11-2005

37th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

Conference on Senior Engineering Design Projects

You are invited to attend the thirty-seventh Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 3 p.m., **Tuesday, November 29, 2005** 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-202	9 a.m. to 10 a.m.	p. 4
Computer Science	D-204	10 a.m. to 11:30 a.m.	p. 5
Electrical and Computer Engineering	D-109	9 a.m. to 12 p.m.	p. 6
Industrial and Manufacturing Engineering	D-208	10 a.m. to 2:30 p.m.	p. 9
Mechanical and Aeronautical Engineering A	D-115	9 a.m. to 3 p.m.	p. 12
Mechanical and Aeronautical Engineering B	D-201	9 a.m. to 1:30 p.m.	p. 16

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
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering

Time	**Room**	**Dept.**	**Topic**
9:00	D-202	CCE	Facility for a Neuro-Science Center
	D-109	ECE	Design of an Integrated Sensor System
	D-115	MAE-A	Structural Analysis and Redesign of a Hawk Midget Chassis
	D-201	MAE B	Design and Simulation of a Test Bench for Pneumatic Valves
9:30	D-202	CCE	Design of a Six-story Commercial Building and Parking Area
	D-109	ECE	Accelerometer-Based Inertial Navigation System
	D-115	MAE A	Suspension Analysis and Redesign of a Handicap Accessible Van
	D-201	MAE B	Investigation of a Radiant Heating Element
10:00	D-204	CS	cs580Lib Bug Handling System
	D-109	ECE	Controls for Fuel Injection Test Bench
	D-208	IME	V-Twin Engine Electromagnetic Compatibility Test Investigation
	D-115	MAE A	Design of a Mechanical Wheelchair lift for a Sport Utility Vehicle
	D-201	MAE B	Analysis of Fluid Flow
10:30	D-204	CS	cs580Lib Online
	D-109	ECE	Infrared Fabric Temperature Measurement System
	D-208	IME	The Redesign of the Swimming Pool Bulkhead Moving Process
	D-115	MAE A	The Design of a Dual Function Shock Absorber Dynamometer
	D-201	MAE B	Exhaust System for a Salamander Broiler
11:00	D-204	CS	cs580Lib Help Page Editor
	D-109	ECE	Sensor-Based Telerobotic Arm
	D-208	IME	Transforming Care at the Bedside (TCAB)
	D-115	MAE A	Refrigerant Recovery Pump
	D-201	MAE B	LabVIEW Interfacing and Testing of an Electroplating System
11:30	D-109	ECE	Radio Telescope Data Storage System

	D-208 IME	Ventilation Ducting Hole Cutter
	D-115 MAE A	Portable Race Car Lift System
	D-201 MAE B	Design of a Telerobotic Arm that Manipulates Objects on a Human Scale
1:00	D-208 IME	Using Virtual Reality Simulation for Safe Human-Robot Interaction
	D-115 MAE A	Coning Reduction in a Commercial Vehicle Brake Rotor
	D-201 MAE B	Experimental Analysis of the Acrwing Design
1:30	D-208 IME	Redesign of an Emergency Medical Chair Manufacturing System
	D-115 MAE A	Lean Manufacturing Solution for Diaphragm Assemblies
2:00	D-208 IME	Reverse Engineering of Complex Parts
	D-115 MAE A	Portable Motorcycle Loading Mechanism
2:30	D-115 MAE A	Interference Press Fit Analysis

CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – Sherif Yehia
Room D-202

FACILITY FOR A NEURO-SCIENCE CENTER

by Dan Behler, Matt Henry, Jon Petriches, and Eric Wolfe
Sponsor: Joel Engels, American Village Builders
Faculty Advisor: Osama Abudayyeh
9:00 a.m. to 9:25 a.m., Room D-202

In an effort to improve patient care and efficiency, a local medical center entered into a three year $76 million renovation of its main campus. The addition of a new Neuro-Science Center was the senior design focus. This center totaled slightly over $7 million, and began construction in early 2005. A work breakdown structure was created, which was used to establish a detailed cost estimate, schedule, safety plan, and project delivery and management systems. Details such as equipment, crew composition, and data collection and handling were also evaluated and included in the project.

DESIGN OF A SIX-STORY COMMERICAL BUILDING AND PARKING AREA

by Brennen Duncan, Christopher Jacobs, Daniel Roberts, and Ryan Stone
Faculty Advisor: Sherif Yehia
9:30 a.m. to 9:55 a.m., Room D-202

A design for a six-story, 10,000-square-foot building was needed to house an insurance company, legal office, engineering firm, and an accounting office. The project started with an existing soil analysis. After checking the Kalamazoo Building Codes, the structural design of footings, columns, and beams was completed. The design of parking in accordance with Kalamazoo City Codes was also included. Graphical representation of the project was provided in the form of AutoCAD drawings, design calculations, SAP2000 structural design evaluation and a cost estimate.

COMPUTER SCIENCE

Session Chair – Thomas F. Piatkowski
Room D-204

cs580LIB BUG HANDLING SYSTEM

by Swaroop Atre, Vincent Blank, Robert Covill, Surekha Goodapati, Joon Teo, and Benjamin Whitt
Faculty Advisor: Thomas F. Piatkowski
10:00 a.m. to 10:25 a.m., Room D-204

The cs580Lib bug handling system is designed to assist the client in product maintenance for its flagship software product *cs580Lib* by providing a bug reporting process and supporting software tools that are matched to both the client and to the user base for *cs580Lib*. The system will offer an effective solution to replace the current ad hoc bug handling system that is error prone and inefficient. Design alternatives that were evaluated include off-the-shelf and custom implemented options. Both Maple and non-Maple implementations were considered.

cs580LIB ONLINE

by Brian Ferrell, Joseph Gasiorek, Joshua Firth, Craig Kemerer, and Jeremy Vainavicz
Faculty Advisor: Thomas F. Piatkowski
10:30 a.m. to 10:55 a.m., Room D-204

cs580Lib is a comprehensive coherent well-planned collection of help pages, procedures, and other Maple objects, that support research and instruction in formal languages and automata theory. The recent introduction of new Maple features such as MapleNET and Maplets has raised interest in the possibilities of providing online access to cs580Lib. A robust implementation strategy was recommended that will enhance cs580Lib to adapt to the current changing computation environment. Options using MapleNET and Maplets, other-vendor software, and custom implemented software were reviewed.

cs580LIB HELP PAGE EDITOR

by Noorain Ahmed, Scott Bogue, James Peoples, Vinit Shah, and Gopi Vignarajah
Faculty Advisor: Thomas F. Piatkowski
11:00 a.m. to 11:25 a.m., Room D-204

cs580Lib Help Page Editor was developed to assist in producing syntactically standardized help pages in cs580Lib, a comprehensive coherent well-planned collection of help pages, procedures, and other Maple objects that supports research and instruction in formal languages and automata theory. This product is intended to be of industrial strength and the extensive collection of help pages in cs580Lib should be similar in style (both syntactically and semantically) to the built-in help pages provided by Maple. The current process for producing help pages is completely manual. cs580Lib Help Page Editor addresses improvements to the design and implementation of the total process of creating and maintaining help pages, including checking that existing help pages conform to the

client's standards. Design options using computer tools, including off-the shelf software and custom implemented software were considered.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room D-109

DESIGN OF AN INTEGRATED SENSOR SYSTEM

by Ali Othman, Robin Datta, and Yew Shean Woon
Faculty Advisor: Massood Zandi Atashbar
9:00 a.m. to 9:25 a.m., Room D-109

A portable and versatile integrated sensor system was designed and built. A differential measurement system was implemented to read the difference in frequency of two oscillators composed of Shear Horizontal-Surface Acoustic Wave (SH-SAW) sensors and related circuitry. One oscillator was used as the reference signal, while the other was in contact with the measurand (typically biological fluids). The differential signal was then fed to a microcontroller and digitally processed for data acquisition. The frequency of the signal was then displayed on an LCD screen and also stored into memory for further processing and decision-making.

ACCELEROMETER-BASED INERTIAL NAVIGATION SYSTEM

by Michael Calabrese, David Engblom, and Aaron Fleckenstein
Sponsor: Michigan Space Grant Consortium
Faculty Advisor: Frank Severance
9:30 a.m. to 9:55 a.m., Room D-109

Accelerometer-based inertial navigation systems present an inexpensive alternative to gyroscope and global positioning navigation systems. An array of accelerometers comprises the basic design of the inertial navigation system. The position of the device can be continuously updated based on the previous device location and measurements of the device acceleration. There are fewer moving parts in an accelerometer-based system than in a gyroscopic device, and it is free of the earth bound constraints of a global positioning system. The prototype wirelessly interfaces with a data-collection system, which processes the data and provides a graphical display of the trajectory traveled.

CONTROLS FOR FUEL INJECTION TEST BENCH
by Robert Hancasky, Brandon Koenigsknecht, and Bryan Martin
Sponsor: Dunigan Motor Racing
Faculty Advisor: Ralph Tanner
10:00 a.m. to 10:25 a.m., Room D-109

An auto racing company required a method of testing their race cars' methanol fuel injectors for proper atomization and flow rate consistency under a variety of engine load and throttle conditions. A system was designed to meet this requirement. The design uses a Motorola 68HC12 microprocessor in collaboration with a PC-based human interface to both read data in from fuel pressure and flow rate transducers and write data out to a mechanical throttle body and an array of solenoid valves. The user of the system is able to either conduct simple tests at a set engine RPM and throttle position or write a command script to carry out more sophisticated dynamic tests with varying conditions.

INFRARED FABRIC TEMPERATURE MEASUREMENT SYSTEM
by Phillip English, Jeff Swinger, and Ryan Wernette
Sponsor: Michele Paustian, Whirlpool Corporation
Faculty Advisor: Ikhlas Abdel-Qader
10:30 a.m. to 10:55 a.m., Room D-109

The home appliance industry is constantly seeking out ways to provide more efficient clothes' dryers. A solution was accomplished by designing and implementing a transferable infrared probe system that monitors the temperature of the clothes in real time and sends that information to a specialized LabView station, where it is saved and displayed graphically. This device has also been modified to work with a microcontroller to show the ability to communicate with the dryer control system in order to maximize dryer efficiency.

SENSOR-BASED TELEROBOTIC ARM
by Aziza Fadadi and Luvlesh Bhajoo
Faculty Advisor: Norali Pernalete
11:00 a.m. to 11:25 a.m., Room D-109

Tele-operation is widely used in medical fields, space exploration, and national defense. A control system for a telerobotic arm was designed, implemented, and built. It uses proximity and pressure sensors to help the user perform a task. The system allows for user defined tasks while

providing appropriate assistance based on the environmental conditions determined by the sensors. The system controls a UMI-RTX robotic manipulator to mimic the movements produced by the user with a small robotic device that senses and tracks the user's movements.

RADIO TELESCOPE DATA STORAGE SYSTEM
by Daniel Kelbel, Zoheb Qureshi, and Matthew Starr
Faculty Advisors: Bradley Bazuin and Frank Severance
11:30 a.m. to 11:55 a.m., Room D-109

Digitized data preprocessing and solar event detection capabilities were incorporated and a flexible, software controlled data storage subsystem was added to an existing solar radio telescope. New system components include an Analog Devices ADSP-BF535 Digital Signal Processor (DSP) that allows continuous, real-time signal processing of solar activity and a Freescale MC9S12UF32 microcontroller that collects, formats, and stores digitized data and other relevant information on an external, portable hard disk drive when commanded. The new system components have provided critical tools that allow radio astronomers to capture solar activity and analyze detected events.

INDUSTRIAL AND MANUFACTURING ENGINEERING

Session Chair – Betsy Aller
Room D-208

V-TWIN ENGINE ELECTROMAGNETIC COMPATIBILITY TEST INVESTIGATION

by Jeff Leppert, Craig Nelson, Michael Perry, Jason Phillips, and Warren White
Sponsor: Michael Kleczewski, Kohler Company
Faculty Advisor: James VanDePolder
10:00 a.m. to 10:25 a.m., Room D-208

Electromagnetic compatibility (EMC) is the ability of multiple electrical or electronic systems to function properly in the same environment without interfering with each other. A major manufacturer's engines need to meet the international standard for EMC. The current solution is neither cost effective nor easy to implement and low cost alternatives are required. Key sources of interference found in a standard engine and electrical system were researched. The V-twin engines were then tested and research into the results was conducted in order to suggest cost effective options for the reduction of emissions.

THE REDESIGN OF THE SWIMMING POOL BULKHEAD MOVING PROCESS

by Megan Lamont, Alejandro Rodriguez, and Justin Vriezema
Faculty Advisor: David Lyth
10:30 a.m. to 10:55 a.m., Room D-208

A need existed for a safe and efficient process to move the bulkhead at a natatorium. Bulkheads are moveable partitions that give flexibility to swimming pools by allowing two activities to go on at the same time. The current method is both inefficient and dangerous. The design team weighed and analyzed several alternative methods for maneuvering this partition, making use of cost analysis, ergonomics, statics, and design principles. Safety, time, and cost efficiency were all taken into consideration as the most feasible method was chosen and recommendations provided.

TRANSFORMING CARE AT THE BEDSIDE (TCAB)
by Jeff Hills, Josh Maes, Corey Semrow, and Carl Utess
Sponsor: Nikki Romence, Bronson Methodist Hospital
Faculty Advisor: Larry Mallak
11:00 a.m. to 11:25 a.m., Room D-208

Research at a local hospital suggests that nurses currently spend less than half of their time delivering direct patient care. The majority of nurses' time is spent moving between patient rooms, in the nursing unit core, or in the nursing station. Current supply processes and procedures were evaluated to develop a nurse supply system, which eliminated backtracking and bottlenecking. Improved nurse efficiency and increased time spent delivering direct patient care allowed nurses to transform care at the bedside. Innovative supply systems were proposed and evaluated based on time and motion studies, efficiency, and amount of nurses' time in direct patient care.

VENTILATION DUCTING HOLE CUTTER
by Adam Ritchie, Luka Bacal, Matt Getty, and Ryan Severns
Sponsor: Daniel Ritchie, EZ Concepts
Faculty Advisor: Mitchel Keil
11:30 a.m. to 11:55 a.m., Room D-208

Traditional methods for cutting holes in Heating, Ventilation, and Air Conditioning (HVAC) ducting include using a reciprocating saw, shears, or a nibbler. These methods are slow, wasteful, and generally ineffective. A portable tool was designed that would cut a 6 inch uniform hole in galvanized sheet steel with minimal scrap. Benefits include efficiency, lightweight design, and the simplicity of cutting from one side. Tests for durability, strength, repeatability, and functionality determined which design would best meet the project's objectives, ultimately leading to a working prototype. If manufactured, this new and innovative tool will be safer, more productive, and more responsive to the needs of the HVAC industry.

USING VIRTUAL REALITY SIMULATION FOR SAFE HUMAN-ROBOT INTERACTION
by Brad Armstrong and Dana Gronau
Faculty Advisor: Pavel Ikonomov
1:00 p.m. to 1:25 p.m., Room D-208

It is becoming more common in manufacturing environments for a human to work alongside a robot. This project explored various ways a robot can successfully interact with a human who enters its range of motion without causing harm to the human. Virtual reality simulation with

EON Reality software was used to test different scenarios with a virtual robot and a virtual human. Results found in the virtual simulations were then transferred to a real robot. The results of this project will help improve safety conditions for those who work alongside robots.

REDESIGN OF AN EMERGENCY MEDICAL CHAIR MANUFACTURING SYSTEM
by Abdullah Al-Abbas, Maria Candela, Deanna Cunningham, and Daniel Grupp
Sponsor: Gary Hagler, Stryker Medical
Faculty Advisors: Steven Butt and Tycho Fredericks
1:30 p.m. to 1:55 p.m., Room D-208

The tragedy of September 11, 2001 caused a rapid increase in demand for emergency evacuation products, such as the Stair Chair Pro. Using work measurement techniques, statistics, and simulation models, the production system of the Stair Chair Pro was evaluated and then re-designed to expand production capacity. Ergonomic issues of the high-weight product manufacture were assessed and incorporated into the proposed changes. The new production system is currently under consideration by the sponsor

REVERSE ENGINEERING OF COMPLEX PARTS
by Clint Barnard, Mark Gajsiewicz, and Roger Anthony
Faculty Advisor: Jorge Rodriguez
2:00 p.m. to 2:25 p.m., Room D-208

After a manufactured part reaches the consumer, various changes may transpire throughout its lifetime such as redesign, improvements, damages, and lost documentation. Reverse engineering (RE) is an ideal option to encompass the range of modifications. Using various hardware and software combinations, study, analysis, and documentation of the procedure was performed to generate practical 3-D models. Guidelines to assist future users to produce effective time and money saving models were then created based on these findings.

MECHANICAL AND AERONAUTICAL ENGINEERING – A

Session Chairs – Richard Hathaway and Phil Guichelaar
Room D-115

STRUCTURAL ANALYSIS AND REDESIGN OF A HAWK MIDGET CHASSIS

by Duriel D. Ellison, Hiroshi Fujimoto, and Aida Kiilu
Faculty Advisor: Richard Hathaway
9:00 a.m. to 9:25 a.m., Room D-115

The structural analysis and redesign of a chassis for a USAC Ford Focus Midget Race car was completed. Power generated by the race car's engine is useless if the driver cannot control the vehicle. Therefore, it is essential for the chassis to maintain its structural integrity and rigidity during the course of a race to effectively compete at a high performance level. To maximize chassis performance, the vehicle structure was redesigned in Pro E and analyzed in ANSYS 8.1.

SUSPENSION ANALYSIS AND REDESIGN OF A HANDICAP ACCESSIBLE VAN

by Kristopher Ellis and James Harden
Sponsor: Dominic Bushini, View Point Mobility LLC
Faculty Advisor: Richard Hathaway
9:30 a.m. to 9:55 a.m., Room D-115

The suspension of a handicap accessible minivan has been redesigned to improve vehicle ride, handling, and reliability. The Ford Freestar minivan was evaluated and redesigned to obtain proper ride rates in the front and rear suspensions; reduce rear ride height; and increase component life. Several design possibilities were analyzed and compared for their reliability, implementation process, and aesthetics. From this analysis, the most cost effective solution was chosen. A second and more costly design of an independent rear suspension was developed for future implementation.

DESIGN OF A MECHANICAL WHEELCHAIR LIFT FOR A SPORT UTILITY VEHICLE

by Jeffrey Brooks, William Morris, and James Stander
Faculty Advisor: James Kamman
10:00 a.m. to 10:25 a.m., Room D-115

A wheelchair lift was designed for a sport utility vehicle (SUV). Presently, lifts are available for use on vans with sliding/butterfly doors. The new lift will expand the automotive market by providing an alternative to the disabled community. The new lift was designed to be compact and inexpensive with minimal vehicle modification. Safety, reliability and ease of use were also incorporated into the design.

THE DESIGN OF A DUAL FUNCTION SHOCK ABSORBER DYNAMOMETER
by Aaron Rimpel, Patrick Ennis, and Shannon Dykman
Sponsors: Greg Griffin, Griffin Tool, Inc. and David Shephard, Bearing Service, Inc.
Faculty Advisor: James Kamman
10:30 a.m. to 10:55 a.m., Room D-115

A dual-function shock absorber dynamometer was designed, built, and verified as a fully functional prototype. The dynamometer characterizes a shock absorber by measuring its dynamic force-velocity relationship. Data is captured using either a simple mechanism (for visual feedback) or using electronic instrumentation and data acquisition. This design incorporates both methods for increased versatility. Currently, there are no dynamometers on the market that utilize both of these capabilities.

REFRIGERANT RECOVERY PUMP
by Lindsay Edwards, Laura Eidson, and Jessica Wingett
Sponsor: Gast Manufacturing, Inc.
Faculty Advisor: Philip Guichelaar
11:00 a.m. to 11:25 a.m., Room D-115

A rocking piston pump was designed that will recover refrigerant from commercial refrigeration units. Alternative designs were evaluated for efficiency and pumping rate. Stress analyses on the operating components were completed to ensure that the pump would meet design life objectives.

PORTABLE RACE CAR LIFT SYSTEM
by Rick Meirndorf, Brian Skiba, and Jonah Standish
Sponsors: Bob Reiger, Depatie Fluid Power and Brad Roberts, L&R Motorsports
Faculty Advisor: Judah Ari-Gur
11:30 a.m. to 11:55 a.m., Room D-115

A portable mechanism was developed for the lifting of race vehicles with a ground clearance of four inches. The design is capable of raising a 3,000 pound car 20 inches from ground level. The entire lifting process is completed in less than two minutes and is performed by a single crew member. This device is safe, compact, and has a cost comparable to systems currently on the market.

CONING REDUCTION IN A COMMERCIAL VEHICLE BRAKE ROTOR
by Jeff Grey and Joe Jerz
Sponsor: Jim Clark and Alan Hendershot, Bendix Spicer Foundation Brakes, LLC
Faculty Advisor: Ho Sung Lee
1:00 p.m. to 1:25 p.m., Room D-115

Minimal coning of a commercial vehicle brake rotor is critical to its useful life and performance. An undesirable amount of coning during braking leads to reduced brake performance and cracks in the rotor faces. Many rotor design alternatives were researched and a preferred design was tested using Pro Engineer computer software, specifically, Pro-Mechanica. Prototypes were then created and tested. Test results of the initial prototypes eventually led to the development of the final brake rotor design.

LEAN MANUFACTURING SOLUTION FOR DIAPHRAGM ASSEMBLIES
by Stephen Kondrat, Bryan Morehouse, and Michelle Moulton
Sponsor: Tom Wessel and Dave Remus, Parker Hannifin Corporation, Pneumatic Division
Faculty Advisor: James Kamman
1:30 p.m. to 1:55 p.m., Room D-115

Electro-mechanical assembly fixtures for manufacturing air pressure regulator diaphragms were designed and built. The new fixtures are designed to assemble and test four different size diaphragms and to meet the Occupational Safety and Health Administration's standards for maximum operator safety. The speed and accuracy of the new fixtures will allow the sponsor to produce higher quality products and reduce inventory levels, which reinforces the sponsor's lean manufacturing philosophy.

PORTABLE MOTORCYLE LOADING MECHANISM
by Ryan Casanova and Nathan Muller
Faculty Advisor: Daniel Kujawski
2:00 p.m. to 2:25 p.m., Room D-115

A motorcycle loading mechanism was designed to provide the means for one person to safely elevate and load a motorcycle into a bed of a pickup truck. The device consists of a rolling ramp, track system, and cable winch. It is capable of lifting any motorcycle that is under 5½ feet in length and under 1,000 pounds. For portability, the mechanism itself was designed to load into the truck bed along with the motorcycle. This device makes the loading process easy and above all, safe.

INTERFERENCE PRESS FIT ANALYSIS

by Jerry Boza, Amy Conine, and Jason Schutter
Sponsor: Rory Adams, FEMA Corporation
Faculty Advisor: Daniel Kujawski
2:30 p.m. to 2:55 p.m., Room D-115

A technique was developed to improve correlation between computer modeling and experimental testing for press fits through the use of Finite Element Analysis (FEA) Software. A press fit is a method of assembling two components in which the interference between the two parts joins them together. There are numerous factors affecting press fits such as, interference, part geometry, and material. These factors as well as the inherent limitations of existing equations for estimating press forces, makes prediction of press fit behavior quite difficult. The ability to use FEA to accurately design a new press fit provides significant reduction in design time.

MECHANICAL AND AERONAUTICAL ENGINEERING - B

Session Chairs – Dennis Vanden Brink and Tianshu Liu
Room D-201

DESIGN AND SIMULATION OF A TEST BENCH FOR PNEUMATIC VALVES

by Nicholas Murphy-DuBay and Ryan Mills
Sponsor: Ronald A. Moner, Parker Hannifin, Brass Products Division
Faculty Advisor: Christopher Cho
9:00 a.m. to 9:25 a.m., Room D-201

Development of a pneumatic system requires a thorough understanding of the impact of the internal geometries of the system on the airflow. A test fixture was designed and constructed to determine the flow coefficient of tube fittings based on an industry standard. The experimental data obtained from the fixture was compared to the results of computational fluid dynamics simulations. A correction factor was derived from this comparison for use in the development of new tube fittings.

INVESTIGATION OF A RADIANT HEATING ELEMENT

by Ryan Allen, Nate Smith, and Phuong Tran
Sponsor: Bob Donarski, Scott Sichmeller, and Dave Thomas, Whirlpool Corporation
Faculty Advisor: Christopher Cho
9:30 a.m. to 9:55 a.m., Room D-201

A radiant electric heating element was investigated for use in a future residential broiling appliance. First, a theoretical model of the system was developed for general assessment. Second, a CAD solid model was created and computationally analyzed using Solidworks and Cosmos software. Finally, a functional prototype was constructed for testing and validation against the analytical and computational models.

ANALYSIS OF FLUID FLOW

by Tony Cribari, Pat Michels, and Paul Schaap
Sponsor: Tom Lago and Charlie Reynolds, Armstrong International
Faculty Advisor: Christopher Cho
10:00 a.m. to 10:25 a.m., Room D-201

Stopping valve leakage in the “K” series steam trap was the overall goal for this project. The operation of the valves in the steam trap failed to close fully with the presence of steam in the trap. Using a computational fluid dynamics program (FLUENT), the flow within the trap was modeled and analyzed. The steam flow was first modeled with a simplified geometry before being modeled in the actual trap. This information allowed the redesign of internal mechanisms to decrease the turbulent flow within the trap. The focus of the redesign revolved around the

baffle plate. Using different design alternatives, prototypes were created and live testing was completed.

EXHAUST SYSTEM FOR A SALAMANDER BROILER
by Kurt Garza, Ryan Kremer, and Chris Reed
Faculty Advisor: Ho Sung Lee
10:30 a.m. to 10:55 a.m., Room D-201

A smoke elimination exhaust system was designed and created to be used with a Salamander Broiler in a residential environment. The exhaust system was designed to capture and filter smoke and other impurities from the air in the broiler before it is allowed to circulate back into the ambient environment. The integration of software and lab testing were used to test a variety of designs and materials to produce the most efficient and economical product.

LABVIEW INTERFACING AND TESTING OF AN ELECTROPLATING SYSTEM
by Deepak Ravindra and Sudesh Woodiga
Faculty Advisor: Muralidhar Ghantasala
11:00 a.m. to 11:25 a.m., Room D-201

An electroplating system for the fabrication of micro and nano structures was developed. The three important objectives of this project were LabVIEW interfacing of an electroplating power supply, design and fabrication of an electroplating jig which can accommodate three different substrate sizes, and electroforming of test patterns with μm size features. The final product of this project is an automated potentiostat connected to an electroplating jig to facilitate plating of a large number of micro structures on single substrate which was tested and verified with the fabrication of micro actuators.

DESIGN OF A TELEROBOTIC ARM THAT MANIPULATES OBJECTS ON A HUMAN SCALE
by James Kamanda and Kevin Doyle
Sponsor: Robert Nelson, PAGE 5
Faculty Advisor: Koorosh Naghshineh
11:30 a.m. to 11:55 a.m., Room D-201

A simple one degree of freedom device for gripping small objects was designed by Robert Nelson in 1995 for use by hobbyists. A new telerobotic arm has been designed to include three additional degrees of freedom, (vertical, horizontal and rotational movement) that can manipulate objects up to five pounds on a human scale. This new telerobotic arm has been designed, built and analyzed while optimizing the cost, weight, materials, manufacturing and assembly process. At least 90 percent of the mechanical and structural elements are made of parts engraved from high strength-to-weight ratio plastic sheets and were assembled with adhesives in place of mechanical fasteners to provide improved structural integrity. This

technology is being developed as a prototype for future designs that can be used to manipulate objects in clean rooms or medical facilities.

EXPERIMENTAL ANALYSIS OF THE ARCWING DESIGN
by Paul Kondrat, Michael Schulte, and Dave Sculthorpe
Sponsor: Bill Bertelsen, Aeromobile Inc.
Faculty Advisor: Tianshu Liu
1:00 p.m. to 1:25 p.m., Room D-201

The experimental analysis of the arcwing design in a wind tunnel yielded aerodynamic characteristics for an arcwing model. The arcwing design is a curve shaped wing designed to function in the propeller wash of an airplane. The aerodynamic characteristics of this wing were determined over a range of airspeeds and angles of attack so that comparisons could be made to standard wing designs. This information was then compared to results from a similarly designed flat wing. The comparison was used to justify the practical applications for an arcwing versus a standard flat wing.

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 November 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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Bendix Spicer Foundation Brakes, LLC
Bronson Methodist Hospital
Depatie Fluid Power
Dunigan Motor Racing
EZ Concepts
FEMA Corporation
Gast Manufacturing, Inc.
Griffin Tool, Inc.
Kohler Company
L&R Motorsports
Michigan Space Grant Consortium
PAGE 5
Parker Hannifin, Brass Products Division
Parker Hannifin, Pneumatic Division
Styker Medical
View Point Mobility LLC
Whirlpool Corporation

The College of Engineering and Applied Sciences offers a wide variety of programs.

Civil and Construction Engineering

- Civil engineering
- Construction engineering

Computer Science

- Computer science – theory and analysis
- Computer science - general option

Electrical and Computer Engineering

- Computer engineering
- Electrical engineering

Industrial and Manufacturing Engineering

- Engineering graphics and design technology
- Engineering management technology
- Industrial engineering
- Manufacturing engineering technology

Manufacturing Engineering (Muskegon and Battle Creek only)

Mechanical and Aeronautical Engineering

- Aeronautical engineering
- Mechanical engineering

Paper Engineering, Chemical Engineering, and Imaging

- Chemical engineering
- Paper engineering
- Paper science
- Imaging

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