



4-2001

28th Conference on Senior Engineering Design Projects

Western Michigan University

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Senior Design Project

The 28th Conference on Senior Engineering Design Projects

You are invited to attend the twenty-eighth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 2:30 p.m. **Tuesday, April 10**, at the Bernhard Center on the 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 circular drive in front of the Bernhard Center and then park in the lot in front of Hoekje Hall.

[\(See map](#) - take North Dormitory Road. Hoekje is #65 on the 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 second floor of the Bernhard Center. Sign-in sheets will be mailed to teachers the day after the conference.

Parking is available in the ramp near the Bernhard Center. Please park in metered spaces. There is a charge for parking. Meters accept quarters only.

Presentations begin on the hour and half hour. Please do not enter a room after a presentation has begun.

Session locations, starting times for project descriptions:

Construction Engineering	242	9:00 to 10:30
Electrical and Computer Engineering	212	9:00 to 12:00
Industrial Design	213	9:00 to 2:30
Industrial and Manufacturing Engineering A-1	208	9:00 to 2:30
Industrial and Manufacturing Engineering B-1	209	9:00 to 2:00
Mechanical Engineering and Aeronautical Engineering A-I	210	9:00 to 2:30
Mechanical Engineering and Aeronautical Engineering B-I	211	9:00 to 2:30
Paper Science and Engineering	208	9:00 to 2:30

Refreshments will be available in the lobby from 8:30 a.m. to 10:30 a.m.

A **lunch** break is scheduled from noon to 1 p.m.

For more information about the conference, call [Cathy Smith](#) at (616) 387-4017.

The 28th Conference on Senior Engineering Design Projects

CE = Construction Engineering

ECE = Electrical and Computer Engineering

ID = Industrial Design

IME = Industrial and Manufacturing Engineering

MAE = Mechanical and Aeronautical Engineering

PSE = Paper Science and Engineering

FL = Faculty Lounge

Time	Room	Dept.	Topic
9:00AM	242	CE	Design of a Project Management System for a Companys Headquarters
	212	ECE	Induction Furnace Temperature Control
	213	ID	Computer Game Controller
	208	IME A-I	Design and Fabrication of a Rolling Test Bench for a Series Hybrid Electric Vehicle
	212	IME B-I	Process Improvement and Marketing Development at a Nonprofit Manufacturing and Processing Facility
	210	MAE A-I	Stealth Washer
	211	MAE B-I	Temperature Conditioning System
	FL	PSE	Analysis of Crepe Blade Vibration
9:30AM	242	CE	Comprehensive Logistics Phase I
	212	ECE	Memory Chip Emulator for Surgical Power Tools
	213	ID	Femoral Nerve Disorder Leg Brace
	208	IME A-I	Optimizing the Electrical System for a Series Hybrid Electric Vehicle
	209	IME B-I	Redesign of a Purchasing System to Comply with ISO 9000:2000
	210	MAE A-I	Design Optimization of Amtryke™ (The Therapeutic Tricycle)
	211	MAE B-I	Hydrodynamic Running Shoe Cushioning System
	FL	PSE	Reducing Decomposition Time in Landfills by an Aerobic Process
10:00AM	242	CE	University Commons Site Development Plan
	212	ECE	Flexible Electrical and Software Programmable Transceivers (FEAST) for Wireless Communications
	213	ID	Childrens Desk
	208	IME A-I	Optimizing the Engine for a Series Hybrid Electric Vehicle
	209	IME B-I	Reducing the Effect of Lead-Time Variability on a Manufacturer with the Cooperation of the Supplier
	210	MAE A-I	Flow Test Design for a Positive Displacement Pump
	211	MAE B-I	Design of Runner Separation System

	FL	PSE	Porous Pigments in Flexographic Printing Applications
10:30AM	212	ECE	Swimming Aid for Visually Impaired Swimmers
	213	ID	Penumbra
	208	IME A-I	Geometric Definition of Flexible Elements in CAD Systems
	209	IME B-I	Quantification of Palletizer Downtime
	210	MAE A-I	Reciprocating Saw Development for Surgical Applications
	211	MAE B-I	Reversible, Non-Lubricated Air Motor
	FL	PSE	Secondary Heat Exchanger for a Fish Hatchery
11:00AM	212	ECE	Computer Controlled Resistance Welder
	213	ID	Nautilus Rack
	208	IME A-I	Finding Brake Hose Interference Using Swept Volume
	209	IME B-I	Study of Material Loss and Waste Reduction
	210	MAE A-I	Probe Positioning System for Sound Measurements
	211	MAE B-I	Design of an Apparatus for Leak Testing of Tubing and Fitting Assemblies
	FL	PSE	The Effects of Hot Storage Under Alkaline Conditions on High Yield Pulp
11:30AM	212	ECE	Win Management Device
	213	ID	Insight, Home Entertainment System
	208	IME A-I	Articulating Endoscopic Cutter Receiver Analysis
	209	IME B-I	Robotic Training Curriculum
	210	MAE A-I	Design and Fabrication of a Vibration Demonstrator
	211	MAE B-I	Effective Thrust Cell Redesign
	FL	PSE	Determining Differences in Printing Quality Between the Gravure and Flexographic Processes on Film
1:00PM	213	ID	Office Workstation
	208	IME A-I	Thermal Distortion in Various Sand Binder Systems
	209	IME B-I	Design of an Early Warning System for Changing Demand in a Lean Manufacturing System
	210	MAE A-I	Cycling Machine for NASCAR Steering Gears
	211	MAE B-I	Optimization of a Family Injection Mold
1:30PM	213	ID	"IRISES" Conceptual Office System
	208	IME A-I	Adjustable Lumbar Support for Weightlifting Bench
	209	IME B-I	Mold Design Factor Establishment to Aid Chrome Retention

210	MAE A-I	Slinger Dynamics in Gas Turbine Combustors
211	MAE B-I	New Cooling System or Method for Cooling Test Stands

2:00PM	213	ID	Evolve: Adjustment in Mobility
	208	IME A-I	Remote Identification and Fiber Optic Sensing of Metal Castings
	210	MAE A-I	Redesign of a Coil-Over Suspension Assembly
	211	MAE B-I	Effects of Heat on Urethane Linings

The College of Engineering and Applied Sciences is grateful to these sponsors which have provided or cooperated in Senior Engineering Design Projects being presented in November 2000. If you have a project for our students or if you would like more information, please call [Dace Copeland](#) at (616) 387-4017.

AMBUCS	American Village Builders, Inc.
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CONSTRUCTION ENGINEERING

Session Chair – Osama Abudayyeh
Room 242

DESIGN OF A PROJECT MANAGEMENT SYSTEM FOR A COMPANY'S HEADQUARTERS

by Scott Petiprin, Jeff Rod, and Craig Schroeder

Sponsor: George Travis – Barton Malow

Faculty Advisor: Osama Abudayyeh

9:00 a.m. to 9:25 a.m., Room 242

A design and construction services company required a new headquarters to assist with the expansion of its business. To complete this structure on time and under budget, an entire project management package was needed. The designed package included: a cost estimate, a complete Work Breakdown Structure (WBS) for all major activities, and a schedule using the Critical Path Method (CPM). Within this package a project management system was also developed which included: a data collection process, a safety program, and a quality assurance plan.

COMPREHENSIVE LOGISTICS PHASE I

by Alicia Torres, Bradley Hurley, and Cheryl Walter

Sponsor: Marc J. Arthur – Granger Construction Company

Faculty Advisor: Osama Abudayyeh

9:30 a.m. to 9:55 a.m., Room 242

Our group estimated, designed a schedule, and calculated man-hours for a distribution facility centrally located in Delta Township, Michigan. The project was designed to be constructed in three (3) phases. The first phase consisted of a 3,902 square foot office/locker room area attached to a 90,000 square foot warehouse. The second and third phases of this project each consisted of approximately 90,000 square foot additions to the existing warehouse constructed in Phase I. The focus was on the construction of Phase I, defining a Project Management System as well as a safety program.

UNIVERSITY COMMONS SITE DEVELOPMENT PLAN

by Mike Gnewkowski, Chris Izzi, and John Christopher Merrill

Sponsor: Zak Bosma – American Village Builders, Inc.

Faculty Advisor: Osama Abudayyeh

10:00 a.m. to 10:25 a.m., Room 242

Western Michigan University has recently announced plans to build additional student housing. Unlike residence halls and campus apartments, this new development will benefit traditional students by providing apartment-like housing. This development is located in the Arboretum Planned Use Development. It is financed by the State of Michigan and will be managed by the University. The Project Team has completed a full development plan of University Commons, which includes construction schedules and a detailed cost estimate. The plan also contains a Management System (data collection, data reporting, safety, and quality control).

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room 212

INDUCTION FURNACE TEMPERATURE CONTROL

by Kelly Arends, Fernando Garcia, and William Mitchell
Faculty Advisor: Frank Severance
9:00 a.m. to 9:25 a.m., Room 212

A temperature controller for an induction furnace was designed and built. The furnace previously had minimal (high, medium, and low) controls that were unsatisfactory for the precision control required. To achieve greater accuracy, an automated control system using solid-state power control and a temperature control function in the LabVIEW program was developed. The controller was designed, built, and installed to provide manual, set-point temperature, and temperature profile control modes. The controller permits greater precision and is now an integral part of the foundry research program.

MEMORY CHIP EMULATOR FOR SURGICAL POWER TOOLS

by Michael Dozeman, Cory Graves, and Grant Westphal
Sponsor: Don Malackowski – Stryker Instruments
Faculty Advisor: Janos Grantner
9:30 a.m. to 9:55 a.m., Room 212

The sponsor of this project uses memory chips in surgical power tools to store motor control settings. During development, engineers perform many experiments to determine the optimal settings for a particular motor. The Memory Chip Emulator was designed to make this process more efficient. It was constructed with a microcontroller circuit and embedded software. With a user-friendly computer program, new settings can be quickly and repeatedly downloaded to the emulator.

FLEXIBLE ELECTRICAL AND SOFTWARE PROGRAMMABLE TRANSCEIVERS (FEAST) FOR WIRELESS COMMUNICATIONS

by Cazzie L. Williams, Garrett T. Spalo, and Jonathan P. Barber
Faculty Advisor: Bradley Bazuin
10:00 a.m. to 10:25 a.m., Room 212

Communications systems have experienced rapid advancement due to the demand created for mobile and local wireless communications devices. Evolving technologies directly support the development of flexible, reprogrammable communications transceivers for the commercial communication industry and NASA's satellites and space-based platforms. The FEAST project has developed a flexible electrical and software programmable radio transceiver for wireless communications. It consists of an instrumentation, scientific, and measurement (ISM) band receiver and transmitter, high-speed analog to digital converter (ADC) and digital to analog converter (DAC), hardware digital upconverter and downconverter, and an advanced digital signal processor (DSP). All critical communication signal formatting, modulation and demodulation processing is performed using software in the DSP.

SWIMMING AID FOR VISUALLY IMPAIRED SWIMMERS

by Michael Franks, Dan Seibert, and Bryan Wagner

Faculty Advisor: Raghvendra Gejji
10:30 a.m. to 10:55 a.m., Room 212

Visually impaired competitive swimmers cannot see when the end of their lane is nearing. The swimming aid for visually impaired swimmers transmits radio signals from the end of the pool lane. The signals are received by a unit on the swimmer. The receiving unit compares the received signal strength to a calibrated value and determines if notification to the swimmer is necessary. Notification via an audible beep is delivered by an earphone in the swimmer's ear.

COMPUTER CONTROLLED RESISTANCE WELDER

by Matthew Wykstra, Salman Anwar, and Steven Brodie
Sponsor: Chris Philipp – Stryker Instruments
Faculty Advisor: Ikhlas Abdel-Qader
11:00 a.m. to 11:25 a.m., Room 212

A welder was needed that would be more versatile and able to supply more power than commercially available welders can. The group has designed and built an automatic resistance welder that can supply pulse-width-modulated, triangle, and sine wave current signals of up to 1000 Amps in magnitude. The welder will eventually be part of an automated welding system in which a computer-controlled robot will perform the actual welding of parts. The power signal properties, such as pulse-width and frequency, are also controlled by the computer using LabVIEW.

WIN MANAGEMENT DEVICE

by Daniel Brimmer and Wendy Taylor
Sponsor: Brimmer Construction & Electric
Faculty Advisor: Damon Miller
11:30 a.m. to 11:55 a.m., Room 212

The Win Management Device (WMD) is used in carnival games for the detection of winners in a "balloon pop" type game. These games allow multiple players to compete against one another. The WMD detects the winner of a game. In addition, it increments counters for number of plays and games and provides the potential for an optional winner indicator light. This new device was designed as an automatic and unbiased method to determine the winner of a game. The WMD was retrofitted and tested in a fully functional game.

INDUSTRIAL DESIGN

Session Chair – Alvaro Correa
Room 213

COMPUTER GAME CONTROLLER

by Evan Detskas and Kevin Smeenge
Faculty Advisor: Alvaro Correa
9:00 a.m. to 9:25 a.m., Room 213

"First person" 3D PC games feature a range of motion in all three Axis X, Y, and Z. Unfortunately, the selection of current 3D game controllers is often limited to little more than a joystick or flightstick. Most commonly, games tend to use the old standby, a keyboard and mouse. By observing gamers' habits, 2D and 3D game genres, and ergonomics, it was possible to derive a new type of controller; one that could easily allow the user to manipulate 2D and 3D games with little or no learning curve. While keeping ergonomics and features in mind, this project also highly stressed the importance of surface textures, colors, and finishes.

FEMORAL NERVE DISORDER LEG BRACE

by Thomas E. DeYoung, Jr.

Faculty Advisor: Alvaro Correa

9:30 a.m. to 9:55 a.m., Room 213

The current designs in Femoral Nerve Disorder braces do not allow the user to put on the brace in a quick and simplified manner. The redesign of this brace addressed this problem of securing and supporting the leg with buckles that are user friendly to anyone with a condition in which they may have less motor skills. Other criterion met was ease of locking and unlocking the knee joint to allow the user to manipulate the mechanism in a more discrete way even under clothing. Other factors considered included ease of modification for different size persons, ease of disassembly for cleaning, and better comfort from heat and perspiration.

CHILDREN'S DESK

by Emily LaLonde

Faculty Advisor: Alvaro Correa

10:00 a.m. to 10:25 a.m., Room 213

In the world of technology, people of all shapes, sizes, and ages are using computers. This includes children as young as three years old. Although there is plenty of software for children to use, there is a limited amount of furniture that suits their special needs. This project was developed to accommodate those needs. The desk was developed and built to best fit children from 3 to 9 years of age. This desk evolves with the child to accommodate growing bodies and minds.

PENUMBRA

by Mark Lee and Brian Woods

Sponsor: Michael Johnson and Jon Moroney – Fredricks Design, Inc.

Faculty Advisor: Alvaro Correa

10:30 a.m. to 10:55 a.m., Room 213

In the process of designing the Penumbra, a mobile workstation was created that meets a broad range of functional applications. Current trends in aesthetics, materials, industry standards, and ergonomic factors were considered. The end result is an easily approachable design that resembles no standard workstation. It consists of a curved aluminum frame, a work surface with adjustable height and angle, a

built in adjustable monitor/computer, a system for easy movement, and an adjustable shade to minimize glare and increase a sense of perceived enclosure.

NAUTILUS RACK

by Andrea Stahl

Faculty Advisor: Alvaro Correa

11:00 a.m. to 11:25 a.m., Room 213

Currently, an integral part of retail marketing is merchandise display units. This aspect of design often goes ignored. The design of retail clothing racks has gone virtually unchanged since their start. To redesign the racks, research was done on current designs. Clerks in various clothing stores were interviewed for their opinions of current designs. New technologies in materials were compared to the standard rack materials. By researching current trends, the Nautilus Rack was created. In the case of merchandise display units, when the retailer has a superior display unit, they will often achieve better sales because of it.

INSIGHT, HOME ENTERTAINMENT SYSTEM

by Shaun Kerschen

Faculty Advisor: Alvaro Correa

11:30 a.m. to 11:55 a.m., Room 213

A concept for a home entertainment system that is possible in the next five to ten years was completed. This entertainment system uses current and new technology to create a system that is seamless and complete in one package. All the components (TV, DVD player, CD player, tuner, and speakers) are assembled into one unit where everything is together, no wires, no mess. It is simply clean, elegant, and a piece of art all on its own. It will pave the way for the future of home entertainment.

OFFICE WORKSTATION

by Leonardo Pomodoro

Faculty Advisor: Alvaro Correa

1:00 p.m. to 1:25 p.m., Room 213

In today's working environment, engineers and architects need large work surfaces to compare drawings, blueprints, etc. The office workstation was designed with maximum adjustability in mind and has a larger work surface area than most conventional office desks allowing the user to maintain a more organized work environment.

"IRISES" CONCEPTUAL OFFICE SYSTEM

by Kevin A. Travis

Faculty Advisor: Alvaro Correa

1:30 p.m. to 1:55 p.m., Room 213

Modern office environments are made of impersonal boxes that limit interpersonal interaction or are simply desks that do not allow for privacy. The "Irises" Conceptual Office System addresses issues of: privacy, aesthetics, work interface, incorporation of technology, ergonomics, interpersonal interaction, ease of assembly, and manufacturing. The "Irises" concept seeks to bring beauty into the office through the use of innovative design. The design is based on the iris flower. Privacy is derived through the use of petal shaped privacy screens. The desk incorporates technology that is simple and user friendly.

EVOLVE: ADJUSTMENT IN MOBILITY

by Jason Friedland and Trevor Lehoczky

Sponsor: Mike Johnson and Jon Moroney – Fredricks Design, Inc.

Faculty Advisor: Alvaro Correa

2:00 p.m. to 2:25 p.m., Room 213

Evolve is a creative mobile workstation that meets a broad range of functional applications by integrating adjustability, form, and practical function into a successful design. The design invites the user into a comfortable, aesthetic, and playful work environment. Many of its components adjust to accommodate a wide range of users and their preferences. The Evolve was designed through processes of research, ideation, mock-ups, and a human factors study.

INDUSTRIAL AND MANUFACTURING ENGINEERING A-1

Session Chair – Colleen Phillips

Room 208

DESIGN AND FABRICATION OF A ROLLING TEST BENCH FOR A SERIES HYBRID ELECTRIC VEHICLE

by Kevin Ferguson, Geoff Lindberg, and Joel Sells

Sponsor: D-K Fence Co., Inc.

Faculty Advisor: James VanDePolder

9:00 a.m. to 9:25 a.m., Room 208

Pressure is being put on automobile makers to produce cars that emit low emissions and achieve phenomenal fuel economy. To accomplish these goals, the hybrid electric vehicle (HEV) is the next progression of the automobile. The design and fabrication of a rolling chassis for testing of components was needed to advance future students' understanding of HEV's. The design of the suspension and the ability of components to be mounted were the main goals of the design. With collaboration from an engine and an electrical group, a rolling test bench was constructed to further investigate the positive and negative aspects of an HEV.

OPTIMIZING THE ELECTRICAL SYSTEM FOR A SERIES HYBRID ELECTRIC VEHICLE

by John Dryden, Kirt Schrottenboer, and Michael Carpenter

Faculty Advisor: James VanDePolder

9:30 a.m. to 9:55 a.m., Room 208

This project focused on developing an operation strategy that maximizes the efficiency of the electrical components used in a series hybrid electric vehicle (HEV). The components included in this project are the main generator, the batteries, the electric motors, and a controller to regulate the voltage and current traveling to and from the motors. The motors were also examined for their regenerative braking properties.

OPTIMIZING THE ENGINE FOR A SERIES HYBRID ELECTRIC VEHICLE

by Jay Hibbard, James Riedl, and Michael Lavander

Faculty Advisors: James VanDePolder

10:00 a.m. to 10:25 a.m., Room 208

A hybrid electric vehicle (HEV) is powered by an internal combustion engine and an electric motor. Besides the engine group, there were two other groups: chassis and electrical. The objective of this project was to match the internal combustion engine output to the requirements of the electrical group. Design considerations included maximizing fuel economy and minimizing emissions.

GEOMETRIC DEFINITION OF FLEXIBLE ELEMENTS IN CAD SYSTEMS

by Kendra A. Greiner and Sarah M. Tinsley

Sponsor: Marcus Hemmye – DaimlerChrysler Corporation

Faculty Advisor: Mitchel Keil and Jorge Rodriguez

10:30 a.m. to 10:55 a.m., Room 208

Traditionally, automotive design engineers use prototype models to predict interference between flexible elements (such as cables and hoses) with the suspension, chassis, and other car components. This requires an excessive amount of time and money for the design and redesign of flexible elements. The objective of this project was to create a virtual environment for the geometric definition of flexible elements, which aids in the reduction of design time and eliminates the guesswork involved with prototype models. The virtual environment created follows user-friendly guidelines and is based on computer aided design (CAD) packages. All models created can be transferred and utilized for dynamic simulation.

FINDING BRAKE HOSE INTERFERENCE USING SWEEP VOLUME

by Scott Beauregard, Michael Howell, Sanjay Lal, and Jenny Rick

Sponsor: DaimlerChrysler Corporation

Faculty Advisor: Mitchel Keil and Jorge Rodriguez

11:00 a.m. to 11:25 a.m., Room 208

Swept volume is a region created by a flexible element moving through a range of motion. This study investigated the feasibility of using ADAMS Software to generate swept volumes for flexible elements such as a brake hose. Once generated, the swept volume can be used to check for interference of a brake hose with other parts in an assembly such as automotive suspension components. This volume can also serve as a region to avoid for the placement of new components within the assembly. This technique will eliminate the need for prototype formation.

ARTICULATING ENDOSCOPIC CUTTER RECEIVER ANALYSIS

by Keith R. Machin, Ryan E. Mack, and Timothy J. Hochthanner

Sponsor: Randy Hoyt – Imagyn Medical Technologies

Faculty Advisors: Jorge Rodriguez

11:30 a.m. to 11:55 a.m., Room 208

The study of a cracking problem in the receiver component of an articulating endoscopic cutter was the primary scope of our project. The study consisted of two types of analysis: simulation of the molding process using Mold Flow and structural analysis using Pro/Mechanica for Finite Element Analysis (FEA). The expected outcome of the project was to determine how and why the defect occurred. Research was also conducted to evaluate the metal injection molding (MIM) process currently used in comparison to other manufacturing processes such as die-casting. A set of recommendations was generated and prototypes were built to test some of the proposed solutions.

THERMAL DISTORTION IN VARIOUS SAND BINDER SYSTEMS

by Eric Hunt, Edward Setyabudi, and Corey Smart

Faculty Advisor: Sam Ramrattan

1:00 p.m. to 1:25 p.m., Room 208

Thermal distortion tests were performed using various sands and binders at the elevated temperature of 2300°F. Additionally, a scratch hardness test and transverse strength tests before and after thermal distortion testing were performed. Each specimen produced a different thermal distortion curve according to its thermo-chemical and thermo-mechanical properties. The data provided a comparison among the different thermal distortion curves on each type of binder system. These curves will be useful in the foundry industry for producing near-net-shape casting.

ADJUSTABLE LUMBAR SUPPORT FOR WEIGHTLIFTING BENCH

by Eric Armbruster, David Palazzolo, and Ryan Schilling

Faculty Advisor: Sam Ramrattan

1:30 p.m. to 1:55 p.m., Room 208

Weightlifters do not have adequate lower back support while performing bench-press type exercises, so a weight bench-top that provides proper spinal alignment was developed. Extensive research was conducted pertaining to ergonomics, human anatomy, and the benefits of utilizing proper lumbar support. Preliminary design ideas were conceived and developed. The design was produced using three-dimensional CAD modeling software. Next, the design was imported into a rapid prototyping machine, and a miniature scale model was created. Materials were selected based on physical properties, function, cost, durability, aesthetics, and manufacturability. Appropriate manufacturing processes were selected and a working prototype was built. Finally, the prototype was tested to meet specifications.

REMOTE IDENTIFICATION AND FIBER OPTIC SENSING OF METAL CASTINGS

by Michael L. Haynes, Thomas C. Nitzsche, and James R. Webb

Faculty Advisor: Sam Ramrattan

2:00 p.m. to 2:25 p.m., Room 208

Our team developed a new concept of embedding a fiber optic cable in an aluminum casting. This concept improved the process of casting a Radio Frequency Identification Device (RFID) in aluminum. Controlled baseline testing was performed to determine the minimum amount of refractory material necessary to protect the RFID and fiber optic cable during casting. The RFID and fiber optic cable, coated with refractory, were then cast in aluminum and tested for functionality. This project developed an entirely new application for RFID's and fiber optics.

INDUSTRIAL AND MANUFACTURING ENGINEERING B-1

Session Chair – Fred Sitkins

Room 209

PROCESS IMPROVEMENT AND MARKETING DEVELOPMENT AT A NONPROFIT MANUFACTURING AND PROCESSING FACILITY

by Ashley Akerman, Patrick Jones, Courtney Lopshire, and Tarana Miller

Sponsor: Kurt Voissem – Michigan Heartland Goodwill Industries

Faculty Advisor: Tycho Fredericks

9:00 a.m. to 9:25 a.m., Room 209

Principles of systems and industrial engineering were applied to increase material handling efficiencies, maximize assembly operation efficiencies, and optimize the layout of a nonprofit manufacturing and processing facility. The methods used included analyzing work history data, conducting interviews with workers, examining the present facility layout, and reviewing processing operations. A final aspect of this project focused on marketing assembly capabilities to local manufacturers. The cornerstone of this

"awareness building" campaign concentrated on the development of a website, and subsequently, an Internet presence. The lasting results of this project include increased efficiencies and future growth for our sponsor.

REDESIGN OF A PURCHASING SYSTEM TO COMPLY WITH ISO 9000:2000

by Vince Brenner, William Durand, and André Hardy

Sponsor: Schupan & Sons, Inc.

Faculty Advisor: David Lyth

9:30 a.m. to 9:55 a.m., Room 209

A new supply base management system was developed to manage the quality of suppliers and to integrate the sponsor's three divisions to meet the new ISO 9000:2000 standards. The existing purchasing system and the standards for purchasing materials were examined. The possible requirements and considerations under the newest revision of ISO were examined and requirements for compliance were developed under ISO 9000:2000 standards for the sponsor's upcoming audit.

REDUCING THE EFFECT OF LEAD-TIME VARIABILITY ON A MANUFACTURER WITH THE COOPERATION OF THE SUPPLIER

by Jason Hart, Dennis Johnson, Jr., Jamayca Stokes, and Chris Timmer

Sponsor: Katy Harman – Motan, Inc.

Faculty Advisors: Steven Butt

10:00 a.m. to 10:25 a.m., Room 209

In this project, we investigated the relationship between a manufacturer and its supplier of customized metal bins. Our project focused on the variability in the lead-time of the metal bins, which was causing scheduling and planning difficulties for the manufacturer. To reduce the impact and to some extent the causes of the variability, the project was divided into two main parts. The first part was to develop a forecasting tool that predicts future sales of the manufacturer's product line using historical demand data and various sales predictors. The use of this tool aids in the scheduling and planning of labor and resources for both the supplier and the manufacturer. The second part was to develop a tool to predict the time it will take for the supplier to deliver an order to the manufacturer given the size, type, and quantity of bins ordered and any current pending orders. The resulting tools were developed and implemented using Microsoft Excel and Visual Basic.

QUANTIFICATION OF PALLETIZER DOWNTIME

by Patricia L. Cramer and Marty Ellen Lemon

Sponsor: Bob Wenglinski – The Minute Maid Company

Faculty Advisor: Fred Sitkins

10:30 a.m. to 10:55 a.m., Room 209

A manufacturer experienced downtime at four palletizing stations due to unknown causes. An initial investigation of the entire packaging process was conducted to determine possible explanations for this downtime. After the analysis of past downtime sheets recorded by two upstream operations was conducted, discrepancies in downtime were discovered. New downtime sheets were then developed specifically for the palletizer stations, and the most significant cause of downtime at each palletizer was determined. Recommendations were then made to minimize the downtime at each palletizer.

STUDY OF MATERIAL LOSS AND WASTE REDUCTION

by Ryan Edds, Jason Host, and Mohammed Ul Haq

Sponsor: Pat Durante – The Minute Maid Company

Faculty Advisor: Kailash Bafna and Fred Sitkins

11:00 a.m. to 11:25 a.m., Room 209

A manufacturer of pouched drinks in southwest Michigan currently experiences heavy loss of material in the form of ingredients and packaging throughout the pouch drink area and blending room. These losses prevent the company from meeting the consumer demand of its product. Our team studied the processing techniques, enabling us to focus on the major areas of loss. As a result of the study, recommendations were made that should enable the company to save large sums of money in the cost of the ingredients and the packaging material.

ROBOTIC TRAINING CURRICULUM

by Amanda Fox, Dan Gregory, and Gurdeep Singh

Sponsor: Bill Higgins and Chuck Worthy – Motoman (a YASKAWA Company)

Faculty Advisors: Tarun Gupta and Fred Sitkins

11:30 a.m. to 11:55 a.m., Room 209

The Robotic Training Curriculum was designed for the trade school and community college level. This curriculum is structured for a student with little or no robotics background. It includes a basic instruction manual for the use and implementation of the robot that is being used in conjunction with the curriculum. In addition to the instruction manual, there are structured lab activities to assist in the overall learning of the students. The lab activities include robot programming, integration with other devices, and troubleshooting. Economic justification and overall impact on manufacturing cost structure is also included.

DESIGN OF AN EARLY WARNING SYSTEM FOR CHANGING DEMAND IN A LEAN MANUFACTURING SYSTEM

by Phil Bowman, Ed Fellows, and Adam Longstreth

Faculty Advisor: Tarun Gupta

1:00 p.m. to 1:25 p.m., Room 209

Manufacturing companies that have implemented lean manufacturing into their production areas are experiencing problems with adjusting production levels to meet their customers varying demand. A local manufacturer of automotive exhaust systems has recently introduced lean manufacturing into one of its production lines and is experiencing similar problems. An early warning system was developed based on historical demand to forecast the production levels needed for future periods of this Tier-1 automotive supplier. This warning system can be used in production scheduling and in redesigning other production systems within the company.

MOLD DESIGN FACTOR ESTABLISHMENT TO AID CHROME RETENTION

by Damian Garland, Matt Machala, Kenny Smith-Wedel, and Michael Westra

Sponsor: Dr. Harold Michels – Copper Development Association, Inc.

Faculty Advisor: Paul Engelmann

1:30 p.m. to 1:55 p.m., Room 209

Research has shown that life of an injection molding tool can be extended by proper application of chrome plating. Additional data was gathered in the study of runner system and ejector wear. From ongoing wear research, it was concluded that proper substrate design should enhance plating longevity. Previous research and industrial experience were used to develop a list of substrate design factors to test plating longevity. Because wear rates were shown to be affected by glass fiber length, the effects of two thermoplastic screw designs on fiber length were investigated. An experiment was designed to test the impact of various factors on plating retention.

MECHANICAL AND AERONAUTICAL ENGINEERING A-I

Session Chairs – Koorosh Naghshineh and Richard Hathaway

Room 210

STEALTH WASHER

by Olivia C. De Longchamp and Justin N. Valencia

Sponsor: Dan Selvidge – Whirlpool Corporation

Faculty Advisor: Koorosh Naghshineh

9:00 a.m. to 9:25 a.m., Room 210

To gain a better understanding of the loads that a washing machine is subject to during the packaging, shipping and handling processes, a Stealth Washer was designed and fabricated. This system is comprised of a washer cabinet that houses a support structure and a data recorder. This support

structure allows the Stealth Washer to have the same dynamic characteristics of a commercial model while providing accurate information, as well as providing a quantifiable testing approach. This system was designed using AutoCAD and was analyzed for integrity, weight, and center of gravity using the ADAMS software program.

DESIGN OPTIMIZATION OF AMTRYKE™ (THE THERAPEUTIC TRICYCLE)

by Moutasim E. Syed, James F. Darmofal II, and Eric Arce

Sponsor: Barbara Rider – AMBUCS

Faculty Advisor: James Kamman

9:30 a.m. to 9:55 a.m., Room 210

The AmTryke™ is a therapeutic tricycle designed to be a form of exercise for patients inflicted with a debilitating condition of the spine, called spina bifida. This condition occurs in 1 out of every 1,000 live births and leaves the patient with a reduction in mobility. This reduction leads to an increased risk of obesity and cardiovascular disease. As a design team, we examined the existing tricycle and made improvements on the mechanical efficiency and stability. Furthermore, we determined under what conditions the cycle will tip and how to reduce the weight of the cycle while maintaining its structural integrity.

FLOW TEST DESIGN FOR A POSITIVE DISPLACEMENT PUMP

by Benjamin Moskalik and Jason Toman

Sponsor: Luis Diaz - Stryker Instrument

Faculty Advisor: James Kamman

10:00 a.m. to 10:25 a.m., Room 210

A disposable pump that provides localized pain relief required testing during production to assure flow accuracy. The pump uses positive displacement technology that sends liquid anesthetic into the body in small pulses. A fixture and test procedure were designed to measure the volume of each pulse. Due to liquid sterility issues, air was used as the fluid for the test, requiring additional air/water volume correlation testing. After the most simple and accurate test concept was chosen, the test fixture was built and validated, and procedures were drafted for its proper use in the future by manufacturing associates.

RECIPROCATING SAW DEVELOPMENT FOR SURGICAL APPLICATIONS

by Elizabeth Chitren, Derek Graham, and Wesley Hetu

Sponsor: David Nic – Stryker Instruments, Powertool Division

Faculty Advisor: Koorosh Naghshineh

10:30 a.m. to 10:55 a.m., Room 210

Medical device innovation enhances patients' lives by simplifying surgical procedures and reducing recovery time. A potential surgical need for a powerful, lightweight reciprocating sternum saw for use in cardiovascular procedures has been identified. The focus of this project involved designing a product that fulfills this need. Primary consideration was given to the design of an efficient drive train to transmit rotary motor output into reciprocating blade motion. The development process consisted of idea conception, prototype fabrication, functional testing, design optimization, and detailed drawing creation.

PROBE POSITIONING SYSTEM FOR SOUND MEASUREMENTS

by Kyle Overheul and Randy Robison

Faculty Advisor: Koorosh Naghshineh

11:00 a.m. to 11:25 a.m., Room 210

A low-cost, automated probe positioning system was needed to perform accurate, repeatable sound level measurements in a research setting. The system was required to be durable, quiet in operation, easy to use, and able to measure the sound emitted from various size objects within a one-meter cube. It was constructed using commercially available, prefabricated, extruded aluminum components. Motors were selected and components were designed to be as quiet as possible. Finally, a user-friendly computer interface was developed to aid the end-user in the operation of the system.

DESIGN AND FABRICATION OF A VIBRATION DEMONSTRATOR

by Jason R. Bond

Faculty Advisor: Koorosh Naghshineh

11:30 a.m. to 11:55 a.m., Room 210

Many times in the classroom, a concept can be difficult to understand without a visual example. This is especially true when considering vibration systems with more than one degree of freedom. Consequently, a vibration demonstration system was designed and fabricated that can handle linear motion with up to three degrees of freedom. Such a system appears frequently in dynamics and vibrations textbooks and provides a clear example of classic theory. The experimental demonstration of this system in the classroom or laboratory environment will add to the understanding of these basic concepts.

CYCLING MACHINE FOR NASCAR STEERING GEARS

by Jody Cagle and Bryan Pitsch

Sponsor: Tom Hillsburg and Mike Weddington – Sweet Manufacturing, Inc.

Faculty Advisor: Richard Hathaway

1:00 p.m. to 1:25 p.m., Room 210

A gear cycling machine for 600 and 700 series Delphi steering gears used in a NASCAR racing application was designed. After a typical long duration race, a new steering gear would show a significant change in

the initial preload settings that allowed for the precise control of the racecar. Little change occurred when the gears were used in subsequent races. A machine was built that simulated a typical long duration race and eliminated the necessity for the realignment of the preload settings.

SLINGER DYNAMICS IN GAS TURBINE COMBUSTORS

by Nathan Cooper, Bubby Johanson, and Samuel Sterlin

Sponsor: Don Gries, Guido Defever, and Jamey Condevaux – Williams International

Faculty Advisor: William Liou

1:30 p.m. to 1:55 p.m., Room 210

Certain aspects of slinger dynamics presented a challenge to the development of larger aero-engines. The slinger, or specialized fuel injector, is a practical device because of its compactness and ability to work without externally pressurized fuel. An experiment was performed using full-scale slingers in realistic test conditions. In this simulation, data was gathered using high-speed videography and laser imaging techniques. From the analysis, an empirical relationship between design parameters and slinger performance was derived.

REDESIGN OF A COIL-OVER SUSPENSION ASSEMBLY

by Matt Latchaw, Yun Liang Ooi, and Giles Smith

Sponsor: Tom Hillsburg – Sweet Manufacturing, Inc.

Faculty Advisor: Richard Hathaway

2:00 p.m. to 2:25 p.m., Room 210

The Quick Adjust Coil Over Spring Mechanism provides the used with an alternative to the standard means of adjusting the height of an automobile. This product was designed with an emphasis on speed, usability, lightweight, and safety. The mechanism was created by using Finite Element Analysis modeling software and Pro-E. The target customers for this product are racing teams in a variety of different performance categories. The time saved during races by using the quick adjust mechanism will translate into better race results, making for a more effective racing team.

Mechanical Engineering and Aeronautical Engineering B-1 – not archived

PAPER SCIENCE AND ENGINEERING

Session Chair – Peter Parker

Faculty Lounge

ANALYSIS OF CREPE BLADE VIBRATION

by Mark J. Peterson

Faculty Advisor: Peter Parker

9:00 a.m. to 9:25 a.m., Faculty Lounge

This project completed the first step in the analysis of crepe blade vibration. An accelerometer was used to correlate the vibration of the doctor blade on a paper machine dryer roll. It was found that there is a distinct correlation between the vibration and the rotational frequency of the roll. This verification of the equipment is the first step towards the application of this technique to the analysis of crepe blade vibrations.

REDUCING DECOMPOSITION TIME IN LANDFILLS BY AN AEROBIC PROCESS

by Cameron J. Clark

Faculty Advisor: David Peterson

9:30 a.m. to 9:55 a.m., Faculty Lounge

The objective is to reduce the decomposition time in paper industry landfills by an aerobic process. The experiment was performed by choosing a sludge produced by a virgin pulp mill and placing it in three separate composting systems, two of which are run under anaerobic conditions and one that is run under aerobic conditions. The rate of composting for each system was determined by the amount of gas they produced. The aerobic composting system was found to compost the sludge more efficiently. Reducing the amount of time the sludge is in the landfills helps to decrease paper mill disposal costs and makes landfills more profitable.

POROUS PIGMENTS IN FLEXOGRAPHIC PRINTING APPLICATIONS

by Stephen Rudy

Faculty Advisor: Margaret Joyce and Charles Klass

10:00 a.m. to 10:25 a.m., Faculty Lounge

The use of water-based inks for the flexographic printing of a wide array of applications and substrates has led to the need for a more compatible coated surface. In this research project, the focus was on improving the coated surface of an unbleached kraft carrier grade paperboard with the goal of improving its flexographic printability with water-based inks. This was attempted by the addition of absorbent pigments into a standardized coating to increase the water holding and liquid absorption rate of the coating.

SECONDARY HEAT EXCHANGER FOR A FISH HATCHERY

by Sara Thelen

Sponsor: Martha Wolgamood – Wolf Lake State Hatchery

Faculty Advisor: Raja Aravamuthan

10:30 a.m. to 10:55 a.m., Faculty Lounge

As part of a hatchery's expansion project, the decision was made to install a heat exchanger to recover some of the energy being discharged in the effluent flow. The problem and possible designs were

studied both on-site and through literature. A heat recovery unit was designed to transfer heat from the effluent to the water feeding the boiler. This design will save the hatchery some of its current power expenses.

THE EFFECTS OF HOT STORAGE UNDER ALKALINE CONDITIONS ON HIGH YIELD PULP

by Jeffrey D. Hampton

Sponsor: Dan Finkler – Menasha Corporation

Faculty Advisor: Raja Aravamuthan

11:00 a.m. to 11:25 a.m., Faculty Lounge

The effect of storage time on unwashed high yield pulp was evaluated. Internal conditions of a blow tank such as temperature, alkalinity and consistency were simulated in the laboratory, under which blow line pulp was stored for increasing time intervals. Pulp samples were then washed and screened. Brightness pads and Pulmac test sheets were formed from the pulp samples at various refining levels and evaluated for brightness, pulp quality index and refinability. With storage time, the brightness and pulp quality index decreases while the refinability increases.

DETERMINING DIFFERENCES IN PRINTING QUALITY BETWEEN THE GRAVURE AND FLEXOGRAPHIC PROCESSES ON FILM

by Peter Welther

Faculty Advisor: Dan Fleming

11:30 a.m. to 11:55 a.m., Faculty Lounge

There have always been quality differences between printing processes. Each printing process has continually tried to improve quality to close the gap between them. This project compared the gravure and flexographic printing processes on film to determine how they differed from each other. Using a gravure printing press and a flexographic printing press, samples are made for print and image analysis testing. To make the determination of quality differences, many print tests were conducted including: gloss, brightness, opacity, ink densities, ink properties, rub resistance, ice-water-crinkle, mottle, strength, and image analysis.