traffic analysis was performed evaluating detour options to re-route traffic during the bridge construction.

## **CONSTRUCTION DOCUMENTS AND SCHEDULE FOR A VEHICLE STORAGE/MAINTENANCE FACILITY**

by Travis Johncock, Mikal Morris, and Jeffrey Wassink

Sponsor: Jack Abate - Miller-Davis Company

Faculty Advisor: Hubo Cai

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

The Van Buren County Road Commission's goal was to create a more efficient facility that met current standards while being fiscally responsible. By implementing current construction practices, a workable set of documents were produced including a schedule, estimate, and management plan in order to complete the project on time and within budget. This facility will enable the Van Buren County Road Commission to streamline its operations by consolidating all of its maintenance functions under one roof.

## **OLIVET COLLEGE CUTLER EVENTS CENTER**

by Eric Kella, Ryan Long, and Jeffrey Vlietstra

Sponsor: Bryan Roy – CSM Group

Faculty Advisor: Ahmad Jrade

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

The Olivet College Events Center was an addition onto the college's existing athletic facility. The new 44,000 square foot addition added a full service, full court gymnasium with bleachers, men's and women's locker rooms, public restrooms, a new fitness center, as well as additional storage and office space. Taking the position as Construction Manager starting with pre-construction services through post-construction: a construction estimate (per CSI Master Format), a full project schedule, scopes of work broken up by/for bid packages, a project management and safety plan for construction, as well as a building integrated model using Rivet Software were developed. The documents developed will allow for a construction management firm or general contractor to take the given information and complete a construction project from start to finish.

## **PARKVIEW BRIDGE OVERPASS US-131**

by Thomas Carlson, Jacob Cinader, and James Stacer

Faculty Advisor: Ahmad Jrade

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

Due to this country's quickly deteriorating infrastructure, construction processes need to become more cost and time efficient. Population growth in the area has caused an overpass on Parkview Ave. to become outdated and in need of replacement. Using the design software Rivet Structure, along with the estimating program M.E.R. L, a 3-D model and cost estimate were created. Next, with the help of the planning program Microsoft Project, a detailed project schedule was developed. With the replacement of the Parkview overpass many new construction codes and safety regulations will be satisfied. Additionally, with the overpass being constructed using pre-fabricated concrete sections, the entire construction process will be accelerated causing less public disturbance.

## **EVALUATION AND REPAIR OF THE JENNINGS DRAIN CULVERT**

by Zachary Beeman, Bryce DeQuoy, John Leite, and Travis Moore

Sponsor: Munawar Azam, PE – Michigan Department of Transportation

Faculty Advisors: Jun-Seok Oh and Paul Romano

2:30 p.m. to 2:55 p.m., D-204/205

The Jennings Drain culvert at I-94 near Paw Paw was deemed necessary to be repaired to prevent damages to the highway. Using structural analysis, soil mechanics, and hydrology, the culvert was analyzed to determine integrity. A cost benefit analysis was performed to determine the most economical repair method. A construction and traffic plan were determined to make the project most effective. This feasible solution prevented a future problem while keeping the impact on highway traffic to a minimum. The project ensured that the culvert would be functional for years to come without a total reconstruction.

## **COMPUTER SCIENCE**

**Session Chair – John Kapenga**

**Room D-210**

## **DISTRIBUTED NETWORK MONITORING**

by Ryan Noble

Sponsor: Noble Networks.net

Faculty Advisor: John Kapenga

9:00 a.m. to 9:25 a.m., D-210

Maintaining a functioning computer network is vital to businesses. A distributed network monitoring system was created to observe the network operations of several small businesses using Nagios, an open source network monitoring application. This system can be utilized to alert technical staff of network errors, record on-going performance characteristics, and predict trends that may cause future problems. The completed software was extended to include site-specific test and performance statistics, GUI enhancements, and easy roll-out installation packages. This system will help to maintain high-availability computer networks, reduce the response time for outages, and provide critical information for preventing future interruptions.

## **MODIFICATION AND REVAMP OF ROOM RESERVATION WEBSITE AND ROOM WIZARDS©**

by Seth Behnke

Faculty Advisor: John Kapenga

9:30 a.m. to 9:55 a.m., D-210

The Room Wizards© outside of each room were not maintainable in their current form. The website back end that allows for room reservation was updated. A completely new operating system was installed on the Room Wizards©, along with a new interface. The overall benefit is a significant improvement in stability, maintainability, and the possibility for future expansion.

## **MAKING AN XBOX 360 GAME**

by Daniel Frandsen

Faculty Advisor: Karlis Kaugars

10:00 a.m. to 10:25 a.m., D-210

One of the biggest popular interests in computer science is in the creation of video games. A video game was created using the Microsoft XNA Framework for the Xbox360 platform. The game, entitled “Olu”, used many different aspects of the computer science curriculum including threading, linear algebra, optimization, graphical design, coding standards, artificial intelligence, and game design. The game was released on the LIVE Community Games service and available for purchase to anyone on Xbox LIVE.

## **MATERIAL SCIENCE VIRTUAL LAB**

by Kyle Chouinard, Daniel Frandsen, and Richard Herrington

Faculty Advisor: John Kapenga

10:30a.m. to 10:55a.m., D-210

Expensive equipment is required for physical labs used in a material science curriculum. The Virtual Lab is an effort to provide the ability of material science students to work on their labs without the need for a physical environment. The students use HP tablet PCs to interact with a virtual environment. Using the application, students can take notes, perform quizzes, send e-mails to the professor, and complete an entire lab using only their tablet PCs. This provides an effective low-cost replacement for expensive physical labs.

## **E-COMMERCE GIFT CARD WEB APPLICATION**

by Adam Flink, Ted McDonald, and Stuart Swope

Sponsors: Jerry Howell – Midwest Business Exchange, Art Pearce - Battle Creek Area Habitat for Humanity, and John Jozef Kapenga - Kapenga Design

Faculty Advisor: John Kapenga

11:00 a.m. to 11:25 a.m., D-210

Charities lack an efficient way to collect funds. An e-commerce website was created to facilitate donations to many charities from one central location. Features of the web application include purchasing a gift card, redemption of a gift card, and administration of the site. During the redemption process the user donates to the charity of their choice. HTML, CSS, Javascript, PHP, and MySql were the tools used in the development process. The web application will benefit charities by allowing a large number of people to easily donate.

## **SOLAR CAR SIMULATOR**

by Paul Adams, Collin Moerman, Cory Nunnery, Brandon VanVaerenbergh, and Ryan Woodcox

Faculty Advisor: John Kapenga

11:30 a.m. to 11:55 a.m., D-210

In major inter-collegiate solar car races, performance modeling and strategy are critical to the success of a team. The Solar Car Simulator utilizes the Java programming language, an interactive information visualization toolkit called Prefuse, NOAA's National Digital Forecast Database, and the United States Geological Survey's Elevation Query Service. The program also takes real-time input from GPS, chase car weather data, and solar car telemetry. The simulation package will enable a team to author and test a strategy before a race, as well as monitor the effectiveness of their plan during the race.

## **ELECTRICAL ENGINEERING**

**Session Chair – John Gesink**

**Room D-208**

## **CONTROLLER-AREA NETWORK (CAN) TEST BENCH**

by Trevor Case, Kyle Hendricks, and Robert Olsen

Sponsor: Karen Cooper-Boyer - DENSO North America Foundation

Faculty Advisors: Bradley Bazuin and John Kapenga

8:30 a.m. to 8:55 a.m., D-208

The Controller Area Network (CAN) is part of the automotive on-board diagnostics required in virtually all 2008 and beyond US passenger cars and light trucks. The WMU Sunseeker solar "rayce" car uses the CAN for communications between all primary electronic modules, including electric motors, brake lights and turn signals, accelerator and cruise control, dashboard displays, etc. The test bench is a fully functioning mockup of CAN related electronic modules and cable interconnections in Sunseeker 2008 and expected in future Sunseeker vehicles. The commercial modules used and custom electronic modules developed will be presented and the broader use of the test bench uses for future CAN developments and classroom education will be discussed.

## **SOLAR CELL CHARACTERIZATION SYSTEM**

by Ruba Afaneh, Hang Guan Cheah, and Ishrak Mamun

Faculty Advisor: Bradley Bazuin

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

All solar cells are not manufactured equally. The Sunseeker solar car team needed a solar cell characterization system to match solar cells in order to collect energy with maximum efficiency. The system measured the current-voltage (I/V) curves for individual solar cells or modules under varying indoor and outdoor lighting conditions. An embedded microcontroller set the device operating point with the digital-to-analog converter (DAC) and then collected current, voltage, and temperature readings with an analog to digital converter (ADC). System control, display, and data storage was performed by a PC using a USB interface.

## **AUDIO SIGNAL QUALITY MONITOR**

by Keith Kurdziel, Megan Natrass, and Alexander Pearce

Faculty Advisor: Raghe Gejji

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

Conference calls are frequently interrupted due to poor audio quality. A device was designed and built to provide real-time response of signal quality during these calls. The device uses signal filtering and a microcontroller for signal processing. Visual feedback is provided using LEDs (light emitting diodes). The efficiency of conference calls can be increased with the use of this device.

## **CAN-BUS BASED VEHICLE TELEMETRY SYSTEM**

by Jeffrey Choate, Laura Szabelski, and Nicholas Tenney

Sponsor: Leonard Pimentel - I.D. Systems Inc.

Faculty Advisor: Janos Grantner

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

I.D. Systems wished to upgrade their current data collection system to be CAN-Bus compatible. The old system collected data on industrial machinery, such as forklifts, via sensors that were hard-wired to a transmitter. Upgrading to a CAN-Bus architecture required creation of new code and circuits that would filter and convert the raw sensor data, based on the individual sensor. The sensors converted to the new system were GPS, distance, impact, and differential voltage.

## **RUGGED MOBILE DATA ACQUISITION UNIT**

by Nathan Cox, Steve Mayr, and Jacob Spitzner

Sponsor: Marie Maddix - Eaton Corporation

Faculty Advisor: Frank Severance

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

Eaton Corporation designs, tests, and builds truck transmissions. To do this it is necessary to accurately acquire, condition, filter, and log voltage signals in real time. An integrated data acquisition system that performs each of these functions was designed. It is a 12" x 9" portable unit that uses National Instruments Data Acquisition cards, Analog Devices 5B Signal Conditioning Modules, and PCB123 to create a single rugged data collection system with an attached laptop for real time analysis. The completed system accepts up to sixteen channels from different embedded sensors for data collection and conditioning.

## **PNEUMATIC PROPORTIONAL CONTROL SYSTEM**

by Ryan Boender, Ryan Cook, Nicholas Hainer, and Corey McClain

Sponsor: Humphrey Products

Faculty Advisor: Dean Johnson

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

An automated control system for proportional pneumatic valves has been designed, constructed, and evaluated for Humphrey Products. The pneumatic proportional control system consists of a LCD display with both a push button interface and a 0-10 volt direct control input. The control system also features real time learning with calibration for individual characteristics for each valve due to manufacturing tolerances and valve wear. The system consists of a hardware based interface that is controlled by a custom developed software backend.

## **PELTIER COUNTERTOP HEATING/COOLING SYSTEM**

by David Geiser, Justin Hobart, and Nick Kennel

Faculty Advisor: Massood Atashbar

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

Advancements in technology have provided the opportunity to bring a professional chef's environment into the average home. Home chefs need a way to heat or cool food products without using the conventional bulky equipment. This was done by attaching multiple peltier devices underneath granite countertops to provide heating and cooling. A battery powered wireless microcontroller unit was designed and implemented to have a closed loop feedback system enabling the control of the temperature of the countertop.

## **INDUSTRIAL DESIGN**

**Session Chair: Roman Rabiej**

**Room D-115**

## **MATH THROUGH ART**

by Julie Keith

Sponsors: Emily Pilloton - Project H Design and Julie Bontrager - VSA Arts of Michigan

Faculty Advisors: Roman Rabiej and Dave Veldkamp

8:30 a.m. to 8:55 a.m., D-115

Children with learning disabilities, such as Dyslexia and Non-Verbal (Math) Disability, have difficulties with understanding math. Special education math programs in public schools primarily teach kids with the same methods, but at a slower pace. This is ineffective because these children are not deficient in their learning abilities, they just learn differently. The Math Through Art learning method uses art methods and ideas such as drawing, music, dance, sculpture, and storytelling to teach, making math interesting and memorable to children.

## **HONEYCOMB DOG KENNEL**

by Stefanie Koehler

Sponsor: Emily Pilloton - Project H Design

Faculty Advisor: Dave Veldkamp

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

Thousands of homeless dogs end up in local animal controls, humane societies, and rescue organizations every year. Designing a dog kennel that allows staff to spend less time cleaning and more time with the dogs was vital. The Honeycomb Kennel provides better visibility of adoptable dogs. The self-contained drainage system reduces cleaning time and medical costs which enables staff to interact with dogs more frequently. Higher quality interactions will make the dogs more adoptable, thus, increasing the turn-over rate. Overall, this system will provide a more pleasant experience for the public, the workers, and most importantly, the dogs.

## **HYGIENE PACK**

by Peter Leite

Sponsor: Emily Pilloton - Project H Design

Faculty Advisors: Roman Rabiej and Dave Veldkamp

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

Homelessness is an issue that affects many people in the United States; approximately 3.5 million people experience a state of being homeless each year alone. One of the big issues facing the homeless is the need to get cleaned up, which can improve one's self esteem and help them attain employment. They only need a few basic amenities to keep themselves clean and by keeping them in a specialized travel case they can still remain independent and become hygienically self-sufficient. This in turn should help them possibly become employed and keep them returning to shelters to help keep clean.

## **KALAMAZOO CAPSULE SHELTER**

by Chris Latta

Sponsor: Emily Pilloton - Project H Design

Faculty Advisor: David Veldkamp

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

Three-quarters of a million people call the streets here in the United States home. The Kalamazoo Capsule Shelter (KCS) incorporates the everyday needs of the homeless with a sense of empowerment as recycling is used to help fund and maintain the units. The design was based on the Japanese capsule motels which use small living quarters contained within a single person capsule. Homeless are then charged with the task of collecting recyclables to gain entry in to the overnight sleeping unit. So as shelter is provided by the city to the homeless, the homeless provide to the city cleaning service and the recyclables are used again to help fund the unit's maintenance and installation costs. Over all, the KCS is a solution to an ever growing homeless population and how the homeless work themselves off the streets.



## **ZAK: AN EDUCATIONAL HANDHELD TOOL**

by Joe Alef

Faculty Advisors: Roman Rabiej and David Veldkamp

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

2.9 million kids in America today have learning disorders, most of them are diagnosed with forms of dyslexia. Zak is an educational handheld unit that utilizes the methods used today to help overcome dyslexia. Influenced by students and teachers, Zak is designed to fit in to their comfort zone with form and function. A basic skill level set up by the teacher allows this handheld device to shape itself to each individual student. Because proven methods are being used, Zak will help students learn what they need to know now and retain that knowledge for the future.

## **MOBILE SHOWERING UNIT**

by Matthew Parr

Sponsor: Emily Philloton - Project H Design

Faculty Advisors: Roman Rabiej and David Veldkamp

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

Homeless people have very little options as to where they are able to shower and clean themselves. In order for them to get a job and off the street, they must be clean and presentable. The mobile showering unit provides this luxury to the homeless by providing a place where they may get a shower. They are also provided with some interview questions and job listings which give them some extra help to better their situation. The completed model provides two showers, two changing rooms, a bathroom, and a consultation room.

## **TOTAL HEALTH HYGIENE PACK**

by Derek DeDecker

Sponsor: Emily Pilloton - Project H Design

Faculty Advisors: Roman Rabiej and David Veldkamp

11:30 a.m. to 11:55 a.m., D-115

Homeless individuals are more subject to health problems, less aware of health issues, and have a lack of proper hygiene necessities to maintain a healthy well being. An educational lecture on health prevention and a hygiene pack were created to help combat the health problems faced by the homeless. Attending the educational health prevention lecture allows homeless individuals to obtain the Total Health Hygiene Pack. These are both intellectual and physical tools to overcome health problems that plague the homeless.

## **HELPING HAND**

by Matthew Allen

Sponsor: Emily Pilloton - Project H Design

Faculty Advisors: Roman Rabiej and David Veldkamp

1:00 p.m. to 1:25 p.m., D-115

There are hundreds of different agencies that can help the homeless in America, but lack of transportation, no phone or address to be contacted, and complex application processes are just a few of the barriers that prevent the homeless from receiving the help they are eligible for. Helping Hand is a service that connects people who are homeless with the agencies that can provide them shelter, food, clothing, healthcare, and other needs. Helping Hand brings all the information and paperwork from these agencies to the homeless at locations such as soup kitchens and homeless shelters. Helping Hand then works with each individual or family and determines which agencies can help, assists filling out paperwork, schedules appointments, answers questions, and walks people through the entire process of receiving benefits and assistance. For people who have lost their home and job, this dramatically helps to alleviate the hardships of getting back on their feet.

## **THE NOCTURNAL**

by Steve Bui

Sponsor: Emily Pilloton - Project H Design

Faculty Advisor: David Veldkamp

1:30 p.m. to 1:55 p.m., D-115

There exists a problem in downtown Grand Rapids where the homeless are using inappropriate areas at night as an alternative restroom solution. This can easily be seen as a serious national problem if avoided too long. An alternative solution has been designed to not only solve this problem but also to aid the homeless in getting their life back on track. The completed project, called the Nocturnal, was designed with these key objectives in mind.

## **TERRA TRIKE FAIRING**

by Brent Paiva

Sponsor: Jack Wiswell - Terra Trike

Faculty Advisors: David Middleton and David Veldkamp

2:00 p.m. to 2:25 p.m., D-115

A semi-enclosed fairing to keep riders from the elements was designed for a line of recumbent style trikes. The existing line of products were previously unable to be used in wet conditions, preventing customers from fully utilizing their potential. The project began with ideation sketches and finalized with a foam and computer model. Focusing on key design criteria such as easy ingress/egress, low manufacturing costs, low production weight, and the ability to break down for shipping, a solution was found. The final design provides a unique solution to a previously unanswered problem.

## **THE K GUIDE**

by Matthew McMullen

Sponsor: Emily Pilloton - Project H Design

Faculty Advisors: Roman Rabiej and David Veldkamp

2:30 p.m. to 2:55 p.m., D-115

Homeless people face many obstacles, one of them being finding the available resources to help them get on the path to self sufficiency. The Kalamazoo Guide to homeless living is designed to combine all the services and resources into one easy to navigate guide. This guide will focus on visual communication to cross communication boundaries and help all homeless people in the Kalamazoo area. The guide will include all kinds of services and resources including health care, shelters, transportation, special events, food services and public restrooms.

## **THE “ECO ESSENTIALS” PAK**

by Eric Greene

Sponsor: Emily Pilloton - Project H Design

Faculty Advisors: Roman Rabiej and David Veldkamp

3:00 p.m. to 3:25 p.m., D-115

In consideration to current homelessness issues in our area, the need for common necessities for these less-fortunate is a continuing struggle. “EcoEssentials” presents an effectively designed parcel to household goods pertaining to sleeping, hygiene and overall wellness. It would be worn and transport with the user while offering ease of maintenance and comfort. Products contained would have arose from recycled materials and when exhausted these can then be re-recycled into further existence. To offer a sense of ownership with the user in mind could provide the empowerment necessary for one to alter their life forever.

## **H-PACK: A MOBILE STORAGE SHELTER**

by Benjamin Lusic

Sponsor: Emily Pilloton - Project H Design

Faculty Advisor: Roman Rabiej

3:30 p.m. to 3:55 p.m., D-115

Through research on the efforts of Project H to improve the lives of the homeless, there exists a need for a product with perhaps a more specific focus. This design will look to fulfill five needs of the homeless: two tangible and three intangible. The need for storage as well as shelter is ever-present in the lives of those less fortunate, but this product will also provide mobility, privacy, and security. This will be a secure storage device with convertibility into an efficient and out-of-the-way temporary shelter. This will be an overall modest, yet effective medium for the homeless to move their lives off the streets and back into a normal way of life. This product is called the H-Pack.

## **SCULPDRATE: THE HYDRATING ART**

by Afroz Munshi

Sponsor: Emily Pilloton - Project H Design

Faculty Advisors: Roman Rabiej and David Veldkamp

4:00 p.m. to 4:25 p.m., D-115

Having pure drinking water on daily basis is a huge problem faced around the world. Sculprate is durable and eco-friendly drinking fountain that is publicly accessible. Its artistic styling allows it to fuse into everyday environment. The design also provides a functional service while beautifying its surrounding. It breaks the discriminating barrier by uniting the homeless with other groups of society. It is not just a fountain but also a functional piece of art.

## **INDUSTRIAL AND MANUFACTURING ENGINEERING**

**Session Chairs – Betsy Aller and Bob White**

**Room D-201**

### **PROCESS DESIGN AND DOCUMENTATION OF ISO 9000 STANDARDS**

by Tim Seitz, Jeremy Bullard, and Kevin Oteng

Sponsor: Melissa Saltzman - Kelm Acubar

Faculty Advisor: David Lyth

8:00 a.m. to 8:25 a.m., D-201

ISO certification enables international trade by providing a single set of standards that industry acknowledges and respects. ISO guidelines ensure worker competence and proper documentation of the work environment. The Management System Model (MSM) and nimble documentation methodologies were used to design and document processes to comply with ISO standards at a local Kelm Acubar. Kelm Acubar is a firm that specializes in high quality OEM and aftermarket machined components.

### **V-PROCESS FOR RAPID PROTOTYPING**

by Kirk Mrozek and Shane Sovia

Faculty Advisor: Sam Ramrattan

8:30 a.m. to 8:55 a.m., D-201

Rapid prototyping (RP) is an evolving technique used to rapidly produce physical models. However, most of these models are not fully functional, posing a problem when design, testing, and research are necessary. CAD and RP technology were used to produce a molding pattern specifically designed for the V-process (vacuum process). V-process produces small to large castings ranging in complexity; zero draft, zero pattern wear, and internal cavities are benefits of the process. All components for the V-process were designed and fabricated to produce fully functional prototype castings in a timely and cost effective manner.

## **COST MODEL CONSTRUCTION FOR PRODUCT FAMILIES**

by Dimas Insani, Yongchul Jeong, Anthony Moguel, and Charles Sibarani

Sponsors: Nikki Crocker - Fabri-Kal

Faculty Advisor: Steven Butt

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

Production standards for a thermoforming plastics manufacturer were validated and associated costing models generated for specific items in a product family. A model that allows quick referencing of financial metrics will help brand managers screen new business opportunities.

## **DESIGN AND MANUFACTURING OF A THREE-WHEELED ELECTRIC VEHICLE**

by Okwui Atueyi, James Callan, Jonathan Engels, and Joseph Schneider

Faculty Advisor: Pavel Ikononov

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

Current consumers are interested in developing alternative fuels and more efficient transportation. A three-wheeled vehicle that exceeds the efficiency of most electric vehicles on the market was developed. Vehicle weight, component placement, stability, safety, and costs were important design criteria. The vehicle was drawn in CAD software and a finite element analysis (FEA) performed to identify stress, strain, and displacement on structural components. The final deliverable is a street legal, three-wheeled vehicle that responds to current demand for fuel efficiency.

## **MODELING A HEAVY TRUCK FOR ROLLOVER STABILITY**

by Sean Duncan, Taylor Krugh, Madeline McAuley, and Todd Simcina

Sponsor: National Transportation Research Center, Inc.

Faculty Advisor: Mitchel Keil

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

Heavy truck rollovers are not a frequent occurrence, but more than 52% of all truck-to-driver fatalities are a result of a rollover. Reverse engineering was performed on a heavy tractor and tanker trailer using the TRITOP photogrammetry and ATOS 3-D digitizer systems. A full-scale model was developed using Pro/ENGINEER. This model will be used in conjunction with simulation software to study rollover characteristics. Information obtained from simulation testing will lead to future designs with increased rollover stability.

## **DETERMINING ENERGY SAVINGS USING A “GREEN” REFRIGERATION PRODUCT**

by Dan Fountain, Brent Giles, Chris Mazzola and Mike Sell

Sponsor: Tim St. Onge - Eliason Corporation

Faculty Advisor: Betsy Aller

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

The growing demand to conserve valuable natural resources is pushing the development of products to help businesses reduce energy use. A testing procedure was designed to determine the effectiveness of using the Econo-Cover, an insulation barrier manufactured by a local company, on a commercial open display refrigeration unit. Data collected were used to determine energy cost savings associated with the product's use. The results of these tests will allow customers to determine their own energy savings associated with using the product.

## **TOTAL PRODUCTIVE MAINTENANCE CUTS COSTS AND ENHANCES QUALITY**

by Charles Birkeland, Tyler Butler, Dennis Howe, and Brandy Taylor

Sponsor: David Beyer - American Axle & Manufacturing

Faculty Advisor: Joseph Petro Jr.

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

With the world economy on the decline, companies must be able to cut costs and maintain quality in order to stay in business. Total Productive Maintenance (TPM) addresses these needs. Plant layouts, Preventive Maintenance (PM) schedules, Gantt charts, statistical data, and other resources were used to create a new production system, which includes greater worker responsibilities, an oiling satellite station, and improved PM scheduling. The new system will have save time and money, increasing productivity and overall plant efficiency.

## **REDESIGN ASSEMBLY LINE THROUGH INVENTORY OPTIMIZATION**

by Sidney Byrd, Josh White, Joshua Wiese, and Chris Zguris

Sponsor: Kristi Brunner - Stryker Medical

Faculty Advisor: David Lyth

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

In response to rising overhead costs and changing demand at a local medical equipment manufacturer, a need existed to redesign and reduce the assembly line footprint and utilize existing infrastructure. Flow process charts, time studies, part analysis, and a parts supermarket concept were used to evaluate and optimize the current assembly process. Through the design process and use of work analysis methods, the inventory management system, part flow, and overall product value per square foot were improved.

## **OPTIMIZING SHIPMENTS TO CUSTOMERS FROM PLANTS AND/OR DISTRIBUTION CENTERS**

by Bryan Dopkins and Aarti Valsadia

Faculty Advisors: Bob White and Abdolazim Houshyar

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

A tool was created to determine optimal solutions for shipments to customers from plants and/or distribution centers (DCs). The tool evaluates the scheduled production at each plant and the demand from customers. Based on partial trailer volume, the tool then determines whether a direct shipment to a customer is more cost-effective than shipping to a DC, where volume can be combined before shipment is made to the customer. Transportation optimization, scheduling, and planning were primary methods used for the analysis and a cost analysis determined if the tool is a good investment.

## **EVALUATION OF A PRT SYSTEM AROUND WMU CAMPUS**

by Matthew Nagy and Nick Polidori

Faculty Advisor: Tarun Gupta

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

Transportation around WMU campus is unreliable, expensive, and time consuming. A personal rapid transit (PRT) was evaluated to give the University more mobility between campuses. A workable transportation model was developed using responses from mail-in surveys, subsequent data analysis, and simulation modeling. The model simulates and investigates interactions of pedestrians, automobiles, and public transit systems on campus and in the community. The evaluation outcome indicates that a fitting and well built PTR system will improve mobility, increase predictability of travel time, and relieve traffic congestion.

## **MECHANICAL ENGINEERING - A**

**Session Chairs – Claudia Hansford, Pnina Ari-Gur, and Rameshwar Sharma**

**Room D-109**

## **DESIGN OF FORMULA SAE FRAME AND SUSPENSION**

by Sara Arendell, Benjamin Frudzinski, Chad Kroll, and Ryan Pringle

Faculty Advisor: Richard Hathaway

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

Formula racing is an exciting and cutting-edge racing field that demands great engineering detail to create a winning car. A new frame, suspension, and steering system has been designed for the 2010 WMU Formula SAE (FSAE) competition vehicle to help assure the teams continued success. The initial designs, which ultimately led to a final design, were created using solid modeling, simulation, and spreadsheet programs. Having a design a year in advance of the competition will place the FSAE team ahead of many teams with which it competes, will allow increased time for assembly and tuning, and will improve the team's competitiveness.

## **REDESIGN OF A SOLAR CAR SUSPENSION AND STEERING**

by Jonathan Eckhart, Ross Ott, and Christopher Rucker

Faculty Advisor: Richard Hathaway

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

A solar car front suspension and steering was redesigned. The new system was designed to maximize efficiency, meet strength requirements, and achieve a minimum weight. A three dimensional model of the suspension and steering system was created and analyzed using solid modeling and simulation software. The modeling and simulation process for the new design focused on minimizing frictional losses between the tire and the road through proper geometry as well as minimizing weight.

## **AERO BODY DEVELOPMENT FOR FORMULA SAE RACE CAR**

by Vivek Kumar, Chyn Wey Lee, Maha Viknesh Muthi, and Michael Paillon

Faculty Advisor: William Liou

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

An aerodynamic body kit for a race car was designed and fabricated for a Formula SAE race car. The design is based on improvement of the previous years' design for the nose cone and side pods with the objective of reducing drag and improving engine cooling efficiency. Fabrication included constructing foam molds and wrapping composite material around the molds creating a full scale functional model.

## **HOUSE GEOMETRY OPTIMIZATION FOR WIND AND SOLAR ENERGY GENERATION**

by Jason Brochu, Brad Craig, and Jeremy Sall

Faculty Advisor: Iskender Sahin

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

The current high demand for renewable energy has driven the increase in the use of wind and solar energy. Optimizing these two sources may ideally create enough energy to sustain an average household. However, most current economical systems are not efficient enough to provide the total amount of required energy. Various configurations were tested using 3-D modeling software combined with computational fluid dynamics (CFD) software. Optimization was done by uniquely designing the houses exterior shape to accommodate the goal. The most efficient computer models were prototyped and wind tunnel tested to verify the computational results.



## **FLOW-CONDITIONING FOR A VERTICAL AXIS WIND TURBINE**

by Philip Chartier, Kyle Schmidt, and Bret Warmhoff

Faculty Advisors: Tianshu Liu and John Patten

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

The solution to the environmental issues associated with the use of combustion based energy presents a serious challenge for today's society. An intake system was designed to increase the velocity and apparent swept area of incoming airflow to a vertical axis wind turbine. The system was modeled with the use of computer aided drafting and analyzed using computational fluid dynamics software. Following preliminary experimentation, a prototype was constructed for wind tunnel testing to define performance characteristics. The intake design enables turbines of similar size to extract more wind energy with low environmental impact than its predecessor.

## **HYBRID PV/T SOLAR COLLECTION SYSTEM**

by Curtis Krallman, William Schleicher, and Nicholas Valente

Faculty Advisor: Ho Sung Lee

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

As energy consumption continues to rise, more focus has been placed on finding cost-effective and renewable sources of energy. A hybrid PV/T (photovoltaic/thermal) solar collection system was developed to provide homeowners with electricity and warm water for daily use. This system, utilizing a combination of photovoltaic and thermal solar collectors, yielded increased efficiency over single energy source units. CFD modeling and simulation were performed to verify the benefits of the hybrid system. Ultimately, homeowners are provided with a practical and renewable energy source.

## **DESIGN OF PNEUMATIC FITTING ASSEMBLY MACHINE**

by Andrew Bornhorst, Jonathon Lawrence, and Kelly Sugg

Sponsor: Tim Vandervest - Parker Hannifin Corporation, Brass Division

Faculty Advisor: James Kamman

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

With the increasing costs of manufacturing, automated machinery will improve efficiency and profitability. An assembly machine for "Push to Connect" (PTC) composite pneumatic fittings was designed. The machine presses components into a composite body and verifies their proper assembly. Tooling for the machine was designed for numerous part configurations using solid modeling software and optimized using finite element analysis. Pneumatic actuators controlled by a Programmable Logic Controller allow for complete process control. The completed design provides improved safety, flexibility, and productivity.

### **eyeBOT: ROBOTIC PERFORMANCE VEHICLE**

by David Kaijala, Cung Sang, Terry Tabata, and Carlos Vargas

Faculty Advisor: James Kamman

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

Dance theatre is always looking for new, innovative ideas. A wheel-driven, camera mounted vehicle was designed to travel through a stage of dancers and record their movement. The robotic vehicle was designed using computer aided drafting to produce the 3-D vehicle models. The prototype vehicle follows a pre-programmed movement which was developed using control software. The completed model provides the means to combine technology and dance into an exciting theatrical performance.

### **AIRCRAFT ROTARY ACTUATOR TESTING STATION DESIGN**

by Nicole Charboneau, Ryan Kobe, Karan Sagar, and Kevin VanDyk

Sponsor: Daniel Wright - Eaton Aerospace

Faculty Advisor: James Kamman

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

Testing stations are used in industry to verify that products meet required production standards. A rotary actuator testing station was designed to replace an obsolete station which tests aircraft luggage door actuators. The station measure actuator properties including output torque, rotational direction, velocity, and other parameters. From the measured properties precision and repeatability was determined. The new station features up to date instrumentation, controls, and structure which saves space and reduces testing time.

## **MECHANICAL ENGINEERING-B**

**Session Chairs – Judah Ari-Gur, Muralidhar Ghantasala, and Javier Montefort  
Room D-212**

### **CLASSIC AIRCRAFT WINDSCREEN AND CANOPY DESIGN**

by Matthew Lytwyn, Brian Strombeck, and Timothy Talladay

Sponsor: Matt George - WACO Classic Aircraft Corporation

Faculty Advisor: Tianshu Liu

9:00 a.m. to 9:25 a.m., D-212

A modified wind screen was designed for an open cockpit airplane to reduce the turbulence the pilot experiences. A removable canopy was also designed to allow comfortable operation in cold and inclement weather. Through the use of solid modeling and computational fluid dynamics (CFD) software the models were designed and evaluated. Scale model testing performed in a wind tunnel, along with the CFD analysis, produced a successful design meeting all project goals.

## **MULTI-ELEMENT WING DESIGN**

by Matthew Magner, Steven Pindzia, and Frank Pulte

Faculty Advisor: William Liou

9:30 a.m. to 9:55 a.m., D-212

The performance of an International SuperModified Association (ISMA) race car was improved by optimizing the main multi-element wing positioned on top of the vehicle. This was accomplished by studying current baseline designs and then testing and validating new designs using wind tunnel testing and computational fluid dynamics analysis. The design was constrained by the current ISMA regulations. The final product is a newly designed wing with increased performance over the previous designs.

## **PNEUMATIC QUICK JACK**

by Aaron Fremuth, Richard George, and Alan Noble

Faculty Advisors: Peter Gustafson and Richard Hathaway

10:00 a.m. to 10:25 a.m., D-212

A traditional quick jack is a simple machine for raising a low-clearance racecar; however, it has inherent safety and performance limitations. A pneumatic quick jack removes these limitations, providing an alternative to a manual quick jack. Charged pneumatic cylinders take the place of crew workers to provide the necessary lifting force. Conceptual models for a pneumatic quick jack were drawn using 3-D modeling software. The efficacy of the final design was evaluated by performing a Finite Element Analysis of the components as well as field testing a prototype.

## **DESIGN AND OPTIMIZATION OF PIPING SYSTEM FOR WATER HEATING PACKAGE**

by Jonathon Rumohr and Neal Sheldon

Sponsor: Cory Hoffman and Paul Knight - Armstrong International

Faculty Advisor: Ho Sung Lee

10:30 a.m. to 10:55 a.m., D-212

Rising energy cost has driven the need for increased control in modern building systems. This increased control was accomplished through the redesign and optimization of an existing water heating packaged piping system for use with a digital mixing valve. The design allowed for the user to have greater control and flexibility in water temperature setpoints. CAD/3D-Modeling software and Computational Fluid Dynamics (CFD) Analysis aided the design process. The final product reduces both manufacturing and consumer costs while providing instant notification of alarms increasing the safety for building occupants.

## **ANALYSIS AND IMPROVEMENT OF A BIOMEDICAL IMPLANT**

by Brian Doorlag and Nathan Urban

Sponsor: Nicholas Horsmon - Biomet Orthopedics

Faculty Advisor: Peter Gustafson

11:00 a.m. to 11:25 a.m., D-212

An existing extendible prosthetic knee implant was studied using finite element analysis (FEA). The results were used to direct two redesign efforts aimed at improvements in structural durability. The first of these efforts involved a re-dimensioning of the components in the existing design. The second involved the development of an original design. Finally, FEA was used to quantify the performance of the new designs relative to each other and to the existing design. The new designs are expected to improve patient quality of life through increased implant durability and the analysis techniques developed will aid in the development of new implants.

## **DESIGN AND CONSTRUCTION OF AN EXPERIMENTAL SUBMARINE PROPULSION SYSTEM**

by Sean Derrick and Jeffrey Rauen

Faculty Advisors: Jorge Rodriguez and Iskender Sahin

2:00 p.m. to 2:25 p.m., D-212

Submarine propulsion systems have not changed much in past years and currently lag behind passive sonar technology. A new dual-impeller jet propulsion system was designed and constructed which has the potential to improve the stealth characteristics of submarines. The objective was reduction of noise and cavitation. Commercial Computer Aided Engineering (CAE) software and an in-house program were utilized to analyze the design. A working prototype was created using rapid prototyping and CNC manufacturing techniques. Tests were run to prove the design concept and compare against current technology. Once the system is fully optimized it could increase survivability of submarines.

## **ASSESSMENT AND TREATMENT OF POOR ACOUSTICS IN A CLASSROOM**

by Krisana Gutierrez and Jay Pliskow

Faculty Advisors: Tycho Fredericks and Koorosh Naghshineh

2:30 p.m. to 2:55 p.m., D-212

The acoustics of a classroom dramatically affects the learning environment. Heating, ventilation, and air conditioning of the space is liable for excessive background noise contributions, which inhibits communication between occupants. An interdisciplinary approach to correct the poor acoustics in a classroom was undertaken to improve its acoustic environment. A cost effective design was implemented which reduced the background noise and modified the reverberation time of the classroom. Background sound pressure measurements were collected and occupants were surveyed before and after implementation of design to verify that a more comfortable learning environment was created.

## **PAPER ENGINEERING, CHEMICAL ENGINEERING, AND IMAGING**

**Session Chair – Peter Parker**

**Room D-208**

### **ERIC MEASUREMENT BY INGEDE 11 AND A NIR SPECTROMETER**

by Joel Robert Wilke

Faculty Advisor: John Cameron

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

Currently the primary way for a paper mill to measure effective residual ink concentration (ERIC) is to use an expensive black box device. This device measures how much ink is in the paper before and after the flotation process. Using the Kubelka-Munk theory, a low cost near infrared spectrometer was used to determine ink content and thus ink elimination for various paper samples. The spectrometer gives a reflectivity value which then is put into a spreadsheet which is able to derive ink elimination. The results were tested against samples with known values measured by the ERIC black box.

### **REDUCING FRESH WATER USAGE IN A PAPER MILL**

by James Bruno, Thomas Tran, and Brian Wilmoth

Sponsor: Erin Zahnow - Graphic Packaging International

Faculty Advisor: Andrew Kline

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

Paper mills use a large amount of water during the paper making process. The effluent water stream from this process cannot be recycled without reprocessing the water to meet operating conditions. Mechanical strainers, chemical treatment, and other new technologies were investigated to determine the most cost effective and environmentally safe option of recycling the process water. The use of recycled water lowers the need for fresh water. Reduction of fresh water lowered both utility costs and the use of well and river water.

### **COMPOUND COATING COST SAVINGS OPPORTUNITY**

by Ramajan Grose, Nimarta Kaur, Robert Missman, and Peter Vigeant

Sponsors: Jorge Cortes and Terry Andren - W.K. Kellogg Institute

Faculty Advisor: Andrew Kline

2:00 p.m. to 2:25 p.m., D-208

Compound coating in the food manufacturing industry is the process of enrobing a material (a coating, e.g. chocolate or yogurt) onto a food product. As transportation costs rise, there is an increasing need to lower shipping distances and/or amounts of material shipped. Instead of purchasing and shipping coating materials from an external source, a method of in-house production of coating was desired. A small-scale on-site facility was proposed to determine whether or not it could meet the production capacity requirements and be economically feasible. An in-house facility will cut down on transportation and storage costs.

## **BAKING OVEN EXHAUST HEAT RECLAMATION**

by Justin Biddle, Ryan Lake, Thomas Larson, and Amy Tomczyk

Sponsors: Marialuci Frangipani Almeida and Nicholson Hirzel - Kellogg Company

Faculty Advisor: Andrew Kline

2:30 p.m. to 2:55 p.m., D-208

Rising energy costs have increased the interest in reclaiming heat from baking oven exhaust. These industrial ovens are gas-heated and bake various food products. Previous studies have identified the oven exhaust as a major source of energy loss. Research on many different heat recovery devices was required. The various options were analyzed by developing a computer model of the oven and reclamation devices. The heat losses needed to be identified so that energy and cost savings could be used to justify the installation of new equipment.

## **METHANOL WASTE DISTILLATION OPTIMIZATION FROM THE MANUFACTURING PROCESS OF BIODIESEL**

by Andrew Muchmore, Nicholas Muller, and Nicholas Peraino

Sponsor: John Oakley - Michigan Biodiesel

Faculty Advisor: Harold Hladky

3:00 p.m. to 3:25 p.m., D-208

In the process of making biodiesel excess methanol is used. This alcohol is vacuum stripped from the co-products of biodiesel and glycerol, purified and recycled through the system. Distillation is essential to the purification of the methanol waste for reuse. The distillation column used for this process was optimized by manipulation of control variables of the column, and by installation of auxiliary equipment necessary for complete distillation. This optimization reduced waste and increased methanol yields for resale.

## **THE AFFECTS OF GRAY COMPONENT REPLACEMENT ON COLOR GAMUT VOLUME**

by Joseph Gauger

Faculty Advisor: Paul Fleming

3:30 p.m. to 3:55 p.m., D-208

The reproduction of RGB color to CMYK requires GCR for ink savings and accurate color reproduction. Color gamut volume is affected by the use of GCR. Through the use of three non-impact processes (Laser, Ink Jet, and Hot Melt), color charts reproduction is assessed through the reproduced color gamut. Color checkers measure the color volumes and then present it on a 3-D plane. With the increased knowledge of the affects of GCR on Color Gamut volume the known reproduction of Color Gamut on a 3-D plane will be more understood as well as more predictable, to produce a more accurate picture reproduction.

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- Industrial and Entrepreneurial Engineering
- Manufacturing Engineering Technology

**Manufacturing Engineering (269) 276-3253** (Muskegon, Battle Creek, Southwest Benton Harbor, and Lansing)

**Mechanical and Aeronautical Engineering (269) 276-3420**

- Aeronautical Engineering
- Mechanical Engineering

**Paper Engineering, Chemical Engineering, and Imaging (269) 276-3500**

- Chemical Engineering
- Paper Engineering
- Paper Science
- Imaging

**College of Engineering and Applied Sciences Advising Office (269) 276-3270**

The **Master of Science in Engineering** is offered in computer, electrical, mechanical, and industrial engineering. The **Master of Science** is offered in computer science, construction engineering, engineering management, manufacturing engineering, operations research, and paper and imaging science and engineering. The **Ph.D.** is offered in computer science, electrical and computer engineering, industrial engineering, mechanical engineering, and paper and imaging science and engineering.

## **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. Daniel M. Litynski
- Associate Dean of Undergraduate Studies: Dr. Edmund Tsang
- Associate Dean of Graduate Studies: Dr. Osama Abudayyeh
- Chair of Civil and Construction Engineering: Dr. Haluk Aktan
- Chair of Computer Science: Dr. Don Nelson
- Chair of Electrical and Computer Engineering: Dr. John Gesink
- Chair of Industrial and Manufacturing Engineering: Dr. Paul Engelmann
- Chair of Manufacturing Engineering: Dr. John Patten
- Chair of Mechanical and Aeronautical Engineering: Dr. Parviz Merati
- Chair of Paper Engineering, Chemical Engineering, and Imaging: Dr. Said AbuBakr

### CEAS Data (Fall 2008)

- Bachelor's Enrollment: 2156
- Master's Enrollment: 319
- Ph.D. Enrollment: 67
- Number of Faculty: 93
- Number of Staff: 28

### CEAS Contact Information

- CEAS Advising Office: (269) 276-3270
- CEAS Dean's Office: (269) 276-3253
- CEAS Student Outreach and Recruitment Coordinator: Scot Conant – (269) 276-3272
- CEAS Cooperative Education and Internships: Fred Sitkins – (269) 276-3261
- CEAS Career Advisor: Heather Highhouse – (269) 276-3263
- CEAS Website: [www.wmich.edu/engineer](http://www.wmich.edu/engineer)