4-2011

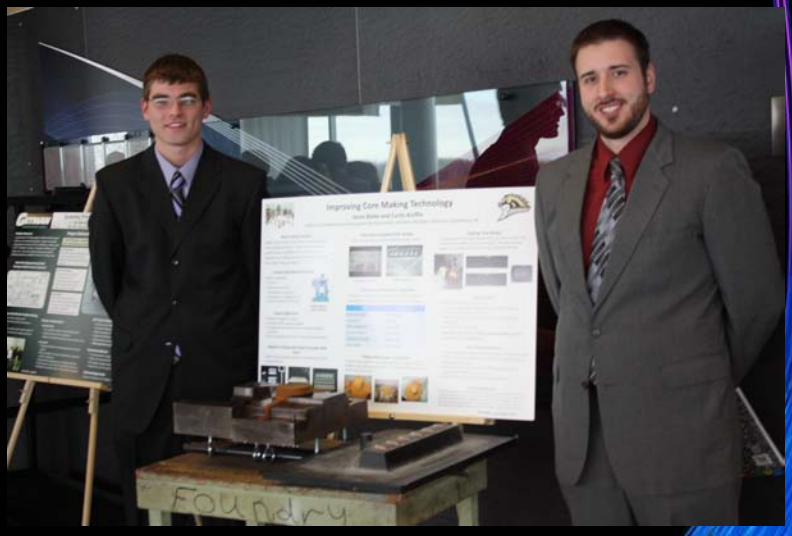
48th Conference on Senior Engineering Design

College of Engineering and Applied Sciences

48th CONFERENCE ON SENIOR ENGINEERING DESIGN

Tuesday, April 19th, 8:00 a.m. to 4:00 p.m.

College of Engineering and Applied Sciences



WESTERN MICHIGAN UNIVERSITY

Conference on Senior Engineering Design Project

You are invited to attend the forty-eighth Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., **Tuesday, April 19th** 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 2:00 a.m.	p.6
Computer Science	D-202	9:00 a.m. to 1:30 p.m.	p.9
Electrical and Computer Engineering	D-204	9:00 a.m. to 1:00 p.m.	p.12
Industrial and Manufacturing Engineering	D-201	8:00 a.m. to 11:30 a.m.	p.15
Industrial and Manufacturing Engineering	D-212	9:00 a.m. to 10:30 a.m.	p.16
Mechanical and Aeronautical Engineering	D-109	9:00 a.m. to 2:00 p.m.	p.18
Mechanical and Aeronautical Engineering	D-210	9:00 a.m. to 2:00 p.m.	p.20
Paper Eng., Chemical Eng., and Imaging	D-208	8:00 a.m. to 4:00 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.

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-208 PCI	**Ceftiofur Free Acid Drying**
	D-201 IME	**Supplier Product Identification System For The Medical Device Industry**
8:30	D-208 PCI	**Crystallization Concentration Optimization**
	D-201 IME	**Implementing and Maintaining Component Lot Identification and Traceability**
9:00	D-115 CCE	**Campus Housing Phase I**
	D-202 CS	**Twitter Sentiment Analysis**
	D-204/205 ECE	**Vehicle Tire Management User Interface**
	D-201 IME	**Optimizing Thermoformed Plastic Containers**
	D-212 IME	**Layout Evaluation**
	D-109 MAE A	**Aerodynamics and Performance Design of Soldier Portable Unmanned Aerial Vehicle**
	D-210 MAE B	**Design of a Life Cycle Test Apparatus**
	D-208 PCI	**Methanol Distillation Optimization**
9:30	D-115 CCE	**M-216 Culvert Replacement**
	D-202 CS	**Laptop Orchestra Direction**
	D-204/5 ECE	**Controlling Steam Washer by Integrating Programmable Logic Controller**
	D-201 IME	**Programming and Fixture Design of a Fanuc Weld Robot**
	D-212 IME	**Eliminating Downtime on Axle Assembly Lines**
	D-109 MAE A	**Structural Design of a Solider Portable UAV**
	D-210 MAE B	**Mobile System for Aerodynamic Testing**
	D-208 PCI	**Economic Evaluation of Cogeneration Operation**
10:00	D-115 CCE	**Southwest Innovation Center Addition Bid Proposal, Schedule, and Analysis**
	D-202 CS	**WMU Android Application for Students**
	D-204/205 ECE	**Wireless Aircraft Security Alert System**
	D-201 IME	**Environmental Growth and Cloning Chamber**
	D-212 IME	**Integrating Two Production Cells**
	D-109 MAE A	**Structural Redesign of Satellite Bus**
	D-210 MAE B	**Torsion Bar Testing Machine**
	D-208 PCI	**Impact of Residual Ash on the Liner Ply for Gypsum Wallboard**

10:30	D-115 CCE	**5th St. Bridge Over Sand Creek**
	D-202 CS	**DVDatabase, A Database Application for Nonprofits**
	D-204/205 ECE	**Current-Voltage Curve Tracer for Photovoltaic cells**
	D-201 IME	**Desktop Additive Manufacturing**
	D-212 IME	**Improving Labor Force Utilization During Changeovers**
	D-109 MAE A	**Solar Ultraviolet Magnetograph Investigation and Redesign**
	D-210 MAE B	**Redesign of Tire Stiffness Testing Machine**
	D-208 PCI	**Puffed Snack Puffing and Seasoning Process Design**
11:00	D-115 CCE	**Rickman House**
	D-202 CS	**WMU iPhone App**
	D-204/205 ECE	**Lithium Ion Battery Tester**
	D-201 IME	**Feasibility of Hydro-Electric Power: A Michigan Case Study**
	D-109 MAE A	**Implementation of Automotive Drag Reduction Components for Optimum Design Configurations**
	D-210 MAE B	**Development of a Fuel Delivery System for a Single Cylinder Gasoline Direct Injection Engine**
	D-208 PCI	**Puffed Snack Pellet Production Line Design**
11:30	D-115 CCE	**Hickory Creek Interceptor**
	D-202 CS	**Merchant Website Design**
	D-204/205 ECE	**Electrophysiology Data Acquisition System**
	D-201 IME	**Additive Mold Design for Functional Prototypes**
	D-109 MAE A	**Formula SAE Aerodynamics Package**
	D-210 MAE B	**Design of a Forced-Air Induction System for a Direct-Injected Engine**
	D-208 PCI	**Waste Water Recovery From a Recycled Board Mill**
1:00	D-115 CCE	**Market Street Drainage Improvement**
	D-202 CS	**Wii-Mote Instrument for Laptop Orchestra**
	D-204/205 ECE	**Vehicle Blind Spot Indicator**
	D-109 MAE A	**Redesign of a Hands Free Crutch**
	D-210 MAE B	**Electric Race Car Redesign**
	D-208 PCI	**Best Sustainable Solution for Meeting Increased Air Filtration Standards**
1:30	D-115 CCE	**QAQC Building Information Systems**
	D-202 CS	**Work Request Web Application**
	D-109 MAE A	**Redesign of a Surgical Retraction System**
	D-210 MAE B	**Hybrid Hydrogen Fuel Cell Power-Train Development**
	D-208 PCI	**AIChE Problem 1**

2:00	D-115 CCE D-109 MAE A D-210 MAE B D-208 PCI	**Traffic Congestion at Rankin Avenue and Business Court** **Magnetic Nanoparticle Based Targeted Drug Delivery System Simulation and Design** **Integrated Heating System for Housing** **AIChE Problem 2**
2:30	D-208 PCI	**Increased Enrollment in the Graphic and Printing Science Program Through Specialty Print Advertisement**
3:00	D-208 PCI	**The Effects Of Suspension Height and Agitation on the Drainage Characteristics of Recycled Fiber**
3:30	D-208 PCI	**A Comparative Study of the Xenon and Thermal Drying of Conductive Silver Inks**
4:00	D-208 PCI	**HDPE Adhesion Optimization**

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

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CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – John Polasek
Room D-115

CAMPUS HOUSING PHASE I

by David Bonga, Oyewole Johnson, Daniel Munson, and Andrew Peruski
Sponsor: Timothy Mitchell, Soils and Materials Engineers; Michael Rutz, WMU Campus Facility Development Planning; John Bakos, American Village Builders; Todd Hurley, Hurley & Stewart
Faculty Advisor: Xioyun Shao
9:00 a.m. to 9:25 a.m., D-115

In response to outdated on-campus student residence facilities, the Western Michigan University Campus Housing project was initiated to provide an attractive living environment for students who have preferred off-campus alternatives. Given specific building dimensions and properties, several alternative site layouts were investigated and the most viable option chosen. On-site soil analysis was utilized in both foundation design and drainage configuration. The topography warranted a significant retaining wall design. Plan sets were created including demolition, grading, construction, utility and detail sheets for reinforced concrete footings and retaining wall. The analysis and design plans emphasize life-span stability, aesthetics, cost effectiveness, and environmental sensitivity.

M-216 CULVERT REPLACEMENT

by Jeff Boyd, Jason McCubbin, and Randy Meert
Sponsor: Therese Kline, Eric Carlson, and Ryan Snook; Michigan Department of Transportation
Faculty Advisor: Dr. Yufeng Hu
9:30 a.m. to 9:55 a.m., D-115

Inspection of a culvert just south of the Hoover and Kelly drains revealed that the culvert had undergone severe deterioration as well as being undersized for the growing storm water demand. Through analyzing soil boring logs and hydrological study data the size of the culvert was determined based on average water flow and the underlying soil. Taking into effect quantities, cost, and culvert performance a final design was selected from three alternative designs. The final design provides a structurally sound culvert with adequate storm water capacity capable of serving the hydrological need of the area for years to come.

SOUTHWEST INNOVATION CENTER ADDITION BID PROPOSAL, SCHEDULE, & ANALYSIS

by Tsolomon Buyantsogt, Matthew Markham, and Ryan West
Sponsor: Mark Mcmullen, Miller Davis Company
Faculty Advisor: Dr. Pingbo Tang
10:00 a.m. to 10:30 a.m., D-115

Bidding and scheduling are very important and common in the field of Construction Engineering. A bid proposal, schedule, and an economic analysis were developed for the Southwest Innovation Center

located on Parkview's campus. The bid proposal allows us to show a cost estimate for materials using RS Means, specifications, blueprint plans, and other pricing resources. Furthermore an economic analysis was done to determine the most cost effective crew and schedule for the project. The completed project shows the overall price and schedule for the Southwest Innovation Center addition.

5TH ST. BRIDGE OVER SAND CREEK
by Ethan Clark, Devin Render, and Stephen Wright
Sponsors: Ms. Joanna Johnson, Mr. Travis Bartholomew; Kalamazoo County Road Commission
Faculty Advisor: Upul Attanayake
10:30 a.m. to 11:00 a.m., D-115

In 2008, the 5th Street Bridge in Alamo Township was closed due to safety reasons associated with its deteriorating condition. Three options were analyzed considering all the constraints and compared in order to determine what is to be done with the bridge. These options included: Rehabilitating the bridge, demolishing the bridge, and building a new bridge. In order to compare these options a hydraulic study was completed along with a detailed soil and structural analysis. The recommended solution was then based off a cost-benefit analysis.

RICKMAN HOUSE
by Perry Lyford-Stojic, Lindsay Mukans, and Garrett Myland
Sponsor: Jerry Vanderveen, M.W. Vanderveen Co.
Faculty Advisor: Xiaoyun Shao
11:00 a.m. to 11:25 a.m., D-115

The Rickman House is a historical building located in the heart of Kalamazoo serving as a home for those with a low income and those living with special needs. Having been built over 100 years ago the building is in need of repair. To prepare for construction a SAP2000 model was made of the building and was used to analyze the structure and the new penthouse proposed to be placed on the roof. Geotechnical reports were used to find the bearing pressure of the groundwork and to check for compatibility of the new elevator. Analysis was done to ensure that the placement of a crane on the construction site will not impact the foundation of the building.

HICKORY CREEK INTERCEPTOR
by Daniel Guastella, Jonathan Hannich, and Alexander Lesher
Sponsor: Alan Smaka, Wightman & Associates, Inc.
Faculty Advisor: Yufeng Hu
11:30 a.m. to 11:55 a.m., D-115

The Hickory Creek interceptor is a large sewage pipe located in Berrian County. The pipe was built in 1972 from primarily corrugated metal. It was suffering from infiltration, inflow and potential pollution to the nearby creek. From video and information gathered, a feasibility study was performed taking future population growth and sewage demand into account. After comparing different rehabilitation methods, the best one in terms of cost and longevity was chosen. The proposed rehabilitation design

will avoid the pollution to the creek and reduce wastewater cost because the pipe is no longer carrying extra water seeped into the sewer.

MARKET STREET DRAINAGE IMPROVEMENT
by Bradley Crofoot, Ling Kit Kong, and Bradley Whitehead
Sponsor: Jeff VanBelle, Kalamazoo County Road Commission
Faculty Advisor: John S. Polasek
1:00 p.m. to 1:25 p.m., D-115

Drainage along Market Street in Comstock Township has degraded to the point where it is under capacity to manage water runoffs. The existing road is in moderate condition but could use some improvements. The project was to analyze the county drainage system to create an effective drainage system with a new road improvement to satisfy future land use. These improvements will allow for future development of the wholesale nursery production complexes in the area which require good storm water management and infrastructure.

QAQC BUILDING INFORMATION SYSTEMS
by Kevin Czarny, Andrew Paglia, and Nick Smith
Sponsor: Anand Sankey, WMU Facilities Management
Faculty Advisor: Pingbo Tang
1:30 p.m. to 1:55 p.m., D-115

3D laser scanning and building information modeling (BIM) are new technologies in the field of construction engineering for automated geometric data collection and facility quality control. In this project, a deviation analysis based approach for QAQC laser-scanned data was used, three-dimensional models of three buildings on Western Michigan University's campus were scanned and compared to the previously created BIMs. The 3D scan revealed the discrepancies of the as-built structures to the BIM for comprehensive and systematical QAQC.

TRAFFIC CONGESTION AT RANKIN AVENUE AND BUSINESS COURT
by Nicholas Mannon, Alex Phelan, and Alexander Wolf
Sponsor: David Dakin II and Susan Kamman, WMU Facilities Management
Faculty Advisor: Rick Rhodes
2:00 p.m. to 2:25p.m., D-115

The flow of traffic at the intersection of Rankin Avenue and Business Court is vital to the population that is commuting by bus or personal transportation. The intersection is congested and fails to meet acceptable standards. Study of this intersection was conducted using HCM and Synchro, traffic analysis software, to determine the level of service and the feasibility of possible alternatives to relieve the congestion. The software helped create models of the possible alternatives and one alternative was chosen to develop into a construction project. The completed project relieves congestion and provides a safe environment for the population.

COMPUTER SCIENCE

Session Chair – John Kapenga
Room – D-202

TWITTER SENTIMENT ANALYSIS

by Thomas L. Lake
Sponsor: William Fitzgerald, Microsoft Corporation
Faculty Advisor: John Kapenga
9:00 a.m. to 9:25 a.m., D-202

Public opinion can be a useful tool for guiding the decisions made by political and business entities. Unfortunately, classical methods for measuring public opinion are time consuming, expensive and error prone. A number of these limitations can be overcome using freely available data sources from online social networking sites such as Twitter. Through the analysis of millions of Twitter updates, algorithms were developed to classify the sentiment of user generated text. This system was then packaged into software which allows users to evaluate current public sentiment in relation to a keyword and made freely available for use via the web.

LAPTOP ORCHESTRA DIRECTION

by Michael McMacken and Matthew Wells
Sponsor: Dr. David Code, WMU School of Music
Faculty Advisors: John Kapenga
9:30 a.m. to 9:55 a.m., D-202

Laptop Orchestras produce computer generated music using the audio programming language Chuck. Some of these Laptop Orchestras are looking for a simpler way for a non-programmer to conduct a performance, including the ability to control tempo and beat emphasis. The system that was developed solves this problem by providing textual communication between orchestra members, as well as allowing the conductor to control which page of score is displayed on each member's screen.

WMU ANDROID APPLICATION FOR STUDENTS

by Ryan Berry, Kyle Falkenstein, and Matthew Rodgers
Sponsor: Dr. Keith Hearit and Scott Puckett
Faculty Advisor: John Kapenga
10:00 a.m. to 10:25 a.m., D-202

Western Michigan University went for years without a way for students to have easy access to essential information. Using Android and the Eclipse IDE along with Java and XML to create an application allows users to quickly and easily retrieve information such as current events, news, maps, campus locations and multimedia. In an increasingly mobile society, a gap is filled by the application for WMU students.

DVDATABASE, A DATABASE APPLICATION FOR NONPROFITS
by Adam Beagle and Jason Hooker
Sponsor: Deborah Nieboer, The Domestic Violence Coalition
Faculty Advisor: John Kapenga
10:30 a.m. to 10:55 a.m., D-202

Businesses of nearly every size and type can utilize a database to organize their information effectively. A database was created that will allow a small business or nonprofit organization to collect client data. The database was created using C# and MySQL to operate on a small Windows network. The framework for the database is free and open source, and can be easily adapted to meet the needs of any company, making it perfect for nonprofit organizations and small businesses.

WMU IPHONE APP
by Christopher Ashbay, Justus Reule and Timothy Wickey
Faculty Advisor: John Kapenga, Keith Hearit, and Scott Puckett
11:00 a.m. to 11:25 a.m., D-202

Western Michigan University does not currently have a smart phone application. The WMU iPhone App was created for WMU students as a mobile source for campus news, weather information, and athletics highlights. It also provides connections to various sources of WMU media, and allows users to access GPS maps of campus buildings. The App is designed to allow for future releases which may include allowing the user to view campus events by department and search campus maps. The WMU iPhone App is accessible on the iPhone, iPod Touch, and iPad, and is available for free through the Apple App Store.

MERCHANT WEBSITE DESIGN
by David Ahlberg, Kyle Mckelvey and Christopher Warner
Faculty Advisor: John Kapenga and Hector Chavez
11:30 a.m. to 11:55 a.m., D-202

A single website wasn't very efficient to host everything for two small businesses, a consulting firm and an art dealer. The artwork, created from crystallized chemicals photographed under a photo microscope, needed its own merchant site for customers to purchase. Therefore, the businesses were placed into separate websites. The websites were made to be easily upgradeable and maintainable by using PHP to connect to a MySQL database. In addition, PayPal was used for the required transactions to ensure a secure environment for both the seller and buyers. The completed websites allow each business to effectively and securely reach their clientele.

WII-MOTE INSTRUMENT FOR LAPTOP ORCHESTRA
by Evan Gipson and Nicholas Hawkes
Sponsor: Dr. David Code; WMU The School of Music
Faculty Advisor: John Kapenga
1:00 p.m. to 1:25 p.m., D-202

Laptop Orchestras would benefit from utilizing a wii-mote to create a more interactive atmosphere during live performances. An interface from the wii-mote to any computer capable of Bluetooth is created using the programming language Python. The Bluetooth messages are parsed and interpreted by Python, and sent over a local connection to the audio programming language currently in use by many Laptop Orchestras, Chuck. The completed project will satisfy the Laptop Orchestra's requirement of a more natural live presentation of music.

WORK REQUEST WEB APPLICATION
by Zak Ford, Matt Kievit and Steven Meyer
Sponsors: Mike Radloff, Jim Campbell and Craig Schneider; Kohler Company
Faculty Advisor: John Kapenga
1:30 p.m. to 1:55p.m., D-202

Rapid application development, along with advancements in web technology, allow for an efficient methodology in the way applications are produced. A redefined and improved web application was developed to allow for the creation of work requests, as well as the ability to assign project coordinators and to manage current work requests. Existing data was transferred and utilized during the development of this application. After the finalized design, Adobe ColdFusion 9 and Adobe ColdFusion Builder, along with CSS and AJAX, were used to implement the design. This application will make for a streamlined process for the daily functions of the company.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room D-204/204

VEHICLE TIRE MANAGEMENT USER INTERFACE

by Andrew Block, Wei Jian Chiu, and Brian Miars
Sponsor: Dana Corporation
Faculty Advisor: Ralph Tanner
9:00 a.m. to 9:25 a.m., D-204/205

Tire pressure management systems allow a driver to actively inflate and deflate tires to match terrain and load conditions in order to improve vehicle mobility. The User Interface Module design uses a color graphical display to view system information, and push buttons for driver input. A 16-bit microprocessor controls the device and a Controller Area Network provides communications with the parent unit. The included power supply is designed for either 12 or 24 volt operation. Overall, this design provides an easy to use driver interface which is flexibly configurable by the parent unit.

CONTROLLING STEAM WASHER BY INTEGRATING PROGRAMMABLE LOGIC CONTROLLER

by Saad Alqahtani, Eric Dangremond, and Mathew Martin
Sponsor: The Kellogg Company
Faculty Advisor: Raghvendra Geiji
9:30 a.m. to 9:55 a.m., D-204/205

The Kellogg Company, a world-leading manufacturer of cereal, uses an industrial size parts washer to periodically clean food production equipment. The machine's control system used mechanical parts that are no longer available for replacement, so a failure in any component would render the entire machine inoperable. A PLC (Programmable Logic Controller) based control system has been designed to replace the outdated mechanical control system. The original dials, switches and indicator lamps have been replaced with a touch-screen user interface. This new control system is equipped with an Ethernet port so that the machine can now be controlled from anywhere in the world.

WIRELESS AIRCRAFT SECURITY ALERT SYSTEM

by Shen Chi, Nylaan Jonathan, and Seymour Joshua
Faculty Advisor: Liang Dong
10:00 a.m. to 10:25 a.m., D-204/205

National security is one of the primary concerns in the eyes of the public and our federal government. The terrorist attacks on September 11th 2001 proved to the world that airplanes do have vulnerabilities, and opened the eyes of the US citizens. To ensure the safety of people in flight, as well as on the ground, a wireless aircraft security alert system has been designed. Each staff member of an airplane in flight will have an electronic key fob equipped with a panic button. If there is an attack, the button will send a distress call wirelessly to the cockpit via several relay modules scattered throughout the airplane.

CURRENT-VOLTAGE CURVE TRACER FOR PHOTOVOLTAIC CELLS
by Andrew Howley, John Veenkant, and Christopher Voorheis
Sponsor: Western Michigan University Solar Car Team
Faculty Advisor: Bradley J. Bazuin
10:30 a.m. to 10:55 a.m., D-204/205

As solar power systems proliferate, the testing and characterization of solar cells and solar panels is required. A solar cell measurement system has been designed and developed for the Sunseeker solar "rayce" car team. The portable test system uses outdoor or ambient light conditions to collect the current-voltage performance curves of a reference solar cell and a solar test device. An embedded microcontroller drives a programmable voltage or current controlled load to collect and upload data under command of a laptop computer. There, the data can be archived, displayed or plotted as needed.

LITHIUM ION BATTERY TESTER
by Hassan Al Nassrullah, Richard Bailey, and Cody Westra
Sponsor: Western Michigan University Sunseeker
Faculty Advisor: Bradley J. Bazuin
11:00 a.m. to 11:25 a.m., D-204/205

Solar, hybrid, and electric cars are powered by advanced batteries and battery technology. An individual battery cell tester for advanced Lithium-Ion and Lithium-Polymer batteries has been designed and implemented. The test system measures battery cell parameters under controlled charging and discharging conditions. An embed microcontroller controls individual tests that collect voltage and current information-over time and computes equivalent series and parallel impedance, capacity, and battery state of charge. The resulting data are then used to validate and match battery cells for use in the WMU Sunseeker solar "rayce" car.

ELECTROPHYSIOLOGY DATA ACQUISITION SYSTEM
by Bryan A. Berger, Stephen D. Goveia, and Leonard L. Morgan
Sponsor: WMU Neurobiology Engineering Laboratory
Faculty Advisor: Damon Miller
11:30 a.m. to 11:55 a.m., D-204/205

A data acquisition system for recording and analyzing the behavior of neural networks cultured on microelectrode arrays (MEA) is required. Signals obtained from the electrodes of a commercial MEA are digitized and recorded in real-time after amplification. Digital representations of neural signals are readily available for use in a time sensitive feedback loop. This minimal-cost system is expandable to accommodate signals from 4 up to 60 MEA electrodes.

VEHICLE BLIND SPOT INDICATOR

by Chen Chien-Wen, Josh Jacunski, and Joseph Runneisum
Faculty Advisor: Liang Dong
1:00 p.m. to 1:25 p.m., D-204/205

A low cost, blind spot indicator system, helps provide safety for drivers of all vehicles. An alternative to expensive ultrasonic systems was created using infrared signals. The concept works by bouncing the infrared signal off any object that is located in a vehicles blind spot. The object within that space will reflect the Infrared signal and the reflected wave can be captured. Using this type of active sensor allows for a cheap system to be implemented on any new or existing car.

INDUSTRIAL AND MANUFACTURING ENGINEERING

Session Chair – Betsy Aller
Room D-201

SUPPLIER PRODUCT IDENTIFICATION SYSTEM FOR THE MEDICAL DEVICE INDUSTRY

by Scott Pavlock, Nick St. Clair and Mark Zeichman
Sponsor: Anupam Dighe, Stryker Medical
Faculty Advisor: Larry Mallak
8:00 a.m. to 8:25 a.m., D-201

Quality medical devices begin with quality manufacturing processes. A local manufacturer of quality medical devices required a more efficient way to identify purchased parts, and monitor their location within their facility. Using process mapping, cause and effect analyses, and data flow diagrams, process improvements were developed. Successful implementation of these improvements will increase quality, decrease costs, and decrease the threat of external recalls.

IMPLEMENTING AND MAINTAINING COMPONENT LOT IDENTIFICATION AND TRACEABILITY

by Jamario Bateast and Tim Shipman
Sponsor: Kristen Garrison, Stryker Medical
Faculty Advisor: David Lyth
8:30 a.m. to 8:55 a.m., D-201

Maintaining component lot identification and traceability in the manufacturing process is important for numerous reasons, including recalls, removing known defective lots from production lines, and federal mandates, such as ISO 9000 certifications and FDA regulations. Baseline performance was initially determined through a series of production plant walkthroughs, audits, and shadowing parts throughout the plant. Flow analysis, value stream mapping, and cost analyses were used to determine the need for a solution and the root of the problem. Individual parts were analyzed to determine which would be considered “high risk” and have the highest likelihood of failure. Recommendations included ways to maintain traceability throughout the production process.

OPTIMIZING THERMOFORMED PLASTIC CONTAINERS

by Aaron Brooks, Jeff Page, and David Pouliot
Faculty Advisors: Mitchel Keil and Jorge Rodriguez
9:00 a.m. to 9:25 a.m., D-201

Plastic processes, such as injection or blow molding, have used product and process modeling for decades. Modeling tools for thermoforming simulation, such as T-SIM, are relatively new, and thus their predictive capability often needs to be tested. T-SIM was used to virtually simulate the thermoforming process of a plastic deli container. A comparison of simulated and physically measured containers determined how effectively T-SIM predicted sidewall thickness. Part models were developed

in CAD software and analyzed with integrated finite element analysis (FEA). Recommendations were provided on how to utilize T-SIM, CAD software, and FEA for product design.

PROGRAMMING AND FIXTURE DESIGN OF A FANUC WELD ROBOT
by Andrew Gronau, Ben Himebaugh, and Adrian Sargent
Sponsor: Tony Fedewa, Borroughs Corporation
Faculty Advisor: Pavel Ikonomov
9:30 a.m. to 9:55 a.m., D-201

In order for a local manufacturer to implement a new welding robot, its programming, fixtures, and usage required definition. Understanding the robot programming language required the use of manuals, outside experts, and trial and error. Using 3D CAD software, a welding fixture was designed and built to accurately and precisely locate parts for welding. Safety concerns were addressed using an established risk assessment to evaluate all possible issues. Simple work instructions were developed to aid in future training of employees. The completed installation, programming, and training of the Fanuc robot will improve the welding process.

ENVIRONMENTAL GROWTH AND CLONING CHAMBER (EGCC)
by Gregorio Amaro and Joseph Simko
Sponsor: G & S Landscaping
Faculty Advisors: Jorge Rodriguez and Betsy Aller
10:00 a.m. to 10:25 a.m., D-201

Current demand for exotic and specialized plants has led to using tissue cultures to clone and reproduce new plants. A growth and cloning chamber was designed, built, and tested to provide a sterile and optimal growth environment. Design constraints included cost, maintenance, size, weight, and efficiency. The dual chambers provide both a sterile environment for plant tissue cloning and an optimal growth setting. The entire chamber will allow mass production of exotic plants at a fraction of typical costs.

DESKTOP ADDITIVE MANUFACTURING
by Ryan Berndt, Ryan Bezemek, and Anthony Butchko
Faculty Advisors: Jorge Rodriquez and Pavel Ikonomov
10:30 a.m. to 10:55 a.m., D-201

Additive Manufacturing has become an important step in the design process, but a limitation is the cost and time involved to produce physical or functional prototypes. An option gaining popularity is “do-it-yourself” desktop 3D printers, such as the MakerBot. Physical parts were created using parametric CAD software. Machine modifications, tooling, and process parameters were improved to increase the performance of the MakerBot. Additionally, a desktop machine with three times the build capacity of the MakerBot was investigated, and an initial design was developed. WMU will be provided with its first user-friendly rapid prototyping machine as well as the initial design for a much larger additive manufacturing machine.

FEASIBILITY OF HYDRO-ELECTRIC POWER: A MICHIGAN CASE STUDY
by Cody Boyne, Daniel Creamer, and Josh Veenstra
Sponsor: Clyde Stanton; Orangeville Baptist Church
Faculty Advisor: Joseph Petro and Betsy Aller
11:00 a.m. to 11:25 a.m., D-201

Hydro-electricity production in the state of Michigan may be a potential solution for rising energy costs and environmental concerns. A case study of a retired hydropower facility in Orangeville, Michigan was used to address the feasibility of small-scale hydro-electric potential. Determining river flow, selecting water turbines, researching legal and environmental concerns, and conducting an economic analysis were key aspects of the investigation. Although some legal barriers are present that hinder small-scale hydropower in Michigan, small-scale hydro-electricity production may be a feasible power source for future needs.

ADDITIVE MOLD DESIGN FOR FUNCTIONAL PROTOTYPES
by Charles Crouch, Joseph DeMenter, Brian Guenther, and Leah VanEeuwen
Sponsor: Jason Reznar and Todd Murray; RayCE Americas Inc.
Faculty Advisor: Jorge Rodriguez
11:30 a.m. to 11:55 a.m., D-201

Prototype injection molding currently can take weeks and thousands of dollars to develop and manufacture. Using Additive Manufacturing to produce injection molds to rapid quote products can drastically reduce those costs and time frame. Functional prototype molds were developed and analyzed with CAD software, then printed on a 3D printer, and tested using a plastic injection molding unit. Calculations for cooling and mold compression were used to develop guidelines for future parts, with measurements taken to validate calculations and dimensions on the molded parts. Upon project completion, the company can rapidly and efficiently produce functional parts for quoting for prospective clients.

INDUSTRIAL AND MANUFACTURING ENGINEERING

Session Chair – Bob White
Room – D-212

LAYOUT EVALUATION

by Mackenzie Meekhof and Lakshmi Madhusudhanan Pillay
Sponsor: Kyle Beyer, Shane Sovia, and Duane Bowman; AC Foundry
Faculty Advisors: Sam Ramrattan and Azim Houshyar
9:00 a.m. to 9:25 a.m., D-212

An expansion into the permanent mold facility at a local aluminum foundry was not planned efficiently to facilitate material flow. The project was to reduce the lead time and increase quality by altering the current layout of machines and material handling. By moving the machines and creating production lines and work cells within the facility, the operating costs of the foundry have been reduced and the throughput of the finished products has been increased.

ELIMINATING DOWNTIME ON AXLE ASSEMBLY LINES

by Fawaz Alghamdi, Grant Flewwelling, and Christopher VanStraten
Sponsor: Saket Thorte, American Axle and Manufacturing
Faculty Advisor: Steven Butt
9:30 a.m. to 9:55 a.m., D-212

The unavailability of pinions and ring gears was causing significant downtime at a large driveline manufacturer. Time studies were conducted from data gathered from each operation of the value stream and was modeled with simulation software in order to find bottleneck stations. Part sequencing was optimized in the heat treat furnace, which played a key role in maximizing material flow. With the increased gear availability and equipment utilization, revenue and the ability to meet customer needs have improved. This also effectively decreased overtime hours and expedited shipping times significantly.

INTEGRATING TWO PRODUCTION CELLS

By Adrien Darby, Danielle Larson-Jaramillo, and Carlee McClintic
Sponsor: Kevin Lapplander, FEMA Corporatioin
Faculty Advisors: Azim Houshyar and Bob White
10:00 a.m. to 10:25 a.m., D-212

Two production work cells were separated by an overnight bake cycle, which caused high work in process and difficulties with scheduling, and did not promote job sharing. A streamlined layout that integrates each work cell was created using simulation through comparison analysis with different layout scenarios. Data collection to complete the simulation included time study data forecasting demand, scrap rates, motion analysis, and processing sequences. The new layout results in one production line that reduces cost by increasing efficiency. Furthermore, the completed layout allows the company to meet customer demand, while providing operators with an improved work environment.

IMPROVING LABOR FORCE UTILIZATION DURING CHANGEOVERS

by Ryan Buurstra, Kimberly Harms, and Lee Washburn
Sponsor: Mark Rhein and Mike Wiersema; Perrigo Company
Faculty Advisors: Azim Houshyar and Bob White
10:30 a.m. to 10:55 a.m., D-212

Simulation, work design, operations research, cost analysis, and other industrial engineering tools were used to improve the labor force utilization during changeovers on a nasal spray line at a local pharmaceutical company. There are five sets of changeovers that occur on this production line between the production of one product and another. By controlling the workforce size and experience, and creating standardized work assignments, changeover costs decreased with improved efficiency, throughput, and changeover times.

MECHANICAL AND AERONAUTICAL ENGINEERING A

Session Chair – Richard Hathaway
Room D-109

AERODYNAMICS AND PERFORMANCE DESIGN OF SOLIDER PORTABLE UNMANNED AERIAL VEHICLE

by Kishaan Ganesh, B.S. Kabbilnath G.B. Saravanan, Benjamin Lightfoot, and Chee Sim
Sponsor: AIAA Western Michigan University
Faculty Advisor: Peter Gustafson
9:00 a.m. to 9:25 a.m., D-109

The aerodynamic and propulsion performance characteristics of a small unmanned aerial vehicle (UAV) were configured to maximize the WMU entry's score in a 2011 inter-collegiate design-build-fly competition. The configuration was chosen using literature surveys, simulation and flight testing. The final design was selected in collaboration with a second team focused on the vehicle's structural design. The completed vehicle is anticipated to be a competitive entry in this year's inter-collegiate competition

STRUCTURAL DESIGN OF A SOLDIER PORTABLE UAV

by Cynthia Kariuki, Kevin Klemp, R.S. Vewen Ramasamy, and Amin Zainal
Sponsor: AIAA Western Michigan University
Faculty Advisor: Peter Gustafson
9:30 a.m. to 9:55 a.m., D-109

Unmanned Aerial Vehicles (UAV) are increasingly used for military applications as an alternative to risking human lives. The primary structure and payload containment system for a soldier portable UAV was designed using 3-D modeling, finite element analysis, and verified through flight testing. The prototype and final aircraft were built in collaboration with the aerodynamics team using resources at WMU's UAV Laboratory. The completed aircraft will compete in an inter-collegiate design, build, and fly competition in Tuscon, AZ.

STRUCTURAL REDESIGN OF SATELLITE BUS

by Anthony Granzotto, Kyle Messenger, and Erin Moore
Faculty Advisor: Peter Gustafson
10:00 a.m. to 10:25 a.m., D-109

Micro and Nano satellites are a means to support scientific payloads in Low-Earth-Orbit in a cost effective manner. With the loss of the Space Shuttle this need will increase. A Satellite Bus Structure was designed utilizing off-the-shelf materials. The initial material layout was developed using a finite element based topology map. Structural member final sizing was accomplished utilizing a coupled evolutionary algorithm and gradient based optimization approach to obtain a minimum mass design. The design met buckling, stress, and deflection requirements. Detailed analyses were performed on the structural joints to ensure adequate performance.

SOLAR ULTRAVIOLET MAGNETOGRAPH INVESTIGATION AND REDESIGN
by Andy Greene and Andrew Jakubielski
Faculty Advisor: Dennis VandenBrink
Industrial Mentor: Mike Tinker
10:30 a.m. to 10:55 a.m., D-109

The direction of the magnetic fields produced by the sun affects communications on Earth and in space. A three-dimensional model of the telescope section of the satellite was generated in Hyperworks, a modeling and optimization package. The model provides a visual representation for optimization of various inertia loads during take-off. Computational modeling software was used to produce load data generated by the model. This model can be used to study the effects of numerous flight loads and stresses on the telescope using Finite Element Analysis. The completed model provides an optimized structure that will aid further inquiry into the sun's behavior.

IMPLEMENTAITON OF AUTOMOTIVE DRAG REDUCTION COMPONENTS FOR OPTIMUM DESIGN CONFIGURATIONS
by Frederick A. Malburg
Faculty Advisor: Tianshu Liu
11:00 a.m. to 11:25 a.m., D-109

Fuel economy is an ever growing problem in today's world, hence the ever growing need for more fuel efficient vehicles. External aerodynamic components were created to be attached to a generic car model called the Ahmed Body. Using a wind tunnel, aerodynamic data was collected to provide optimized design parameters for an adjustable rear spoiler, rotating mechanism, and a ducting system. Along with the experimental testing, a computational model to predict the drag reduction was developed. The information and outcome obtained will be useful for validation of computational fluid dynamics models and in the design of components for full scale vehicles.

FORMULA SAE AERODYNAMICS PACKAGE
by Chris Adams, Darren Brown, and Robert Curtis
Sponsor: WMU Formula Society of Automotive Engineering
Faculty Advisor: Tianshu Liu
11:30 a.m. to 11:55 a.m., D-109

To improve the performance of WMU-Formula SAE racing vehicles, a three piece aerodynamics package was designed to fit future race vehicles and meet competition specifications. Modeled using computer aided design programs and simulated with computational fluid dynamics, a front wing, rear wing, and underbody air diffuser were designed. After scale model testing and optimization in the wind tunnel, a full scale prototype was manufactured. The designed package will increase down-force, and thereby improve the cornering performance of the vehicle.

REDESIGN OF A HANDS FREE CRUTCH
by Robert Clinansmith, Aaron Glimm, and Adam Miller
Sponsor: Thomas Schwab; Surgical Specialties LLC.
Faculty Advisor: Daniel Kujawski
1:00 p.m. to 1:25 p.m., D-109

Lower leg injuries are common and require the use of a stable walking aide. A redesign of the Freedom Leg©, or Hands-Free crutch, was performed to increase stability, reliability and comfort. Models of the redesign were created in SolidWorks and then tested using finite element analysis to determine the mechanical properties of the system. A prototype was created to improve aesthetics as well as test the basic functionality of the crutch. The successful design provides improved stability and comfort while maintaining a light weight and hands-free operation.

REDESIGN OF A SURGICAL RETRACTION SYSTEM
by Julian Aburto and Adam Rickert
Sponsor: Litho's Surgical Innovations
Faculty Advisor: Judah Ari-Gur
1:30 p.m. to 1:55 p.m., D-109

A surgical retractor system is a common tool used in many surgeries to hold back skin, tissue, and other organs. Surgical retraction systems are traditionally large and heavy, with parts that restrict a surgeon's motion during surgery. A retraction system was re-designed, using computer modeling software, and analyzed for stresses and deformations on the retraction system, using finite element analysis. The new retraction system is lighter and allows an improved range of motion for surgeons.

MAGNETIC NANOPARTICLE BASED TARGETED DRUG DELIVERY SYSTEM SIMULATION AND DESIGN
by Ahmed Albaghly, Abdullah Alghulam, and Ibraheem Kaseb
Faculty Advisors: Muralidhar Ghantasala and Pavel Ikonomov
2:00 p.m. to 2:25 p.m., D-109

Nano drug delivery is one of the most recent innovations in nonsurgical drug administration techniques. This project simulated velocity profiles and forces involved in electromagnetic drug delivery and retention at identified locations. The simulations were performed in 2 and 3-dimensional space. A 2-D model of a human blood vessel was created using a parametric solid modeling software package. The model showed the changes in the electromagnetic nano drug delivery system and demonstrated the behavior of drug coated nanoparticles due to various magnetic field shapes and internal forces. The knowledge attained from this study will improve the current methods of delivering and retaining drugs by using magnetic nanoparticles that target disease affected cells using external magnetic fields.

MECHANICAL AND AERONAUTICAL ENGINEERING B

Session Chair – Richard Hathaway
Room D-210

DESIGN OF A LIFE CYCLE TEST APPARATUS

by Ryan Cowherd, Matthew Gilman, and Benjamin La Belle
Sponsor: Parker Hannifin Fluid System Connectors
Faculty Advisor: Koorosh Naghshineh
9:00 a.m. to 9:25 a.m., D-210

A system which allows life cycle tests to be performed on quick-connect fuel fittings conforming to the SAE J2044 standard was designed. This life cycle test is performed to assure that a fitting will meet the functional requirements of a semi truck's fuel system. This includes exposure to pressure, temperature, and vibration cycles typical of severe duty in transportation applications. A cost effective plan to build and implement this test fixture was developed and the equipment necessary to perform the test was selected. A vibration table, variable speed pump, ball and check valves and pressure sensors are some of the components incorporated in the design.

MOBILE SYSTEM FOR AERODYNAMIC TESTING

by Thomas Henderson, Jesse Mahoney, and Barbara Vermeersch
Sponsor: Holbrook Racing
Faculty Advisor: Richard Hathaway
9:30 a.m. to 9:55 a.m., D-210

The Mobile System for Aerodynamic Testing was designed and built as an alternative to conventional wind tunnel testing to reduce aerodynamic testing costs for race car teams. Aerodynamic down force and drag play a large role in the design of any race vehicle. This mechanism has the ability to be mounted in the bed of a pick-up truck and acquire real-time data on the aerodynamic properties of airfoils. The system was designed using 3D modeling software, with finite element analysis, to assure failure would not occur under the anticipated loads. This simple, user friendly system allows a racing team to easily gather the same data a wind tunnel would produce, but at a much lower cost.

REDESIGN OF TIRE STIFFNESS TESTING MACHINE

by Peter Feldpausch and Benjamin Williams
Sponsor: Sweet Manufacturing, Inc.
Faculty Advisor: James Kamman
10:00 a.m. to 10:25 a.m., D-210

An existing tire spring rate testing machine was in need of further development before its deployment in the automotive racing supply marketplace. The structural frame and control system of the hydraulically actuated testing machine were redesigned for greater durability and ease of use. The redesign utilized LabVIEW software for instrumentation and control and finite element analysis software for verifying

structural design revisions. The redesigned testing machine will have increased market acceptance due to its increased durability and ease of use.

TORSION BAR TESTING MACHINE
by David Lawrence, Brian Maher, and Amanda Meiser
Sponsor: New England Motor Racing Supply
Faculty Advisor: Richard Hathaway
10:30 a.m. to 10:55 a.m., D-210

Many types of vehicles utilize torsion bar suspensions including race cars. To facilitate more effective testing of torsion bars, a torsion bar rating machine was designed using 3D solid modeling and finite element analysis software. Some distinct advantages over current testing machines include: a smaller, lighter, and more compact frame; a computer program with real time data analysis, display, and storage capability; and the ability to accommodate both torsion bars and torsion bar systems of varying sizes. The final design provides a safe, reliable and versatile approach to torsion bar and torsion bar system evaluation.

DEVELOPMENT OF A FUEL DELIVERY SYSTEM FOR A SINGLE CYLINDER GASOLINE DIRECT INJECTION ENGINE
by Adam Bolen, Daren DiStefano, and Brad Mathis
Faculty Advisor: Claudia Fajardo
11:00 a.m. to 11:25 a.m., D-210

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

DESIGN OF A FORCED-AIR INDUCTION SYSTEM FOR A DIRECT-INJECTED ENGINE
by Scott Hamilton, Conrad Meekhof, and Elliot Rose
Sponsor: Western Michigan University
Faculty Advisor: Claudia Fajardo
11:30 a.m. to 11:55 a.m., D-210

A forced-air induction system was designed for a direct-injected internal combustion engine. This engine is being designed for use in a student designed formula race vehicle which competes in collegiate formula competitions. The design encompassed the selection of a forced-induction system, re-design of the valve train components, and design of the intake and exhaust systems. Design optimization was completed using numerical analysis and computer simulation methods, which resulted in an engine with increased power-to-weight ratio and improved efficiency.

ELECTRIC RACE CAR REDESIGN
by Steven Blair and Austin McGregor
Sponsor: Comstock High School
Faculty Advisor: Richard Hathaway
1:00 p.m. to 1:25 p.m., D-210

A single person, electric car was redesigned to maximize efficiency. The vehicle is designed to compete in an inter-high school competition. Scoring is based on the vehicles ability to cover the furthest distance in the allotted time. Optimizations were performed on the suspension, steering and aerodynamics. The suspension and frame were analyzed using finite element analysis. The vehicle was modeled and wind tunnel tested to improve the aerodynamics. The steering was redesigned for maximum vehicle controllability. The final design improved the performance and efficiency of the vehicle.

HYBRID HYDROGEN FUEL CELL POWER-TRAIN DEVELOPMENT
by Alexander Buist and Cody Kammeraad
Faculty Advisor: Bade Shrestha
1:30 p.m. to 1:55 p.m., D-210

Hydrogen fuel cells are an alternative energy source that could reduce the reliance of industry on fossil fuels. A complete drive-train, powered by fuel cells, was designed, built and implemented into an existing single passenger concept vehicle. Solid Works was used to design all mounting hardware and power-train components. The designs were then used to produce the parts needed which were subsequently mounted into the vehicle. Testing software and a dynamometer were used to test the performance of the completed power-train.

INTEGRATED HEATING SYSTEM FOR HOUSING
by Blaise DiDonato, Samuel Tomlinson, and Nicholas Whitney
Sponsor: Dan Confer; Conatus Inc.
Faculty Advisor: Ho Sung Lee
2:00 p.m. to 2:25 p.m., D-210

An integrated system for self-sufficient residential heating was designed to meet requirements in Southwest Michigan while lowering utility costs. This system required the design and analysis of a thermal storage tank, heat exchanger, and piping system. The wind turbine and batteries were selected from commercially available sources and sized to meet the energy demand. The final system design successfully meets the requirements and lowers the heating costs appreciably.

PAPER ENGINEERING, CHEMICAL ENGINEERING, AND IMAGING

Session Chair – Peter Parker
Room D-208

CEFTIOFUR FREE ACID DRYING OPTIMIZATION

by Andrew Bachman, Alison Paver, Ashley Stevens, and Michael Voorheis
Sponsors: James Keeler and Nicole Finn; Pfizer Inc.
Faculty Advisor: Andrew Kline
8:00 a.m. to 8:25 a.m., D-208

Ceftiofur Free Acid (CFA) is an antibiotic of the cephalosporin type used in treating food-producing livestock. Due to an increase in market demand there is a need to increase the production capacity of CFA. Ideas for improving understanding of the drying process, and possible optimization of the process, were formulated by analyzing past batch record of the crystallization and drying. Recommendations were made for improving the rate of drying based on these analyses.

CRYSTALLIZATION CONCENTRATION OPTIMIZATION

by Adam Edwards, Rochelle Gillette, Caleb Pease and Nick Streeter
Sponsor: Andrew Branson; Pfizer, Inc.
Faculty Advisor: Andrew Kline
8:30 a.m. to 8:55 a.m., D-208

Industrial crystallization concentration increase is used to improve productivity. A lab analysis has been used to determine if the crystallization concentration increase is efficient enough to remove impurities with a proposed scale up. Another benefit considered is determining the maximum concentration that the distillation would function at by increasing concentrations at set increments. At these increased concentrations, solubility is an issue, so it is a required consideration. Overall, this is an optimization for an operation around crystallization to allow for a 20% scale up of the current manufacturing process.

METHANOL DISTILLATION OPTIMIZATION

by Kristen Bellmer and Scott Sherrod
Sponsor: John Oakley; Michigan BioDiesel, LLC
Faculty Advisor: Harold Hladky
9:00 a.m. to 9:25 a.m., D-208

A previous senior design group has studied the methanol distillation process at Michigan Biodiesel and made recommendations to optimize this process. Since then, most of the changes have been implemented, and the benefits of these changes had yet to be quantified. Once the effect of the previous changes was determined, an Aspen Process Simulation was used to predict the added benefits of altering the feed rate, reflux ratio, bottoms reboiler rate, and feed temperature. From this, conditions to maximize the methanol output and throughput, as well as a minimization of the methanol waste were determined.

ECONOMIC EVALUATION OF COGENERATION OPERATION
by Courtney Heath, Thomas Merckley, Kyle Vincent, and Rindy
Sponsor: Larry Hill and Dave Misner; USG Otsego Paper Mill
Faculty Advisor: Peter Parker
9:30 a.m. to 9:55 a.m., D-208

In an industrial setting, energy use is usually one of the major costs for a company. An economic evaluation was used to determine the viability for the plant's cogeneration operation to produce all of its own electricity. A model was developed to find out the generated electrical cost and the steam load produced from the cogeneration process for the plant's use.

IMPACT OF RESIDUAL ASH ON THE LINER PLY FOR GYPSUM WALLBOARD
by Casey Kick, Adam Stemaly, Tim Swainston and Brad Wishart
Sponsor: Larry Hill and Gary Roys; USG Otsego Paper Mill
Faculty Advisor: Peter Parker
10:00 a.m. to 10:25 a.m., D-208

The residual ash content in a liner ply has a significant impact on the quality of gypsum wallboard paper. High ash content in the board products is synonymous with issues arising from poor sheet strength, dusting, board layer delamination, and poor sheet formation. Effects of the ash component on the liner ply's paper properties were studied. A complete model of the paper machine area was created to trace the sources and endpoints of the ash component. Economic and feasible options were also explored for the best methods towards removing and disposing of excess amounts of residual paperboard ash.

PUFFED SNACK PELLET PRODUCTION LINE DESIGN
by Adeel A. Khan, Leslie M. Klein, and Ashley A. Saberniak
Sponsor: Kellogg Company
Faculty Advisor: Andrew Kline
10:30 a.m. to 10:55 a.m., D-208

Due to the increase in healthy snack popularity, "puffed snacks" continue to sell well because of their nutritional content. Few companies have invested in the production of puffed snacks, but future growth is predicted as the technology and products advance. The scope of the project was to design a puffing and seasoning process for the production of 10 million pounds of puffed snacks per year in different shapes and flavors. Special emphasis was placed on the capital cost as well as the payback period for the new process. Specific compliance with food regulations were also met in the design process.

PUFFED SNACK PUFFING AND SEASONING PROCESS DESIGN
by Hannah E. Davis, David M. McNish, and Christopher D. Rumsey
Sponsor: Kellogg Company
Faculty Advisor: Andrew Kline
11:00 a.m. to 11:25 a.m., D-208

Due to the increase in healthy snack popularity, "puffed snacks" continue to sell well because of their nutritional content. Few companies have invested in the production of puffed snacks, but future growth is predicted as the technology and products advance. The scope of the project was to design a puffing and seasoning process for the production of 10 million pounds of puffed snacks per year in different shapes and flavors. Special emphasis was placed on the capital cost as well as the payback period for the new process. Specific compliance with food regulations were also met in the design process.

WASTE WATER RECOVERY FROM A RECYCLED BOARD MILL
by Anthony Boyle, Joshua Ciesiolka, Carter Cole and Bryan Stull
Sponsor: Graphic Packaging
Faculty Advisor: Andrew Kline
11:30 a.m. to 11:55 a.m., D-208

The mill has a separate effluent stream that contained contaminants derived from pressure sensitive adhesives, glues, and similar materials from the pulping process known as stickies. Due to the presence of stickies, this stream is unsuitable for the paper making process and must be disposed of at a high cost to the company. After analysis of the stream and various processes for the removal of stickies, a complete financial analysis and recommendation of studied removal methods has been made. The recommendation will result in reduced effluent charges and energy savings.

BEST SUSTAINABLE SOLUTION FOR MEETING INCREASED AIR FILTRATION STANDARDS
by Riley Lokar, Sean O'Connell, Natasha Sequeira, and Jennifer Wagg
Sponsor: Ed Winegar; WK Kellogg Institute
Faculty Advisor: Andrew Kline
1:00 p.m. to 1:25 p.m., D-208

Changing requirements in the food manufacturing industry has brought about the need for improved air filtration technology. It is critical for the development of quality products, protection of employees from hazardous material, and prevention of health problems from prolonged exposure to allergens. One major consideration was the reduced consumption of raw material and waste in the filtration process. Based on the information gathered through the data collection process and an economic analysis of the most feasible design, a sustainable technology was recommended. The proposed model proved to be the most sustainable design for meeting increased air quality standards while being economically beneficial.

AMERICAN INSTITUTE OF CHEMICAL ENGINEER STUDENT CONTEST PROBLEM 1
by To Be Announced
Faculty Advisor: Andrew Kline
1:30 p.m. to 1:55 p.m., D-208

The AIChE Student Contest Problem is a chemical engineering design problem developed by a team of chemical engineers and made available to chemical engineering departments as one means of testing chemical engineering design skills. Departments are encouraged to submit their department's best solutions. The problem is made available to students in early March and they have 30 days to solve it. These two presentations present the best work of the seniors doing the contest problem at WMU.

AMERICAN INSTITUTE OF CHEMICAL ENGINEER STUDENT CONTEST PROBLEM 2
by To Be Announced
Faculty Advisor: Andrew Kline
2:00 p.m. to 2:25 p.m., D-208

The AIChE Student Contest Problem is a chemical engineering design problem developed by a team of chemical engineers and made available to chemical engineering departments as one means of testing chemical engineering design skills. Departments are encouraged to submit their department's best solutions. The problem is made available to students in early March and they have 30 days to solve it. These two presentations present the best work of the seniors doing the contest problem at WMU.

INCREASED ENROLLMENT IN THE GRAPHIC AND PRINTING SCIENCE PROGRAM THROUGH SPECIALTY PRINT ADVERTISEMENT
by Christa Ickowski
Sponsor: Mark Cummins, Larry Brink Print Lab
Faculty Advisor: Larry Ahleman
2:30 p.m. to 2:55 p.m., D-208

Enrollment in the Graphic and Printing Science (Imaging) program resides at an all-time low. To increase interest and enrollment in the program, recruiting tactics involving specialty printed and folded mailers were printed and sent to potential students. A control group received the standard form letter in current use while the experimental group received the new printed piece. Based on the results, the Imaging program would benefit in the way of increased enrollment from using the newly designed specialty piece which is more geared toward the target audience.

THE EFFECTS OF SUSPENSION HEIGHT AND AGITATION ON THE DRAINAGE CHARACTERISTICS OF RECYCLED FIBER
by Kyle Neal
Faculty Advisor: Dewei Qi
3:00 p.m. to 3:25 p.m., D-208

With a growing emphasis on sustainability in the world, the corrugated industry has shifted to producing more and more recycled packaging. Laboratory drainage equipment and recycled softwood fiber was

used to simulate the drainage characteristics of a paper machine. Simulations at various consistencies, shear rates, and fiber lengths were performed to create a model that is applicable to a wide number of production machines. The model provides the industry with tools that will allow greater strength indexes and drainage rates to be achieved with the inferior fiber.

A COMPARATIVE STUDY OF THE XENON AND THERMAL DRYING OF CONDUCTIVE SILVER INKS

by Daniel J. Rickli
Sponsor: Xenon Incorporated
Faculty Advisor: Margaret Joyce
3:30 p.m. to 3:55 p.m., D-208

Paper and other low cost substrates are not able to withstand the high temperature requirements required to cure electronic materials on press, an on-press curing technology suitable for paper in these applications is needed. Xenon lamps are capable of supplying a high amount of energy with limited penetration below the surface. These unique characteristics may make this a suitable technology for the on-press cure of electronic materials printed on paper. In this work the resistance of the printed circuits is compared to the voltage that is applied to a Xenon lamp. The effectiveness of the Xenon drying technology in comparison to thermal drying is presented

HDPE ADHESION OPTIMIZATION

By Timothy J. Sedlecky
Sponsor: Peter Riehle and Michael Stang; Loparex LLC
Faculty Advisor: Margaret Joyce
4:00 p.m. to 4:25 p.m., D-208

A good bond is essential in producing a quality polycoated product. Decreasing line speed for HDPE is a band-aid fix and only hinders production capacity. Pretreatment of the substrate and the molten polyethylene are needed to accomplish an acceptable level of adhesive without sacrificing production volume versus a LDPE product. Pretreatments such as corona ozone are vital to solving this issue. The objective of this research is to evaluate various melt temperatures, die heights and points of ozone application in an effort to maximize line speed while maintaining a sufficient bond between HDPE and the substrate. The trials conducted provide data that will aid in future studies of HDPE adhesion to a bleached Kraft paper.

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

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
- 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 2009)

- Bachelor's Enrollment: 2185
- Master's Enrollment: 293
- Ph.D. Enrollment: 78
- Number of Faculty: 94
- 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: Christopher Sell – (269) 276-3263
- CEAS Website: www.wmich.edu/engineer