4-2005

36th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

36th Conference on

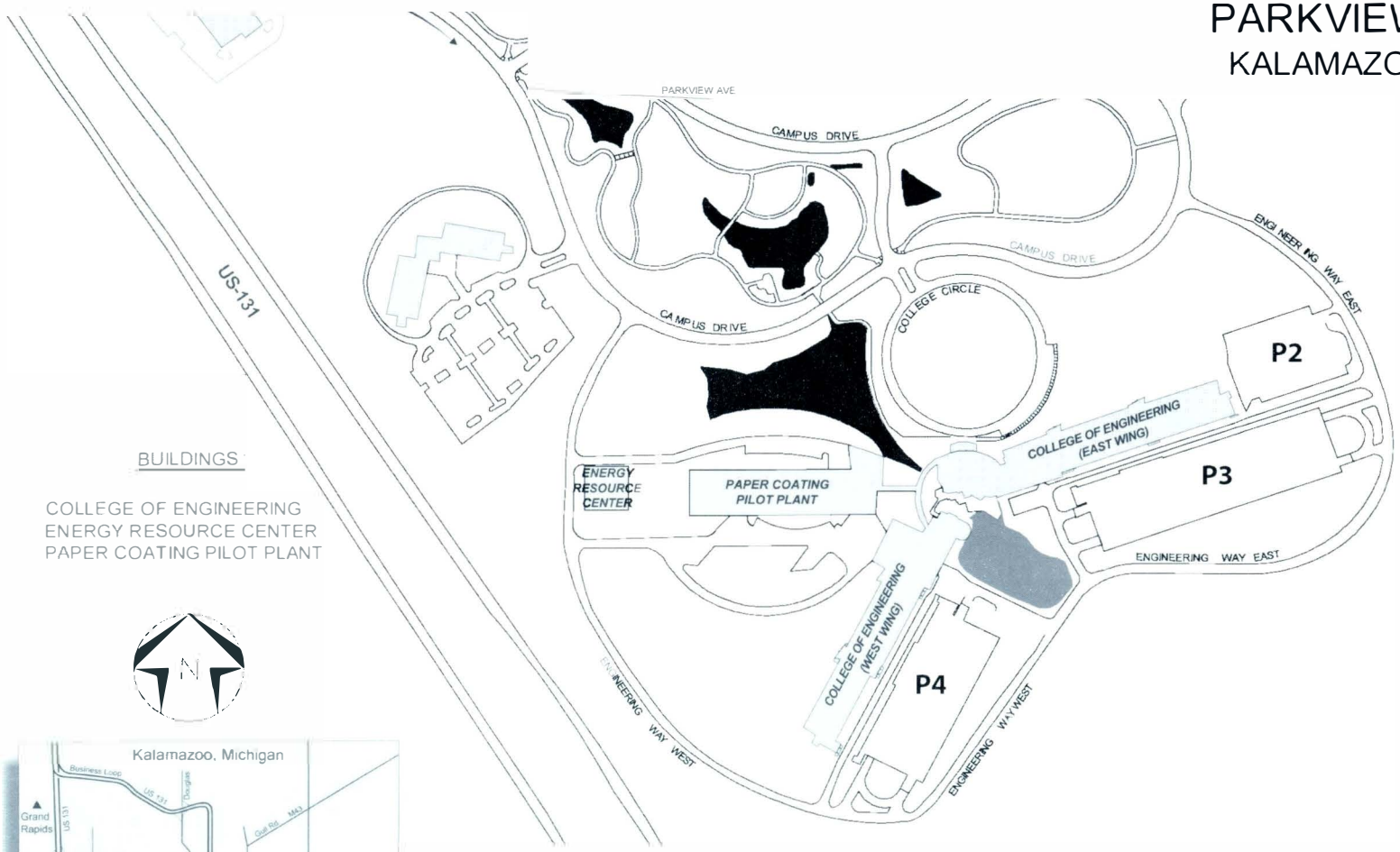
Senior Engineering Design Projects

Tuesday, April 12, 2005
College of Engineering and Applied Sciences
Parkview Campus
9:00 a.m. to 4:00 p.m.

WESTERN MICHIGAN UNIVERSITY
College of Engineering and Applied Sciences

WESTERN MICHIGAN UNIVERSITY

PARKVIEW CAMPUS
KALAMAZOO, MICHIGAN



BUILDINGS

COLLEGE OF ENGINEERING
ENERGY RESOURCE CENTER
PAPER COATING PILOT PLANT

0 100 300 500

SCALE IN FEET

--Directions--

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

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

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

Conference on Senior Engineering Design Projects

You are invited to attend the thirty-sixth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 4 p.m., **Tuesday, April 12**, at the College of Engineering and Applied Sciences on the Parkview Campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry. The conference is **free** and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the College Circle in front of the building and then park in lot P-2. (See map)

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

Parking is available in the ramps behind the College of Engineering and Applied Sciences (See Map: Lots P3 and P4). There is no charge for parking for those attending the Conference.

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

Session locations, times, and page number for project descriptions:

Civil and Construction Engineering	D-201	9 a.m. to 11:30 a.m.	p. 5
Computer Science	D-210	11:30 a.m. to 4:00 p.m.	p. 7
Electrical and Computer Engineering	D-115	9 a.m. to 3:00 p.m.	p. 10
Industrial Design	D-109	9 a.m. to 12:00 p.m.	p. 14
Industrial and Manufacturing Engineering A	D-202	10:00 a.m. to 12:30 p.m.	p. 16
Industrial and Manufacturing Engineering B	D-208	9:30 a.m. to 12:30 p.m.	p.18
Mechanical and Aeronautical Engineering A	D-204	9 a.m. to 2:30 p.m.	p. 21
Mechanical and Aeronautical Engineering B	D-206	9 a.m. to 12:00 p.m.	p. 24
Mechanical and Aeronautical Engineering C	D-212	9 a.m. to 3:00 p.m.	p.26
Paper Engineering, Chemical Engineering, and Imaging	D-201	1:00 p.m. to 3:30 p.m.	p. 30

A **lunch** break is scheduled from noon to 1 p.m. There is a café available on site.

For more information about the conference, call Cathy Smith at (269) 276-3244

CCE = Civil and Construction Engineering
CS = Computer Science
ECE = Electrical and Computer Engineering
ID = Industrial Design
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
PCI = Paper Engineering, Chemical Engineering, and Imaging

Time	Room	Dept.	Topic
9:00	D-201	CCE	Development of a Construction Schedule and Estimate System
	D-115	ECE	Maximum Power Point Tracker
	D-109	ID	DNA Model
	D-204	MAE-A	Modeling and Optimal Thermal Design of a Stirling Engine
	D-206	MAE B	Design of a Light Sport Aircraft Landing Gear System
	D-212	MAE C	Overloaded Axle Assembly Analysis
9:30	D-201	CCE	Evaluation of Campus Bus Services with Analyses of Travel Behavior
	D-115	ECE	Race Car Data Acquisition System
	D-109	ID	Powered Pickup Loader
	D-208	IME B	Hybrid Hydraulic Bicycle Design
	D-204	MAE A	Redesign of a Small Engine for a Supermileage Vehicle
	D-206	MAE B	Air Ambulance Design
	D-212	MAE C	Optimization of a Race Car Transmission
10:00	D-201	CCE	Air Traffic Control Tower
	D-115	ECE	Power Factor Correction of a Manufacturing Facility
	D-109	ID	VWAU (Vehicle Wash Assist Unit)
	D-201	IME A	Integration of an Air Intake Manifold and Air Intake System
	D-208	IME B	Design of an Affordable Lightweight Wheelchair
	D-204	MAE A	Chemical Injection System Redesign
	D-206	MAE B	Determination of the Aerodynamic Characteristics for a Paradrogue Component of the Aerial Refueling System
	D-212	MAE C	Cable Driven Power Transmission
10:30	D-201	CCE	Careerline Tech Center
	D-115	ECE	Integration of Heterogeneous Wireless Communications Systems
	D-109	ID	The Breeze
	D-201	IME A	Distortion, Degradation Losses, and Collapsibility of Various Sand Binder Systems at Iron Fill Temperatures
	D-208	IME B	Non-profit Transit Cart Redevelopment
	D-204	MAE A	Improved Cooling of an Industrial Electric Motor
	D-206	MAE B	Unmanned Aerial Vehicle Flight Test and Data Analysis
	D-212	MAE C	Human-Driven Hydraulic Bicycle

11:00	D-201 CCE	High School Area B Addition
	D-115 ECE	A Low Cost Automobile Diagnostic Tool
	D-109 ID	LiveFree
	D-201 IME A	Re-engineering a Process to Verify a Vital Link in an EGR Valve Assembly
	D-208 IME B	Implementation of Radio Frequency Identification (RFID) In to a Production Process
	D-204 MAE A	Elimination of Plating Loss During a Valve Forming Operation
	D-206 MAE B	Design and Optimization of the Ground Support Equipment (GSE) Alignment Stand for all Models of the Lear Jet
	D-212 MAE C	Body and Frame Design of Supermileage Vehicle
11:30	D-210 CS	EvaluWeb Coordinated Login and Website Administration
	D-115 ECE	Speaker Test System
	D-109 ID	"The Spring"
	D-201 IME A	Cost and Capability Analysis of Visual Inspection Methods
	D-208 IME B	Redesign of a Low-cost Automotive Truck Rear Window Slider
	D-204 MAE A	Swage Joint Redesign
	D-206 MAE B	Design, Manufacture, and Testing of WREN 54 Miniturbojet Exhaust Nozzle
	D-212 MAE C	Redesign of a Flux Feed System for a Manufacturing Process
12:00	D-201 IME A	Throughput Increase of a Multi-Product Packaging Line
	D-208 IME B	Commissioning of a Sheet Extrusion Line
1:00	D-210 CS	Task Assessment System Online (TASO)
	D-115 ECE	Demonstrations of Electrical Engineering Principles for High School Students
	D-204 MAE A	Solenoid Valve Redesign
	D-212 MAE C	Axial Thrust Clearance Measurement System
	D-201 PCI	Wet End Spray Application for Fluorocarbon Oil/Grease Resistance (OGR)
1:30	D-210 CS	Calendar-Zoo, an Online Calendar Database
	D-115 ECE	Celestial Finder Using Sensors and Micro-controllers
	D-204 MAE A	Lab Sterilizer Vacuum Pump Valve Design
	D-212 MAE C	Outside Temperature Sending Unit Redesign
	D-201 PCI	Macronutrient Requirements for the Biological Treatment of Nutrient Deficient Wastewater

2:00	D-210 CS	Faculty Publication and Research Database
	D-115 ECE	A Handheld Radio Frequency Spectrum Analyzer
	D-204 MAE A	Redesign of a Dust Collection Drive System
	D-212 MAE C	Geometric Data Acquisition System
	D-201 PCI	Recycled Fiber Recovery
2:30	D-210 CS	Study Abroad Course Equivalency Database
	D-201 ECE	Inertial Navigation System (INS)
	D-212 MAE C	Error Detection Device to Prevent Production of Undersized Pinion Gear Bores
	D-201 PCI	Capacity and Fluid Transfer Study of a Waste Header Stream
3:00	D-210 CS	Website Date and Time Audit System
	D-201 PCI	Evaluation of Chilled Water Distribution
3:30	D-210 CS	Cemetery Database System

CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – Osama Abudayyeh
Room D-201

DEVELOPMENT OF A CONSTRUCTION SCHEDULE AND ESTIMATE SYSTEM

by Patrick Ostroth, Jeff Pitcher, and Jason Schwannecke
Sponsor: Zack Bosma - American Village Builders, Inc.
Faculty Advisor: Osama Abudayyeh
9:00 a.m. to 9:25 a.m., Room D-201

A detailed cost estimate and construction schedule were developed for a multiple tenant office building in Portage, Michigan. The entire scope of the project was carefully studied and a relative project delivery system was developed. A work breakdown structure was created and used to perform a quantity take-off and a detailed schedule. Safety was a top priority for this project; therefore, a thorough safety plan was organized and implemented.

EVALUATION OF CAMPUS BUS SERVICES WITH ANALYSES OF TRAVEL BEHAVIOR

by Jamie Byce
Faculty Advisor: Jun-Seok Oh
9:30 a.m. to 9:55 a.m., Room D-201

A transportation model was developed to analyze transportation modes along a campus bus route. A survey was developed to collect data from students and faculty on their transportation preferences. A multinomial logit model and Synchro software were used to analyze traffic behavior and evaluate transportation systems. By investigating the transportation mode choice behavior for the route between campuses, this transportation study has provided solutions to improving the existing bus services.

AIR TRAFFIC CONTROL TOWER

by Amber Dibert-DeYoung, Brooks McIntosh, and Jeff Taggart
Sponsor: Stan Keagle – Skanska
Faculty Advisor: Osama Abudayyeh
10:00 a.m. to 10:25 a.m., Room D-201

Due to the growing population of the Battle Creek and Kalamazoo area, there is an increasing need for a local commercial airport with the capabilities of offering more convenient methods of travel. A new centrally located air traffic control tower was built to help satisfy these growing needs and improve air travel safety. A work breakdown structure, a detailed cost estimate, a project schedule, on-site safety plan and a total project management system for the new air traffic control tower were developed.

CAREERLINE TECH CENTER

by Adam Gaynier, Charles Hammond, and Mike Maurovich
Sponsor: John Bedard – The Christman Company
Faculty Advisor: Osama Abudayyeh
10:30 a.m. to 10:55 a.m., Room D-201

The Careerline Tech Center was expanded to accommodate a growing student population and the addition of several new programs. A comprehensive schedule of construction activities was developed that included a breakdown of all work to be completed, a safety plan, and a project management system. This project had an owner-imposed timeline of only ten months. A detailed cost estimate using current cost data was also developed. Challenges to the design of the system included adverse winter weather conditions and an inflexible timeline due to the start of school.

HIGH SCHOOL AREA B ADDITION

by Kevin Arenson and Benjamin Harger
Sponsor: Rick Schroeder – The Christman Company
Faculty Advisor: Osama Abudayyeh
11:00 a.m. to 11:25 a.m., Room D-201

A public school system was plagued by outdated and overcrowded facilities. Renovations and additions were done to all areas of the school complex. A work breakdown structure, schedule, estimate, project management system, and safety program for the addition to Area B of the high school were developed. Several factors needed to be taken into account when creating these management tools in order for a smooth operating job site. These factors included limited space, time constraints, and small town public involvement.

COMPUTER SCIENCE

Session Chair – Mark Kerstetter
Room D-210

EVALUWEB COORDINATED LOGIN AND WEBSITE ADMINISTRATION

by Tim Miley, Soujanya Venkatesh, Corey H. Viegelahn, and Yvette Yoder
Faculty Advisor: Mark Kerstetter
11:30 a.m. to 11:55 a.m., Room D-210

EvaluWeb was developed to provide a centralized interface and repository of resource modules to help manage evaluation theory and process. Historically, these applications were managed by multiple administrators without centralized user authentication; however, the Coordinated Login System (CLS) was developed to provide a unified login page to grant varying levels of access based on a user's database profile. Additionally, the Website Administration Module (WAM) was developed to provide tools for the administrator to manage users and the site and for individual users to manage their personal information. A database review and testing of the CLS and WAM were also performed.

TASK ASSESSMENT SYSTEM ONLINE (TASO)

by Rida H. Al-Faraj, Seow Chui Leong, Kenneth Michalak, and Brian Whitesell
Faculty Advisor: Mark Kerstetter
1:00 p.m. to 1:25 p.m., Room D-210

Task Assessment System On-Line (TASO) offers a simple and customizable alternative to gathering and distributing assessment forms among students in a class. These forms help students positively improve by telling them what they do well, what needs improvement, and what has been helpful or interesting. It was developed to eliminate the need for paper handouts and the tediousness of collecting, sorting, and delivering assessments. Assessment completion and review has become easier and more efficient under a Web-based environment. What was done manually before became automated through this project with the help of an organized filing system.

CALENDAR-ZOO, AN ONLINE CALENDAR DATABASE

by Jamie Kahgee, Patrick J. Lombardo, Kevin Militello, Robert Robinette, and Brian L. Whitacre
Faculty Advisor: Mark Kerstetter
1:30 p.m. to 1:55 p.m., Room D-210

Calendar-Zoo enhances an online calendar of events. The system allows authenticated sponsors to enter event information directly into the public calendar. The calendar system that the client used was evaluated and an interface to input events was designed and implemented. The interface is simple to understand and easy for the sponsors to enter multiple events, without having to enter redundant data. Since the client wanted to review the submitted events before they were posted to the calendar, this process was simplified by creating an interface that cycles through the pending events and allows easy posting, editing, and deletion.

FACULTY PUBLICATION AND RESEARCH DATABASE

by Robert S. Dreslinski, John Ingersoll, Cressy J. Larson, Jo Wee Lee, and Wilson Ngu
Faculty Advisor: Mark Kerstetter
2:00 pm. to 2:25 p.m., Room D-210

The Faculty Research and Publication Database manages publications created by faculty. This system allows faculty to add, remove, and modify records of their publications while allowing access to the general public through the World Wide Web. General users can search for publications to view or choose from the most recently submitted or most frequently viewed publications. A support center and navigation system promotes user-friendliness by making the site easier to use. Faculty members have additional privileges that allow them to add and modify records of their publications as well as generate a report of their professional activity.

STUDY ABROAD COURSE EQUIVALENCY DATABASE

by Kevin Bailey, John Brown, Josh Higbee, Jimin Kang, and Nathan Wittstock
Faculty Advisor: Mark Kerstetter
2:30 p.m. to 2:55 p.m., Room D-210

An online database system was needed to keep track of course equivalencies for classes. This database helped both students and faculty find course equivalences for courses taken overseas, so that there was no dispute on the credit received for the courses taken. The system was set up to make it searchable by country, major, and/or university and could be easily used by anyone seeking information on studying overseas. The interface was designed to use a content management system under development by the client. This system allowed for seamless integration into the international areas of the client's database and website.

WEBSITE DATE AND TIME AUDIT SYSTEM

by Saad Bader, Michael C. Naebers, Jason Soong, and Jameskutty Thomas
Faculty Advisor: Mark Kerstetter
3:00 p.m. to 3:25 p.m., Room D-210

The Website Date and Time Audit System was created as a means to instantly search Web sites for any references to outdated times. The resulting program also needed to follow any links found in the given Web page and search the new page for any old dates. The ability to ignore any date chosen by the user was provided, so that Time Audit System would never detect the outdated time again. The means to make this code portable, not only between different web clients but also between the Windows and Linux operating systems, was provided.

CEMETERY DATABASE SYSTEM

by Matthew S. Gullikson, Joshua Hoyt, Patrick E. McDonald, and Daniel A. Tucker
Faculty Advisor: Mark Kerstetter
3:30 p.m. to 3:55 p.m., Room D-210

The Cemetery Database System was designed to help track and catalog burial plot data and for the production of a cemetery index. Four main features needed implementation: formatted printing of the records, improved query functionality, compatibility across differing platforms, and two separate versions for data input and database management. Update and delete functions require a primary key whereas other queries can be made with secondary keys. When a query returns multiple records, the user is able to choose which record to work with. User interface in use and installation is as simplified as possible to ensure its stability.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room D-115

MAXIMUM POWER POINT TRACKER

by Lip How Chen, Chao Koon Lee, and Yen Han Liu
Faculty Advisor: Johnson Asumadu
9:00 a.m. to 9:25 a.m., Room D-115

A low cost and high efficiency power point tracker was designed and built to optimize power transfer between the photovoltaic panels and the battery bank on a solar-powered car. The design consists of a microcontroller (MSP430) and a DC-DC boost converter. The microcontroller takes care of both battery management and adjustment of the DC-DC boost converter and pulse width module (PWM) to transfer the optimum power into the battery under varying light and temperature conditions.

RACE CAR DATA ACQUISITION SYSTEM

by Kasi Martin, Ryan Moneybrake, and David Wine
Sponsor: Sweet Manufacturing, Inc.
Faculty Advisor: Damon A. Miller
9:30 a.m. to 9:55 a.m., Room D-115

A system that monitors and provides real time measurements of critical system parameters was developed to assist users in fine tuning their steering control systems for optimal performance. The data acquisition system provides the ability to quickly download steering performance data during a race and is intended for use in NASCAR events. Sensors and amplifying circuitry were used to provide electrical signals proportional to parameters of interest that are subsequently converted to a digital representation for computer processing.

POWER FACTOR CORRECTION OF A MANUFACTURING FACILITY

by David Boser, Saurabh Malpani, Greg Stechschulte, and Mutmainna Tania
Sponsor: Anil Verma – Parker Hannifin, Brass Products Division
Faculty Advisor: Joseph Kelemen
10:00 a.m. to 10:25 a.m., Room D-115

A manufacturing facility had a low power factor resulting in high utility bills. An unbalanced plant load caused the poor utilization of power. Data was gathered and logged from the plant and the necessary components were determined. Capacitors were the primary component used for power factor correction. The values of the capacitors used and the locations in the plant electrical system were then determined. This served to raise the plant's power factor to an acceptable level and reduced utility bills.

INTEGRATION OF HETEROGENEOUS WIRELESS COMMUNICATIONS SYSTEMS

by Yu Ming Chen, Narie Lee, and Anthony Wickey
Faculty Advisor: Liang Dong
10:30 a.m. to 10:55 a.m., Room D-115

Future wireless communications systems will rely heavily upon flawless integration. It has been proposed to integrate such wireless systems based on an Internet-protocol (IP) network. These network architectures that connect user and core networks are being developed using unlicensed radio spectrum combined with high data rates. The initiative for this kind of network is to be able to transfer voice traffic on an IP network. Such a network will likely see a high popularity once it is fully integrated. An open and scalable architecture based on the public IP network was designed.

A LOW COST AUTOMOBILE DIAGNOSTIC TOOL

by John Bunn, Justin L. Hudson, and Eric Patterson
Sponsor: Kevin Hykin – Burke E. Porter Machinery Company
Faculty Advisor: Janos Grantner
11:00 a.m. to 11:25 a.m., Room D-115

In the automotive industry, all new vehicles are equipped with an in-vehicle network that enables the electronic control units to exchange information. There are many different configurations for these networks but the Controller Area Network is rapidly becoming the universal standard. Because of this, there are many tools on the market today that can be used by a PC to communicate with the modules. A low cost debug tool was created to implement the communication between an automobile and a PC.

SPEAKER TEST SYSTEM

by David Hirsch, Benjamin L. Mitchell, and Joe Semann
Sponsor: R Ave. Engineering, LLC
Faculty Advisor: Frank Severance
11:30 a.m. to 11:55 a.m., Room D-115

The custom speaker industry requires several diverse pieces of equipment to test sound system configurations to ensure they meet customer specifications. This equipment is often costly, and the number of different devices required for accurate test results makes the whole process slow and difficult. The Speaker Test System consolidates almost all of the tasks that a custom speaker designer would require into a single device. The benefits of the Speaker Test System include lower equipment cost, less time required to test various sound systems and speakers, and decreased difficulty in completing these tasks.

DEMONSTRATONS OF ELECTRICAL ENGINEERING PRINCIPLES FOR HIGH SCHOOL STUDENTS

by Marcus Chandrapal, Andy Gang Li, and Shahbaz Munir
Faculty Advisor: Norali Pernalete
1:00 p.m. to 1:25 p.m., Room D-115

The need for a practical example of a working system is important when introducing students to the world of electrical engineering. A total of four demonstrations were designed and implemented; the demonstrations were divided into subcategories of electronic, electromagnetic, and power principles in electrical engineering. The electronic segment consisted of two demonstrations, a rheostat circuit displaying Ohm's Law and a solar powered utility light. The electromagnetic segment was geared towards developing an electromagnetic voltage generator that also behaves as a DC motor. In the power segment, a miniature hydroelectric generator was constructed to demonstrate power generation from flowing water.

CELESTIAL FINDER USING SENSORS AND MICRO-CONTROLLERS

by Hatim Moiz Ali Mallu and Lester Pinto
Faculty Advisor: Raghvendra Gejji
1:30 p.m. to 1:55 p.m., Room D-115

A celestial finder to determine the azimuth and the angle of elevation of any given celestial object was designed and built. Both these calculations were performed by pointing an optical telescope coupled with the celestial finder towards the celestial object. Magneto-resistive sensors were used to determine the azimuth while an accelerometer was used to calculate the angle of elevation. An atomic clock module was also used to record the time when observations were performed. A micro-controller was implemented to sample and store the readings sent from both the magneto-resistive sensors and the accelerometer. A Visual Basic interface was designed to archive the sampled observations from the micro-controller and present the captured data on a personal computer.

A HANDHELD RADIO FREQUENCY SPECTRUM ANALYZER

by Mang Lian, Amer Malik, and Yuchung M. Wang
Faculty Advisor: Bradley Bazuin
2:00 p.m. to 2:25 p.m., Room 115

An inexpensive, portable RF Spectrum Analyzer that operates in the Instrumental, Scientific, and Medical (ISM) band from 902 to 928 MHz has been developed. The analyzer will be used for testing and monitoring radio frequency identification (RFID) system field installations. The device consists of a superheterodyne receiver, a micro-controller with signal processing and operational software, mode selection switches for inputs, and an LCD screen for displaying analyzer operations with spectral output. The analyzer was constructed using multiple conversion stages and modules that allowed more rapid development and testing and supported future upgrades and device refinements.

INERTIAL NAVIGATION SYSTEM (INS)

by Raheel A. Chaudhry, Li Hsien Chen, and Voon Ping Teng
Faculty Advisor: Dean Johnson
2:30 p.m. to 2:55 p.m., Room D-115

The Inertial Navigation System (INS) for tracking objects on a 2-dimensional field was designed, constructed, and tested as a short distance tracking technique. A 2-D accelerometer was used as a sensor to measure the acceleration of a moving object. The analog measurements of the accelerometer were sampled by a micro-controller and transmitted wirelessly to a personal computer. A software driver was written in Visual Basic, to drive the signals and manipulate them. The acceleration signals were integrated twice to get the position of the moving object. The real-time position of the moving object was displayed on the monitor of the PC.

INDUSTRIAL DESIGN

Session Chair – Alvaro Correa
Room D-109

DNA MODEL

by Jonathan Marson
Sponsors: National Science Foundation Grant EEC-0315695
Learn and Serve America Grant 03LHHMI001
Faculty Advisor: Alvaro Correa
9:00 a.m. to 9:25 a.m., Room D-109

The DNA Model was designed to provide a 3-D conceptual learning aid for high school students. The model enhances the biology classroom lecture portion of the fundamental aspects of DNA. The model is easy to use and shows all of the key concepts of replication, transcription, translation, and amino acid production, as well as the twisting aspect of DNA.

POWERED PICKUP LOADER

by Matt Brand, Ryan Garf, Steve Kuntz, and Hector Morales
Sponsor: Eric Hanson, Roger Quinlan, Adam Ruppert, and Jared Weston – Crown Equipment Corporation
Faculty Advisor: Alvaro Correa
9:30 a.m. to 9:55 a.m., Room D-109

Pickup truck owners experience the problem of loading and unloading heavy and/or multiple objects to and from their pickup truck bed. The Powered Pickup Loader turns multiple lifts into a single lift alleviating multiple task situations where lifting heavy items in and out of the truck becomes difficult and dangerous. Whether you are lifting an ATV or numerous rolls of sod, this lift will provide the assistance needed to maneuver and lift them safely into the pickup truck bed.

VWAU (VEHICLE WASH ASSIST UNIT)

by Tobias Bridges, Scott Tornga, and Matt Vidro
Sponsor: Crown Equipment Corporation
Faculty Advisor: Alvaro Correa
10:00 a.m. to 10:25 a.m., Room D-109

Imagine if the laborious task of washing a vehicle could be made more simple and convenient. The Vehicle Wash Assist Unit (VWAU) does just that by enabling the user to move horizontally and vertically, significantly reducing hard to reach areas. The VWAU also provides storage for all of the necessary tools and keeps them close at hand, reducing the time lost in gathering and finding equipment. VWAU's versatile design provides the user many comfort and storage options.

THE BREEZE

by Kristen Cotugno, Dave Vedkamp, and Lee Webb
Sponsor: Eric Hanson, Roger Quinlan, Adam Ruppert, and Jared Weston – Crown Equipment Corporation
Faculty Advisor: Alvaro Correa
10:30 a.m. to 10:55 a.m., Room D-109

Through research it was found that many people who live in apartments and retirement communities find it difficult to navigate long hallways, stairwells and security doors when carrying heavy loads to and from their vehicles. Chores such as bringing in the groceries and going to the laundromat can be difficult, awkward, or even annoying. Through the use of simple mechanics and leverage, The Breeze enables its user to move or tote large loads that would otherwise be difficult to lift.

LIVEFREE

by Lance Aldrich, Alex Navarre, and Benjamin Purrenhage
Sponsor: Eric Hanson, Roger Quinlan, Adam Ruppert, and Jared Weston – Crown Equipment Corporation
Faculty Advisor: Alvaro Correa
11:00 a.m. to 11:25 a.m., Room D-109

People over the age of 65 are the fastest growing demographic group in the United States. As the human body ages, mobility becomes limited due to joint discomfort, muscle weakness, and heart problems. Simple tasks such as walking, sitting, and standing become painful and uncomfortable. The LiveFree Lift is a home assist device for the elderly with unique capabilities to be used as a walker, wheelchair, personal lift and stair climbing aid. New materials and manufacturing processes are utilized to break the conventional look and negative attitudes associated with using a walker.

"THE SPRING"

by Cara Hedstrom, Susan Landon, and Tana MacKillop
Sponsor: Rick Chatelain, Scott Hopkins, and Cari Rairick – The River
Faculty Advisor: Alvaro Correa
11:30 a.m. to 11:55 a.m., Room D-109

The Spring coffeehouse is a multipurpose area that is connected to the main sanctuary of a post-modern, multicultural church in Kalamazoo. Multifunctional furniture, an effective serving bar, proper lighting, dishware, and a name and logo were designed for the space. A more functional and cohesive environment was created by improving the traffic flow through the room, repairing and painting the walls, and adding accessories. In addition to developing sturdy and durable products, all elements were created to fit within the budget.

INDUSTRIAL AND MANUFACTURING ENGINEERING - A

Session Chairs – Azim Houshyar and Bob White
Room D-202

INTEGRATION OF AN AIR INTAKE MANIFOLD AND AIR INTAKE SYSTEM

by Benjamin Hormann and Brian Workman
Sponsor: Brad Olson – MANN + HUMMEL USA
Faculty Advisor: Jim VanDePolder
10:00 a.m. to 10:25 a.m., Room D-202

A major goal for the auto industry is to reduce size, space, weight, and cost. Incorporating an air intake system (AIS) and an air intake manifold (AIM) into one component reduces cost and component space. A new compact filter called the CompactPlus®, which is a small filter that outperforms other filters of greater size, was incorporated into the design of the system. Design concepts underwent finite element analysis using IDEAS CAD software. A working prototype was created on a rapid prototype machine and then analyzed using a flow bench to determine air flow properties. Integrating the AIS and AIM will help the auto industry approach the desired goal of reducing cost, space, and weight.

DISTORTION, DEGRADATION LOSSES, AND COLLAPSIBILITY OF VARIOUS SAND BINDER SYSTEMS AT IRON FILL TEMPERATURES

by Kevin King, Ryan Schwark, and Philip Skrzypek
Sponsor: Kelley Kerns – Fairmount Minerals Ltd.
Faculty Advisor: Sam Ramrattan
10:30 a.m. to 10:55 a.m., Room D-202

Chemically bonded sand cores and molds are an important part of metal casting technology, and their behavior in contact with molten metal is of great interest. With today's emphasis on near-net-shape, thin wall castings, stricter tolerances, and surface finish required by customers, there was a demand for test methods that accurately measure the thermal distortions of chemically bonded binder systems. Two sand systems, two cure times, and three binder levels were utilized to study the changes from the thermo-mechanical reactions of resin coated silica sand systems. Goals were achieved by focusing on quantifying distortion and integrity differences found in various silica sand systems at a gravity cast iron fill temperature.

RE-ENGINEERING A PROCESS TO VERIFY A VITAL LINK IN AN EGR VALVE ASSEMBLY

by Cheryl Emanuel, Sumith Sai Juvvadi and Sachet Shah
Faculty Advisor: Azim Houshyar and Bob White
11:00 a.m. to 11:25 a.m., Room D-202

A problem in an Exhaust Gas Recirculation (EGR) valve assembly produced at a local manufacturing company often caused engine damage. An improved and robust method with a redesigned tool would help verify the presence of a vital link in the EGR assembly. Several engineering design tools were used to obtain a feasible solution. Various studies were conducted to test the robustness of the new verification process. An installation tool was created to replace the current two-tool process and simplify the coupling of the link in the EGR valve assembly. This process will ensure quality parts while maintaining current cycle time.

COST AND CAPABILITY ANALYSIS OF VISUAL INSPECTION METHODS

by Mark David, Matt LaBelle, and MacKenzie Reich
Sponsor: Meg Forest and Michael Muday – Systex Products Corporation
Faculty Advisor: Azim Houshyar and Bob White
11:30 a.m. to 11:55 a.m., Room D-202

The complexity of many manufactured components requires that final inspections be conducted by people rather than machines. The use of individuals to detect defects creates capability and repeatability issues. An analysis was conducted to determine the current accuracy of these systems and subsequent costs of their failure. Areas of interest included operator capability and repeatability, customer sorts, non-conformities, and multiple layer inspections. A recommendation was made to modify the existing system to improve the detection of defects and reduce costs.

THROUGHPUT INCREASE OF A MULTI-PRODUCT PACKAGING LINE

by Alana Dumasius, Leslie Dzingle, and Lindsay Tabbert
Sponsor: Jeff Ablin, Roy Downs, Wayne Gould, Claude Little, Ann Martin, and Paul Solomon – Kellogg Company
Faculty Advisor: Azim Houshyar and Bob White
12:00 p.m. to 12:25 p.m., Room D-202

A production and packaging plant sought to increase productivity on a variety pack packaging line. Due to changes made in the packaging process, the line was averaging less throughput than the system was designed to produce. Reasons for the low line productivity were investigated through the use of industrial engineering tools, and recommendations were provided. As a result of the downtime solutions, throughput on the packaging line increased to the point that a single crew is able to meet peak production requirements.

INDUSTRIAL AND MANUFACTURING ENGINEERING - B

Session Chair – Betsy Aller
Room D-208

HYBRID HYDRAULIC BICYCLE DESIGN

by Jacob Bacon, Michael Desjardins, Gregory Kobrzycki, and Anthony Lipke
Sponsor: Mark E. Leineke and Jason Walters – Parker Hannifin Corporation
Faculty Advisor: Alamgir Choudhury
9:30 a.m. to 9:55 a.m., Room D-208

Conventional direct drive bicycles do not store energy or supply sufficient amount of energy during an uphill motion. A hydraulic system was designed to overcome these problems. In this system the energy from the motion of the pedal is transmitted to the driving wheel or stored in an accumulator to be used as needed. An existing bicycle frame was modified for integration of the hydraulic system and the frame. The hydraulic circuit was tested in the laboratory for its performance, and finite element analysis was performed on the frame to ensure its structural integrity. A prototype of the final design will participate in a national hydraulic bicycle design and performance competition in August of 2005.

DESIGN OF AN AFFORDABLE LIGHTWEIGHT WHEELCHAIR

by Marc P. Egan, Michael J. Gianunzio, Toan V. Van, and Blake A. Zeeman
Sponsor: Gary Crosby – Oasis Medical
Faculty Advisors: Betsy Aller and Fred Sitkins
10:00 a.m. to 10:25 a.m., Room D-208

Research supports the need for an affordable, user friendly, lightweight wheelchair. Current standard wheelchairs are heavy and awkward, and current lightweight wheelchairs are expensive. A user-friendly design was developed using CAD and finite element analysis (FEA), and materials were investigated, including aluminum alloys and fiberglass composites. After a design was chosen, a cost analysis was performed, and fabrication of the wheelchair will follow. Safety issues, as well as ANSI and FDA regulations, were addressed during the design phase, and user testing will be completed upon prototype development. This design will benefit those who need a lightweight wheelchair but who cannot afford the current cost.

NON-PROFIT TRANSIT CART REDEVELOPMENT

by Brian Demos, Todd Lambkin, William Leach, Terry Lee, and Eric Locker
Sponsors: National Science Foundation Grant # EEC-0315695
Learn and Serve America Grant # 03LHHMI001
Faculty Advisor: Edmund Tsang
10:30 a.m. to 10:55 a.m., Room D-208

Shipping carts used by a local non-profit distributor of donated clothing and household goods are saddled with high maintenance and presented physical impediments to the user. An analytical comparison of the old and new designs utilizing finite element analysis and ergonomic testing was achieved, ensuring a new cart that incorporated advantages of each. The prototype cart provides improved ergonomic and mechanical designs, increased durability and lower maintenance, improved operational efficiency, and reduced long-term cost. Other important issues researched by the group included individual user safety and the financial potential of producing the carts for profit.

IMPLEMENTATION OF RADIO FREQUENCY IDENTIFICATION (RFID) INTO A PRODUCTION PROCESS

by Michael Gaddes and Brad Glessner
Sponsor: Rik Fleming and Dave Jerovsek – Invensys Appliance Controls
Faculty Advisor: David Lyth
11:00 a.m. to 11:25 a.m., Room D-208

Radio Frequency Identification (RFID) represents the future in inventory management and product information tracking. Benefits of RFID over conventional barcodes include increased data capacity and transfer, as well as real-time tracking throughout the production and shipping processes. A local electronics manufacturer wishes to integrate this technology into their production process to reduce warranty repair, scrap, and rework costs, as well as to improve inventory control. Using current information on RFID technology, along with cost analyses, a system was designed that will allow the company to reduce the quality costs and closely monitor inventory throughout the production process.

REDESIGN OF A LOW-COST AUTOMOTIVE TRUCK REAR WINDOW SLIDER

by Emily Ebejer and Nina Simanca
Sponsor: Darin Snider – Magna Donnelly Corporation
Faculty Advisor: Jorge Rodriguez
11:30 a.m. to 11:55 a.m., Room D-208

A study of the large market for automotive truck rear window sliders proved they are expensive to produce. A decision was made to redesign this type of window at as low a cost as possible. Feasibility and packaging studies for current systems were performed to define the project direction. CAD models and dimensional layouts were created for the final design. Cost analysis was performed on each component of the window to determine material selections and processes that would prove most cost efficient. A prototype was constructed to test the durability, safety, and appeal of the window.

COMMISSIONING OF A SHEET EXTRUSION LINE

by Lucas Graham, Ken Lothschutz, and Brian Sather
Faculty Advisor: Paul Engelmann
12:00 p.m. to 12:25 p.m., Room D-208

To give students the opportunity to learn about the production of plastic sheet, a sheet extrusion line was assembled in a plastic processing laboratory. The three major components – a 2-inch single-screw extruder, sheet die, and calendar rolls – were non-functional and required repair or modification to operate properly. The extruder was commissioned, including re-calibration of the controls. To attach the sheet die to the extruder, the existing die adapter required modification. Safety guards were added to the calendar rolls, several mechanical features were repaired or upgraded, and a system was developed to wind the sheet for takeoff. The completed sheet extrusion line will be used for future student instruction.

MECHANICAL AND AERONAUTICAL ENGINEERING – A

Session Chairs – Chris Cho and Ho Sung Lee
Room D-204

MODELING AND OPTIMAL THERMAL DESIGN OF A STIRLING ENGINE

by Terry L. Groth and Dennis Tuckowski
Faculty Advisor: Ho Sung Lee
9:00 a.m. to 9:25 a.m., Room D-204

A palm top Stirling Engine was re-designed using the design tool SolidWorks, which is a computer aided drafting program. The mechanism of the engine's operation was verified based on simple thermodynamic theories. The three dimensional geometry of the Stirling Engine was constructed and the engine's operation was verified using a special feature of animation in the SolidWorks program. From the findings of the simulation an optimal thermal design of the engine was created which maximized heat transfer and work output of the engine.

REDESIGN OF A SMALL ENGINE FOR A SUPERMILEAGE VEHICLE

by Sathyaveer Maganti, Adam Poznanski, and Ho Ming Sze
Faculty Advisor: Richard Hathaway
9:30 a.m. to 9:55 a.m., Room D-204

A single cylinder, four-cycle engine was redesigned to achieve maximum fuel economy when installed in a single person lightweight vehicle. This vehicle will compete in the SAE (Society of Automotive Engineers) Intercollegiate Supermileage Competition. The engine was resized to meet the power requirements of the vehicle, to optimize the engine for the intended application, and to minimize internal losses to attain maximum fuel economy. All modifications to the engine were limited to the guidelines set by SAE.

CHEMICAL INJECTION SYSTEM REDESIGN

by Mary Beth Greendonner and Andrew Rahn
Sponsor: Terry Beilman – American Electric Power
Faculty Advisor: Chris Cho
10:00 a.m. to 10:25 a.m., Room D-204

Chemical injection systems have become common in utilities drawing water from the Great Lakes to minimize the impact of the invasive zebra mussel. An existing design for a chemical injection system of an electric power generation plant was analyzed and improved to ensure dependable operation. The redesign provides a reliable injection method, while reducing projected maintenance activities, thus reducing operational costs. Analysis of previous system failures was performed utilizing numerical modeling methods to understand the flow characteristics of the existing system and the forces generated during various modes of system operations and environmental conditions.

IMPROVED COOLING OF AN INDUSTRIAL ELECTRIC MOTOR

by Adam Honhera, Jayson Latowski, and Yoong Chi Yan
Faculty Advisor: Chris Cho
10:30 a.m. to 10:55 a.m., Room D-204

Improved electric motor cooling was studied using 3-D modeling and heat transfer software. Once initial conditions were determined, two variant models were created, both of which yielded lower core temperature. Consistently lower core temperatures lead to longer motor life and higher potential output. A user-friendly spreadsheet was also created that allowed for easy representation of the cooling which occurs throughout the rotating element.

ELIMINATION OF PLATING LOSS DURING A VALVE FORMING OPERATION

by Bryan Lewis and Kurt Skov
Faculty Advisor: Philip Guichelaar
11:00 a.m. to 11:25 a.m., Room D-204

Recommendations intended to eliminate the flaking of zinc chromate from an electro hydraulic valve housing during a cold work assembly process are provided. Plating loss creates a contamination hazard and a less than desirable cosmetic appearance. Optimization of the plating and forming processes were investigated and alternate forming and surface treatment options were explored to address the damaged plating surface that occurs during valve manufacture.

SWAGE JOINT REDESIGN

by Kevin Dolezan, Jeff Hiatt, and Charlie Krug
Sponsor: Steve Pear and Jeff-Fauna Ware – Bosch Chassis Division
Faculty Advisor: Daniel Kujawski
11:30 a.m. to 11:55 a.m., Room D-204

Redesign of the swage joint used in a rod assembly for the hydroboost line of braking systems was required. The redesign was necessary to improve the factor of safety of the braking component. Various components of the swage joint were analyzed and tested in real and simulated environments to produce a new rod end assembly capable of meeting the company's requirements.

SOLENOID VALVE REDESIGN

by Daniel Johnson Jr. and Jake Randall
Sponsor: Rob Knepple and David Klein – Humphrey Products
Faculty Advisor: James Kamman
1:00 p.m. to 1:25 p.m., Room D-204

A solenoid air-valve was redesigned, built, and tested. The new valve has the same flow characteristics as an existing valve, but it is considerably smaller and less expensive. The housing and internal components of the new valve were designed around a smaller and more efficient solenoid. A new manifold with a twist-style connection to accept the valve was also developed. Testing was done on the solenoid and the complete valve assembly. The valve was evaluated based on leak rates, volumetric flow-rates, and response time.

LAB STERILIZER VACUUM PUMP VALVE DESIGN

by Dan Geerlings, Matt Jeske, and Kevin Sides
Faculty Advisor: Iskender Sahin
1:30 p.m. to 1:55 p.m., Room D-204

The valves on a vacuum pump were redesigned to decrease their susceptibility to failure when the pump is used in sterilization environments. The new valve designs were required to withstand liquid condensate and other chemicals without failure due to corrosion or bending. Three new possible valve concepts were created, prototyped and tested to evaluate their performance. The best valve design will be placed on an endurance test to ensure the necessary life of the valve system.

REDESIGN OF A DUST COLLECTION DRIVE SYSTEM

by Michael King
Sponsor: Jeff Weyhmiller and Richard Winsemius – Cannon-Muskegon Corporation
Faculty Advisor: Koorosh Naghshineh
2:00 p.m. to 2:25 p.m., Room D-204

The amount of uncollected exhaust particulate from an Argon Oxygen Decarburization (AOD) vessel has been significantly decreased by redesigning and implementing a new drive system that controls a dust collection hood. This drive system was needed in order to synchronize the movement of the hood with the motion of the AOD vessel. The uncollected exhaust particles fill the plant air and pose health problems to the workers and create maintenance problems for electrical components and bearings. The previous method of controlling the hood was proven insufficient due to the lack of control and synchronization it had with the AOD vessel. Several methods of position control were considered for the hood and a final design was chosen based on various factors such as cost, performance, and reliability. The motion of the hood was simulated using Solidworks and design calculations were verified using FEA programs.

MECHANICAL AND AERONAUTICAL ENGINEERING - B

Session Chair – Kapseong Ro
Room D-206

DESIGN OF A LIGHT SPORT AIRCRAFT LANDING GEAR SYSTEM

by Matthew Jahn, Jay Jepkema, and Emily Nicol
Sponsor: Eric Pederson – Phantom Aeronautics LLC
Faculty Advisor: Judah Ari-Gur
9:00 a.m. to 9:25 a.m., Room D-206

A landing gear system for use on a two-seat light sport aircraft was designed. The landing gear was developed for an aircraft that will operate under the Federal Aviation Administrations' new sport aircraft category. The analysis proved the system is capable of withstanding the loading conditions specified by the ASTM Standards on Light Sport Aircraft. The final design is a trailing link system that provides for soft landings, adapts to other aircraft models, and is lightweight.

AIR AMBULANCE DESIGN

by Jen Ho Chong and Kentaro Fujiwara
Faculty Advisor: Judah Ari-Gur
9:30 a.m. to 9:55 a.m., Room D-206

There is a need to design a rescue mission aircraft that can transport critically injured patients from remote towns to nearby cities where medical facilities are available and also to serve other medical purposes. The design requirements were specified and research was carried out regarding the portable medical instruments used in the rescue mission aircraft such as the portable patient's bed. This preliminary design includes layout, lofting, sizing of the control surfaces, selection of engines, landing gear and detailed weight analysis.

DETERMINATION OF THE AERODYNAMIC CHARACTERISTICS FOR A PARADROGUE COMPONENT OF THE AERIAL REFUELING SYSTEM

by Michael Booms and Hilda Vivas
Sponsor: Mike Feldmann – Smiths Aerospace Electronic Systems
Faculty Advisor: Kapseong Ro
10:00 a.m. to 10:25 a.m., Room D-206

Through wind tunnel testing, aerodynamic characteristics of the paradrogue stabilizing mechanism for mid-air refueling were determined. During an aircraft aerial refueling process, the success of this procedure is related to an overall recognition of the drag force exerted by the paradrogue assembly. A mathematical model that parameterizes the aerodynamic characteristics of the paradrogue was developed using wind tunnel test data. This project included the completion of an accurate characterization of the drag, lift, and pitching moment on the basis of various paradrogue design parameters such as angle of attack, drag chute surface area, and gore (gap) spacing of the paradrogue component.

UNMANNED AERIAL VEHICLE FLIGHT TEST AND DATA ANALYSIS

by Brandon J. Hulway and John T. Schmitz
Faculty Advisor: Kapseong Ro
10:30 a.m. to 10:55 a.m., Room D-206

A data telemetry system was employed to perform flight tests on an unmanned aerial vehicle (UAV). Utilizing a UAV with a sufficient cargo capacity for the data telemetry system, multiple flight tests were performed. Sensors were built and selected to experimentally determine the neutral point, maximum climb, and maximum turning rates. After compiling and analyzing the data, 3-D graphics software was used to recreate a flight in a computer-generated environment.

DESIGN AND OPTIMIZATION OF THE GROUND SUPPORT EQUIPMENT (GSE) ALIGNMENT STAND FOR ALL MODELS OF THE LEAR JET

by Stephen Olson, Matt Wagner, and Kwee Lin Yap
Sponsor: Duncan Aviation
Faculty Advisor: Dennis VandenBrink
11:00 a.m. to 11:25 a.m., Room D-206

A stand to support the front landing gear of Lear jets while the alignment of the plane was checked and adjusted was needed. The alignment stand was designed, optimized and built to assist in the landing gear alignment process of all Lear Jet models. The stand securely holds the landing gear, allows for easy transportation and provides measurements of wheel angle. This was accomplished through CAD modeling, finite element analysis (FEA) software and prototype testing.

DESIGN, MANUFACTURE, AND TESTING OF WREN 54 MINITURBOJET EXHAUST NOZZLE

by Adam Parker and Christopher Young
Faculty Advisor: William Liou
11:30 a.m. to 11:55 a.m., Room D-206

To give aeronautical engineering students a hands-on experience, an exhaust nozzle was designed, manufactured, and tested for the WREN 54 miniturbojet engine. The exhaust nozzle was designed using Fluent, machined to design specifications, and installed on the WREN 54 engine. The WREN 54 test stand was also modified to properly measure the increased thrust produced by the addition of the exhaust nozzle. The results from testing proved that the engine's thrust increased while providing students with an engine that more resembles real world applications.

MECHANICAL AND AERONAUTICAL ENGINEERING - C

Session Chair – Muralidhar Ghantasala and Bade Shrestha
Room D-212

OVERLOADED AXLE ASSEMBLY ANALYSIS

by Adam Armstrong and Sean Miles
Sponsor: Dana Corporation – Commercial Vehicle Systems Division
Faculty Advisor: Philip Guichelaar
9:00 a.m. to 9:25 a.m., Room D-212

An axle shaft for a truck was analyzed to determine if the weight rating could be increased. The analyses included finite element analysis and fatigue stress under varying loads. When the analysis was completed, the axle shaft dimensions and heat treatment were altered, resulting in a substantially longer design lifetime.

OPTIMIZATION OF A RACE CAR TRANSMISSION

by Carl T. Beiser and Adam Trella
Sponsor: Herb Brinn – Brinn Incorporated
Faculty Advisor: Richard Hathaway
9:30 a.m. to 9:55 a.m., Room D-212

Optimization of a late model, oval-track racecar transmission was required to increase the functionality of the current design. Using finite element analysis software, core components were analyzed for stress concentrations and overall integrity. The main case was redesigned for the strength and improved counter-shaft positioning. The bell housing was redesigned for integrity and starter location. These two improvements increase the compatibility of the transmission with aftermarket starters. The reverse gear configuration was modified by removing the idler and replacing it with a space-saving chain-driven system. All modifications made needed to stay within the rules of the sanctioning bodies across the globe.

CABLE DRIVEN POWER TRANSMISSION

by Davitt Broderick (ME), Bryan Leslie (IME), and James Sweet (ME)
Sponsor: Jim Ziech – Dana Corporation
Faculty Advisors: Richard Hathaway and Mitch Keil
10:00 a.m. to 10:25 a.m., Room D-212

Current gear-driven axle designs are costly due to the required machining processes. It has been proposed to design a new type of right angle drive axle that will be less costly to build but share the same characteristics of durability. This new system uses friction between a continuous loop of cable and two drums to transmit power. This design was modeled and evaluated through a series of tests. Based on initial analyses, design changes were made and final recommendations were given to the sponsor for further testing.

HUMAN-DRIVEN HYDRAULIC BICYCLE

by Louis J. Baweja IV, Brad M. Eklov, and Mark A. Schneider
Sponsor: Parker Hannifin Corporation
Faculty Advisor: James Kamman
10:30 a.m. to 10:55 a.m., Room D-212

The design and evaluation of a human powered, hydraulically driven bicycle was completed. Alternately powered bicycle systems were analyzed as benchmarks for the evaluation of the completed design. The frame was designed using CAD software and the structural integrity was verified using FEA analysis. The hydraulic system was designed using simulation software and tested in the Motion and Control Laboratory.

BODY AND FRAME DESIGN OF SUPERMILEAGE VEHICLE

by Kristopher Ellis
Faculty Advisor: Richard Hathaway
11:00 a.m. to 11:25 a.m., Room D-212

The body and frame of a supermileage vehicle have been redesigned to improve fuel economy. The vehicle was evaluated and redesigned to create a more aerodynamic shape, add structural rigidity, and remain lightweight. This was accomplished by repositioning the driver, incorporating the body into the frame, and fabricating the body out of a fiberglass composite. The supermileage vehicle will participate in an international competition that takes place in June, sponsored by the Society of Automotive Engineers (SAE). Improvements to the vehicle provide the first step in achieving the desired fuel economy of 1,258 miles per gallon.

REDESIGN OF A FLUX FEED SYSTEM FOR A MANUFACTURING PROCESS

by Chris McDermott
Sponsor: DENSO Manufacturing Michigan, Inc.
Faculty Advisor: Richard Hathaway
11:30 a.m. to 11:55 a.m., Room D-212

A single flux feed unit was redesigned to supply flux powder to multiple systems in a manufacturing process. The unit is the start of the powder coating process on a production line with a braze furnace. The unit receives an electronic signal from the conveyor for activation. Safeguards, electrical panel, pneumatics, design package, budget, design process, SolidWorks drawings and Finite Element analysis will be presented.

AXIAL THRUST CLEARANCE MEAUREMENT SYSTEM

by Andy Borgyos and Andrew Luepke
Sponsor: Mike Smitley – DENSO Manufacturing Michigan Inc.
Faculty Advisor: Judah Ari-Gur
1:00 p.m. to 1:25 p.m., Room D-212

A cost-effective machine capable of measuring axial displacement of a motor shaft under thrust loading has been designed. If the fan motor, which is used for interior heating and cooling, is designed with excessive displacement of the shaft, it can "rattle" causing customer complaints and warranty claims. Previously there was no system to check these parts by the automotive supplier. The machine is designed for use on a high volume assembly line.

OUTSIDE TEMPERATURE SENDING UNIT REDESIGN

by Eric Ahlquist and Kai Sheong Yeong
Sponsor: Diane Johnson – Johnson Degree Day Systems
Faculty Advisor: Muralidhar Ghantasala and Ho Sung Lee
1:30 p.m. to 1:55 p.m., Room D-212

A redesign of the outdoor temperature sensor to a fuel demand meter was performed in order to obtain quicker cycling times, increased reliability and easier manufacturing ability. Analysis was performed and verified using computer modeling and tested in real world conditions. LabView was used to increase the cycling and production while decreasing labor costs. A new thermostat was built and tested to increase the reliability while saving costs. The complete unit was then tested against the current model to verify the results.

GEOMETRIC DATA ACQUISITION SYSTEM

by Joseph Sosinski and Ronald Weaver
Sponsor: Kevin Mead – Pratt and Whitney AutoAir, Inc.
Faculty Advisor: William Liou
2:00 p.m. to 2:25 p.m., Room D-212

A data acquisition system was needed to improve the reverse engineering process. This process involves gathering geometric information on existing parts returning to the plant for repair. Before the implementation of the chosen system, time and financial constraints were incurred by one of two methods: hand measuring the defective part on the plant floor, or outsourcing the part to another company to obtain the desired information. Research was conducted on various three-dimensional imaging machines and their accompanying software. Once all the information was gathered, the equipment packages were evaluated to find the best possible solution for the particular problem.

ERROR DETECTION DEVICE TO PREVENT PRODUCTION OF UNDERSIZED PINION GEAR BORES

by Scott Koepplin and Neil Maurer
Sponsor: Chris Allen – Eaton Corporation
Faculty Advisor: Koorosh Naghshineh
2:30 p.m. to 2:55 p.m., Room D-212

An automatic gauging system was designed to measure the bore on every pinion gear produced by a machine and provide feedback to the machine when a problem is detected. These pinion gears are part of the internal gear set used in a differential. During previous production, the tool that finished the inside diameter was often wearing or breaking, resulting in an undersize bore. Project work was focused on selecting the gauging technology and designing the conveyor and structure that will support the gauge.

PAPER ENGINEERING, CHEMICAL ENGINEERING AND IMAGING

Session Chair – Peter Parker
Room D-201

WET END SPRAY APPLICATION FOR FLUOROCARBON OIL/GREASE RESISTANCE (OGR)

by Brian Leonard
Faculty Advisor: Margaret Joyce
1:00 p.m. to 1:25 p.m., Room D-206

An experiment was conducted to improve the oil and grease resistance (OGR) properties of paper by spraying a fluoropolymer material at various points along the wet-end of a paper machine. By varying the points of application, the amount of fluoropolymer present at the surface and intermixed with the paper fibers near the surface was altered.

MACRONUTRIENT REQUIREMENTS FOR THE BIOLOGICAL TREATMENT OF NUTRIENT DEFICIENT WASTEWATER

by Nick Wildey
Faculty Advisor: David Peterson
1:30 p.m. to 1:55 p.m., Room D-206

The paper industry produces wastewater that is rich in organic matter, but it lacks the nutrients needed for efficient biological treatment. The organic content is typically measured by the Biochemical Oxygen Demand (BOD), which is the amount of oxygen required for microorganisms to consume the organic matter. Microorganisms require macronutrients, namely Nitrogen (N) and Phosphorus (P), to degrade organic matter. Using standard BOD test methods, the optimum nutrient addition ratio for nutrient deficient wastewater was determined by experimenting with different nutrient dosages.

RECYCLED FIBER RECOVERY

by Laela Hampton, Chad Herremans, and Michel Sarr
Sponsor: Jeromy Timmer – Graphic Packaging International, Inc.
Faculty Advisor: Andrew Kline
2:00 p.m. to 2:25 p.m., Room D-206

A local paper manufacturer produces paper products using 100% recycled fiber. The plant has three main waste streams, all of which contain different amounts of fiber. The waste stream with the greatest potential for fiber recovery was identified. This was determined through mass and energy balances and by sampling each waste stream. Once the stream with the greatest potential was targeted, an economic analysis was performed. Recommendations were made concerning the implementation of a fiber recovery process using solid separation equipment.

CAPACITY AND FLUID TRANSFER STUDY OF A WASTE HEADER STREAM

by Matthew Bet, Saruboon Hoontrakool, and Melinda Marsh
Sponsor: Laura Berry – Pfizer
Faculty Advisor: Andrew Kline
2:30 p.m. to 2:55 p.m., Room D-206

A study was conducted to determine the nature of waste fluid transfer problems between buildings at an API (Active Pharmaceutical Ingredient) production site. Problems in the current waste fluid transfer system result in a backpressure, or back flushes, which causes contamination of intermediate API batches, or freshly cleaned vessels. Problems may be due to pipe corrosion or blockage, inadequate flushing pressures, competing line pressures, or inefficient design capacity. Line inspection, computer simulation, and cost benefit analysis were used to make process recommendations to eliminate problems.

EVALUATION OF CHILLED WATER DISTRIBUTION

by Charles M. Combs, Michael L. Corwin, and Nichole H. Weddig
Sponsor: Mark Lummis – Pfizer, Inc.
Faculty Advisor: Andrew Kline
3:00 p.m. to 3:25 p.m., Room D-206

The pharmaceutical industry uses chilled water as a process utility. Because it is consumed in excess and is a requirement for proper operation of many processes and air conditioning, any inefficiency in the system may lead to costly problems. During this project, the chilled water supply system for the process was evaluated by creating a simulation in Pipe-Flo. Inefficiencies were identified in the system and proper recommendations were made to eliminate problems and make the process more economical. Cost estimates and cash flow analyses were completed to determine the most cost-effective solutions to their problems.

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 2005. If you have a project for our students or if you would like more information, please call Cathy Smith at (269) 276-3244.

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