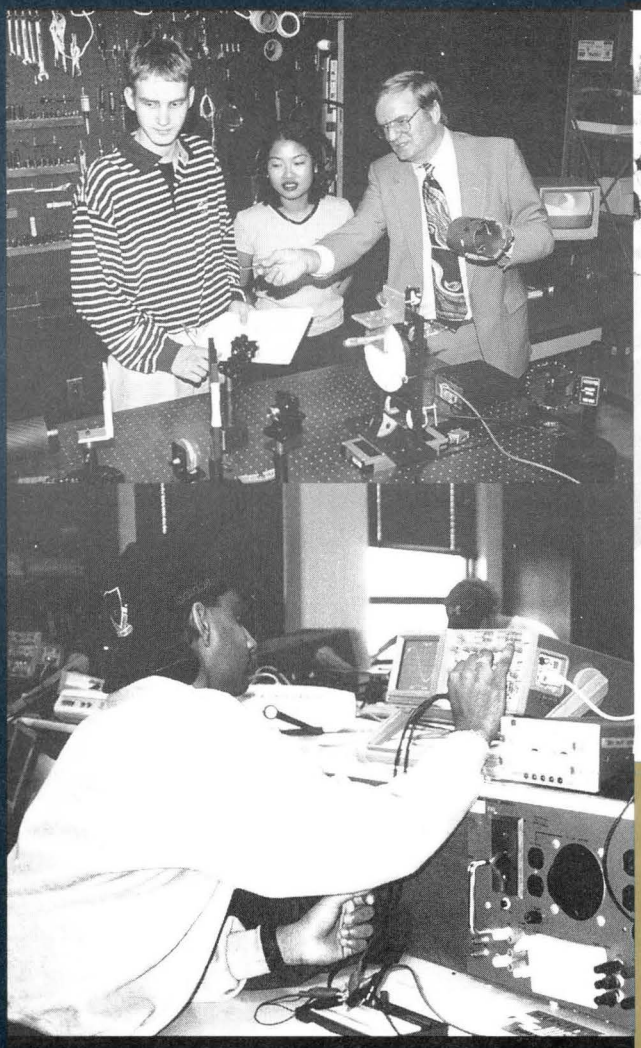
4-2000

26th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

26th Conference on Senior Engineering Design Projects



Tuesday, April 11, 2000

Bernhard Center

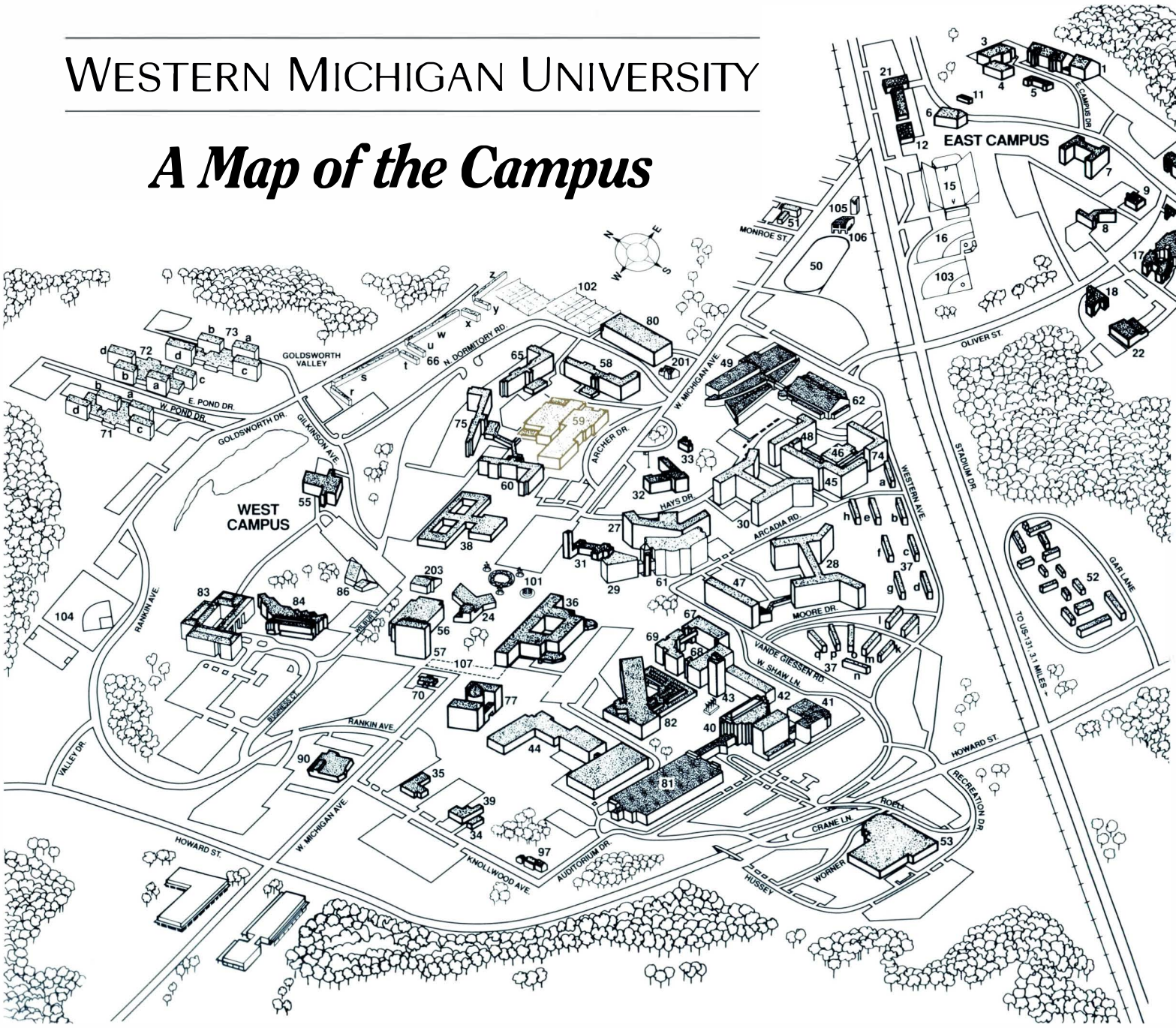
9:00 a.m. to 3:30 p.m.

College of Engineering and Applied Sciences

Western Michigan University

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Alphabetical guide to buildings

32	Administration Building	D3
40	Auditorium, Miller	D4
16	Baseball Field, Hyames	E2
59	Bernhard Center	C3
12	Brink Printing Services	E1
42	Brown Hall	D4
22	Campus Services Building	F2
31	Chapel, Kanley	C3
29	Computing Center	D3
82	Dalton Center	D4
68	Dunbar Hall	D4
01	East Hall	F1
103	Ebert Softball Field	E2
58	Ellsworth Hall	C2
57	Everett Tower	C4
77	Faunce Student Services Building	C4
84	Fetzer Center	B4
62	Fieldhouse, Read	E2
67	Friedmann Hall	D4
85	Gilmore House	G2
18	H.O.I. Building	F2
55	Health Center, Sindecuse	B3
60	Henry Hall	C3
24	Honors College, Lee	C3
16	Hyames Field	E2
53	Ice Arena and Natatorium	E5
104	Intramural Fields	A3
31	Kanley Chapel	C3
50	Kanley Running Track	D2
69	Knauss Hall	D4
39	Knollwood Building	C5
34	Knollwood Metal Building	C5
44	Kohrman Hall	C4
101	Kruglak Sundial and Promenade	C3
53	Lawson Ice Arena and Gabel Natatorium	E5
24	Lee Honors College	C3
61	Library, Waldo	D3
27	McCracken Hall	D3
40	Miller Auditorium	D4
19	Montague House	F2
47	Moore Hall	D3
53	Natatorium and Ice Arena	E5
03	North Hall	F1
06	Oakland Gymnasium	E1
09	Oakland Recital Hall	F1
33	Oaklands, The	D3
80	Parking Structure I	D2
81	Parking Structure II	D5
21	Physical Plant Building	E1
12	Printing Services, Brink	E1
101	Promenade and Kruglak Sundial	C3
51	Public Safety	D1
70	Public Safety Annex	B4
62	Read Fieldhouse	E2
105	Repelling Tower	D2
56	Rood Hall	B4
86	St. Aidan's Chapel	B3-4
38	Sangren Hall	C3
97	Sara Swickard Preschool	C5
83	Schneider Hall	A4
107	Science Addition (Proposed)	C4
32	Seibert Administration Building	D3
41	Shaw Theatre	D4
55	Sindecuse Health Center	B3
104	Soccer Field	A3
103	Softball Field	E2
102	Sorensen Tennis Courts	C2
05	Speech and Hearing Center	F1
43	Sprau Tower	D4
49	Student Recreation Center	D2
77	Student Services Building, Faunce	C4
41	Theatres, University	D4
106	Track Building	D2
35	Trimpe Building	B4
11	Upholstery Shop	E1
17	University Medical and Health Sciences Center	F2
41	University Theatres	D4
61	Waldo Library	D3
15	Waldo Stadium	E1
10	Walwood Hall	F1
90	Welborn Hall	B4
04	West Hall	E1 D1
36	Wood Hall	C4

Residence Halls and Apartments

75	Bigelow Hall and Annex	C3
28	Burnham Halls	D3
45	Davis Hall	E3
46	Davis Food Commons	D2
30	Draper Hall	D3
37	Elmwood Apartments A-Q	E3-4
74	French Hall	E3
66	Goldsworth Valley Apartments	B2
60	Henry Hall	C3
65	Hoekje Hall	C2
30	Siedschlag Hall	D3
8	Spindler Hall	F2
52	Stadium Drive Apartments	F3
7	Vandercook Hall	F1
48	Zimmerman Hall	D3

Goldsworth Valley Units 1, 2, 3

73b	Ackley Hall	A2
73c	Britton Hall	B2
72a	Eicher Hall	A2
71b	Eldridge Hall	A2
71d	Fox Hall	A2
72d	Garneau Hall	A2
73a	Hadley Hall	B2
71a	Harrison Hall	A2
72b	Harvey Hall	A2
72c	LeFevre Hall	A2
73d	Shilling Hall	A2
71c	Stinson Hall	A2

Private Property

201	Lutheran Student Center	D2-3
203	Wesley Foundation	B3-4

Conference on Senior Engineering Design Projects

You are invited to attend the twenty-sixth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 3:30 p.m. **Tuesday, April 11**, at the Bernhard Center on the campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry.

The conference is **free** and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the circular drive in front of the Bernhard Center and then park in the lot in front of Hoekje Hall. (See map; take North Dormitory Road. Hoekje is #65 on the map.)

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

Parking is available in the ramp near the Bernhard Center.

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

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

Construction Engineering	242	9:30 to 10:00	p. 4
Construction Science and Management	242	10:00 to 10:30	p. 5
Electrical and Computer Engineering	208	9:00 to 2:30	p. 6
Industrial and Manufacturing Engineering A-I	204	9:00 to 10:30	p. 9
Industrial and Manufacturing Engineering B-I	205	9:00 to 11:30	p. 12
Industrial Design	242	11:00 to 11:30	p. 15
Materials Engineering	242	9:00 to 9:30	p. 18
Mechanical and Aeronautical Engineering A-I	157	9:00 to 3:00	p. 19
Mechanical and Aeronautical Engineering B-I	158	9:00 to 12:00	p. 23
Mechanical and Aeronautical Engineering C-I	159	9:00 to 12:00	p. 25
Paper and Printing Science and Engineering	215	9:00 to 11:00	p. 27

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

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

For more information about the conference, call Dace Copeland at (616) 387-4017.

CE = Construction Engineering
CSM = Construction Science and Management
ECE = Electrical and Computer Engineering
ID = Industrial Design
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
MSE = Materials Engineering
PSE = Paper Science and Engineering

Time	Room	Dept.	Topic
9:00	242	MSE	Electrodeposited Nano-composite Coatings
	208	ECE	Universal Wire Harness Tester
	204	IME A-I	Simulating Performance of the Solar Car Chassis
	205	IME B-I	Capacity Analysis of Origination Department for Lean Manufacturing
	157	MAE A-I	Sample Cooler
	158	MAE B-I	Biaxial Extensometer
	159	MAE C-I	An Aerodynamic Study and Redesign of Landing Gear Fairings
	215	PSE	Haptics Methodology and Physical Characteristics of Tissue
9:30	242	CE	Milham Road U.S.-131 Overpass / Bridge Reconstruction
	208	ECE	Data Acquisition System
	204	IME A-I	Analysis and Redesign of Bracket
	205	IME B-I	Development of an Academic Course Scheduling Interface
	157	MAE A-I	Gauge Design for Spider Assembly
	158	MAE B-I	Improved Wear In Commercial Ball Joint Application
	159	MAE C-I	Overhead Projector Wind Tunnel
	215	PSE	Web-Based Interface to Enhance Advanced Learning
10:00	242	CSM	Construction Plans for a Transportation Service Center
	208	ECE	Electrocardiograph Monitor with Software Analysis
	204	IME A-I	Evaluation Methodology for MCAD Software Comparison
	205	IME B-I	Completion of Copper Wear Data for Plastic Injection Molds
	157	MAE A-I	Analysis of a Vibratory Finishing Machine
	158	MAE B-I	Buckling Phenomena Testing Apparatus
	159	MAE C-I	Airflow Simulation of Compressor Valves
	215	PSE	The Effect of Tale on the COF of LWC-Rotogravure

10:30	208	ECE	Digital Dynamometer Test Stand
	204	IME A-I	Advanced Parametric Modeling
	205	IME B-I	Inventory Planning and Production Control System: Supplier to Point-Of-Use
	157	MAE A-I	Design of Admustment Fixture for Hydraulic Valve
	158	MAE B-I	Modification of Robotic Extractor Arm
	159	MAE C-I	Air Flow Measurement for a Surgical Helmet
	215	PSE	Hot Melt Inks for a Gravure Process
11:00	242	ID	Connecting the Campuses
	208	ECE	Induction Motor Speed Controller
	204	IME A-I	The Effect of Vibrations in Handheld Tools
	205	IME B-I	Modular Packaging for a Sub Shop
	157	MAE A-I	Stabilizer Optimization for Auto Racing Applications
	158	MAE B-I	Collapsible Airfoil Mounting Mechanism
	159	MAE C-I	Feasibility Study on Alternate Energy Systems for the Proposed College of Engineering
11:30	242	ID	Scapular Fusion Harness
	208	ECE	NOVRAM Simulator
	204	IME A-I	Distortion of Aluminum Castings in Various Sand Binder Systems
	205	IME B-I	Implementing Lean Manufacturing in the Automotive Industry
	157	MAE A-I	Date Code Application Device
	158	MAE B-I	Fluid Traction Testing Machine
	159	MAE C-I	Alternative Household Power Generator
1:00	242	ID	Golf Pro Golf Cart
	208	ECE	Meteor Time-Stamping Device
	204	IME A-I	Thermal Distortion Testing of Various Sand Binder Systems
	157	MAE A-I	Feasibility of a Composite Frame in the WMU Solar Car
1:30	242	ID	Ready-to-Assemble Student Workstation
	208	ECE	Six-Cell Nickel-Metal Hydride Battery Pack Charger
	157	MAE A-I	Noise Reduction of an Acme-Gridley Multi-Spindle Bar Machine
2:00	242	ID	Compact Personal Transportation Vehicle
	208	ECE	Electrical Discharge Machine (EDM)
	157	MAE A-I	Redesign of an Orthopedic Shaver
2:30	242	ID	Corporate Jet Aircraft Interior Systems
	157	MAE A-I	Pressure Seal Door for a Washing Machine
3:00	242	ID	Modular/Plastic Vehicle

CONSTRUCTION ENGINEERING

Session Chair – Mohammed Haque
Room 242

MILHAM ROAD U.S.-131 OVERPASS / BRIDGE RECONSTRUCTION

by Clayton Martin, Paul Stack and Jeff Tessmer
Sponsor: Greg Johnson, P.E. – Michigan Department of Transportation
Faculty Advisor: Osama Abudayyeh
9:30 a.m. to 9:55 a.m., Room 242

This project studied the Milham Road Bridge / U.S.-131 overpass. An extensive cost estimate, a thorough time schedule, and an effective project management system were provided.

CONSTRUCTION SCIENCE AND MANAGEMENT

Session Chair – Osama Abudayyeh
Room 242

CONSTRUCTION PLANS FOR A TRANSPORTATION SERVICE CENTER

by Kurt Brandstatter and Jon Stepanovich
Sponsor: Michigan Department of Transportation
Faculty Advisor: Osama Abudayyeh
10:00 a.m. to 10:25 a.m., Room 242

Construction plans for a transportation service center were evaluated. An estimate of cost, time schedule, safety plan for the construction phase, and general project management to exercise control on costs and time restraint were supplied. Data related to the construction of this project was collected and compiled for an historical database for the future construction of similar buildings.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair – John Gesink
Room 208

UNIVERSAL WIRE HARNESS TESTER

by Matthew Johncox, Quentin Kingsbury and Jody Williford
Sponsor: Jeff Earl – Eaton Corporation
Faculty Advisor: Janos Grantner
9:00 a.m. to 9:25 a.m., Room 208

A truck component manufacturing company needed a tester to check wire harnesses. The Universal Wire Harness Tester (UWHT) was designed and built to solve this need using both hardware and software components. The Harness Tester includes a Programmable Logic controller programmed to automate the test. The UWHT has the ability to check a wire harness for continuity and short circuits. It can evaluate harnesses with up to 300 terminals. A Wire Harness Adapter unit was also designed and built to connect wire harnesses to the UWHT.

DATA ACQUISITION SYSTEM

by Mohamed Dilshard Harris, Kian Hoe Tan and Eng Lam Yap
Faculty Advisor: Johnson Asumadu
9:30 a.m. to 9:55 a.m., Room 208

A legacy portable magnetometer "Model G-816, EG&G Geometric" was used to measure the earth's magnetic field intensity. This device required the operator to manually record its measurements, causing a high risk for error. An automatic data acquisition system was developed to upgrade the magnetometer. The upgrade includes features such as automatic data storage in solid state memory, improved visual display and the ability to communicate to a computer via a serial link.

ELECTROCARDIOGRAPH MONITOR WITH SOFTWARE ANALYSIS

by Mohammed Al-masri, Mohamad Assadi and Brandon Schaefer
Faculty Advisor: Masood Atashbar
10:00 a.m. to 10:25 a.m., Room 208

Analyzing heart signals requires monitoring a patient's electrocardiograph (EKG) signals. A smart prototype system was developed and successfully tested to monitor these signals. The EKG signals were interfaced to a computer, and the developed software gave an elementary interpretation of the EKG data. The system has a capability of showing the EKG signals from ten different angles. The user can choose one or more of these angles. The signals may be viewed on a computer screen. The system then produces a final report of the heart's condition and suggests further testing as necessary to the physician.

DIGITAL DYNAMOMETER TEST STAND

by Lentz Becraft, Hermell Carter and George Lawrence
Faculty Advisor: Joseph A. Kelemen
10:30 a.m. to 10:55 a.m., Room 208

A digital instrumentation system for a D.C. motor dynamometer test stand was needed. The existing test stand used analog meters to measure voltages, currents, torque, and speed, which were manually recorded. A computer monitoring system was developed using LabVIEW software to achieve a more efficient way of recording and presenting data. A data acquisition board was used to convert analog signals into digital signals for use by LabVIEW. The software was used to create an instrumentation diagram of the test stand and to compute and display the motor's performance.

INDUCTION MOTOR SPEED CONTROLLER

by Hon Chun Chong, Amizahwati Abd Jaffear and Ahmad R. Mokhtar
Faculty Advisor: Johnson Asumadu
11:00 a.m. to 11:25 a.m., Room 208

An induction motor speed controller was built to control the speed in the range between one octave above and below the motor's rated speed. This was done by using a single phase, forced-self-commutated inverter, which provided a variable frequency and variable voltage supply to the motor. The motor power losses, due to the high frequency components of the square wave voltage, though higher than with a sine wave voltage, were not large enough to overheat the motor. The method used gave an excellent speed control without a modification to the motor.

NOVRAM SIMULATOR

by Gregory Foster, Christopher Nagarah and Brian Suggs
Sponsor: Greg Rabick – Stryker Instruments
Faculty Advisor: Frank L. Severance
11:30 a.m. to 11:55 a.m., Room 208

A simulation device to improve software design was developed for a medical instruments company. Currently software is designed and then loaded into a memory chip called NOVRAM. This chip is then placed into a surgical instrument and tested for proper operation. If errors are found, software changes are made and the implementation process is repeated. To achieve greater efficiency, a NOVRAM Simulator has been developed that will test software programs while shortening design time and lowering cost. A prototype program can be loaded into the NOVRAM Simulator and tested by engineers. Because the Simulator uses FLASH memory, the process can be repeated as many times as necessary without replacing parts.

METEOR TIME-STAMPING DEVICE

by Dhananjaya K. Gamage, Kah Yin Ng and Myat Tun Oo
Sponsor: Kalamazoo Astronomical Society
Faculty Advisor: Frank Severence
1:00 p.m. to 1:25 p.m., Room 208

The frequency of meteors and meteor showers are of major interest to astronomers. Currently, observers tally the occurrences of meteors at an hourly rate to produce a time histogram. To achieve a more accurate analysis, higher precision in date recording of meteoric events is required. Therefore, a portable Meteor Time-Stamping Device was designed, tested, and built to fulfill these needs. Data recording and processing capabilities were handled by a microcontroller. The recorded data was transferred off-line to a PC for statistical analysis. A Visual Basic program was used to process, analyze and display the summarized data.

SIX-CELL NICKEL-METAL HYDRIDE BATTERY PACK CHARGER

by Brian Bates, Jade Lynn Huee and Mo Hiang Lee
Sponsor: Bates Tech
Faculty Advisor: Dean Johnson
1:30 p.m. to 1:55 p.m., Room 208

Nickel-Metal Hydride (Ni-MH) batteries have been introduced into consumer markets. A specialized charger was built to handle a 6-cell pack of batteries used in remote controlled cars. The charger operates at 12 volts DC with currents reaching 6 Amps. A microcontroller was used to control the charge rate, time, and display. This portable charger can be connected to a wall power outlet or a 12 Volt battery. Convenience and safety were the main considerations in the design. The assembled charger's performance was evaluated against the original design specifications.

ELECTRICAL DISCHARGE MACHINE (EDM)

by Wesley Leonard, Steve Seyffert and Chad Stewart
Sponsors: Andrew Oswald – OZY Robotics and David Figgins – Figgins Machine Shop
Faculty Advisor: John L. Mason
2:00 p.m. to 2:25 p.m., Room 208

An inexpensive benchtop Electrical Discharge Machine (EDM) device was designed and built to provide spark erosion machining. The machine is controlled manually or by personal computer. The device drives three stepper motors for X, Y, and Z plane motion using microncontrollers. The EDM positions a grounded metal piece to be cut on its X-Y plane and then plunges a charged cutting head toward it until an electrical arc occurs. The arc removes a fragment of the metal, effectively cutting the material. The cutting head then retracts while the electrical charge of the power supply is restored.

INDUSTRIAL AND MANUFACTURING ENGINEERING A-I

Session Chair – Ralph Tanner
Room 204

SIMULATING PERFORMANCE OF THE SOLAR CAR CHASSIS

by Elaine Gilliam, Geoffrey Klein, Tom Rozema and Eugenia Tripp
Faculty Advisor: Mitchel Keil
9:00 a.m. to 9:25 a.m., Room 204

The WMU Sunseeker solar car is constantly evolving. Models must be created and tested. In the past, most of this testing was completed using prototypes – an expensive and time consuming process. The goal of this project was to use ADAMS simulation software to simulate tests performed on two solar cars. Data collected from these computer simulations were compared to physical data. Similarities and differences were noted so these models could be refined for use in the future development of WMU solar cars.

ANALYSIS AND REDESIGN OF BRACKET

by Vincent Tang Chee Kiong, Maha Maganderalingam, and Mike McCauley
Faculty Advisors: Mitchel Keil and Jorge Rodriguez
9:30 a.m. to 9:55 a.m., Room 204

A zinc die casting manufacturer was experiencing some problems with one of its die casting machines. The component that experienced failure was a bracket that supports the hydraulic cylinders that provide the clamping force for the die. The excessive deflection reduced the clamping force on the die, which resulted in increased re-manufacturing cost and lower productivity of this machine. Finite Element Analysis (FEA) software was utilized to study the design and evaluate the proposed improvements. A new design was manufactured, installed and tested.

EVALUATION METHODOLOGY FOR MCAD SOFTWARE COMPARISON

by Sara Deller, John Huhn and Jeff LaCroix
Faculty Advisors: Jorge Rodriguez and Murari Shah
10:00 a.m. to 10:25 a.m., Room 204

With the numerous Mechanical Computer Aided Design (MCAD) packages out on the market today, companies and individuals need to know which one is right for them. This project developed a generic methodology that evaluates MCAD software. The methodology, which can be applied to any solid modeling software, was developed based on three major PC-based MCAD packages: Solid Edge, SolidWorks, and Mechanical Desktop. In order to develop the methodology, several steps were taken. These steps included an identification period, an experimentation period, a criteria setting period, and an evaluation period. Finally, an evaluation checklist and documentation were developed.

ADVANCED PARAMETRIC MODELING

by Paul Breyer, Mark Bugnell, Brad Holmes and Scott Oakes
Sponsor: Western Michigan University
Faculty Advisors: Jorge Rodriguez and Murari Shah
10:30 a.m. to 10:55 a.m., Room 204

Parametric Modeling is a parameter-based method of creating CAD models. Due to global competition of today's consumer products, parametric modeling is a vital aspect of the design and manufacturing industry. It saves companies time and gets products to the consumer ahead of the competition. A key aspect of parametric modeling is the concept of Design Intent. Using Pro-Engineer modeling software, a series of part assemblies were created in order to establish and document efficient design techniques. Guidelines and tutorials were generated, tested and then updated to serve as a reference to improve parametric design modeling techniques.

THE EFFECT OF VIBRATIONS IN HANDHELD TOOLS

by Michael Corbat, Jon LaCroix, Ramsey Shurafa and Tameatha Towers
Faculty Advisor: Tycho Fredericks
11:00 a.m. to 11:25 a.m., Room 204

The goal of this project was to determine the consequences of vibrations on the human hand-arm sub-system, which are encountered while using hand held tools. This was accomplished using various tests and tools to determine which tool designs minimize the effects. This included the use of gloves and the application of dampening materials to the grips of the hand tools. Time and frequency domain calculations were utilized to quantify the effects of the vibrations. During the course of this project, it was determined that certain precautions can be taken to reduce the vibrations caused by hand held tools.

DISTORTION OF ALUMINUM CASTINGS IN VARIOUS SAND BINDER SYSTEMS

by Tariq Ali, Brian Chase, Mike Inyang and Jim Scarpelli
Faculty Advisors: Mitchel Keil, Sam Ramrattan, and Jorge Rodriguez
11:30 a.m. to 11:55 a.m., Room 204

The distortion of aluminum castings in various sand binder systems was studied. Silica sand and various chemical binders were used for making molds. Molten aluminum was poured into these molds at 1400° F. Using a machine, the thermal distortions of these different sand binder systems were measured. The results identified actual thermo-mechanical distortions on aluminum castings for established processing parameters.

THERMAL DISTORTION TESTING OF VARIOUS SAND BINDER SYSTEMS

by Eric Markos, Steven Poston and Mark Schuman
Faculty Advisor: Sam Ramrattan
1:00 p.m. to 1:25 p.m., Room 204

A thermal distortion tester was developed and used to test various sand binder systems used in the metal casting industry. Samples were tested under a predetermined temperature and load. The results were graphically represented as a time vs. temperature curve. The distortion information was compared to actual results under pouring conditions, which validated distortion testing usefulness to the casting industry in core and mold design.

INDUSTRIAL AND MANUFACTURING ENGINEERING B-I

Session Chair – Azim Houshyar
Room 205

CAPACITY ANALYSIS OF ORIGINATION DEPARTMENT FOR LEAN MANUFACTURING

by Bob Blower, Eric Osborn, Vay Phang, and Long Tran
Sponsor: Scott Eisen – Benteler Automotive
Faculty Advisor: Tarun Gupta
9:00 a.m. to 9:25 a.m., Room 205

Due to a four-fold increase in demand for exhaust systems used in the automotive industry, it became crucial to add new production lines with additional machinery and auxiliary equipment. This project involved analyzing existing capacities in the context of increasing projected demand levels over the next five years. Critical bottlenecks in the facility were determined and recommendations for additional capacity in respective areas were made. Finally, a total redesign of the existing department layout using lean manufacturing philosophy was performed to meet customer expectations.

DEVELOPMENT OF AN ACADEMIC COURSE SCHEDULING INTERFACE

by Jim Fox, Sally M. Makarewicz and Zadil Hanief M. Zaidi
Faculty Advisors: Michael B. Atkins and Steven E. Butt
9:30 a.m. to 9:55 a.m., Room 205

Academic scheduling is one of the most difficult tasks faced by departmental administrators. The conventional method is a manual process, which requires hours of sifting through paperwork. During the course of this project, software was developed to automate the course scheduling process. This process was based on a previously developed mixed integer programming model. The input interface was used to collect the relevant data and convert it into the form necessary for use by the scheduling engine. An output interface was developed to display the schedule developed by the engine. The interface was designed so that it could be used in conjunction with the current engine allowing any department throughout the university to use the system with little or no modifications.

COMPLETION OF COPPER WEAR DATA FOR PLASTIC INJECTION MOLDS

by Leonid Fedorovitch, Jeff Lewis, Marshall Proulx and Jen Vanover
Sponsor: Copper Development Association
Faculty Advisor: Paul Engelmann
10:00 a.m. to 10:25 a.m., Room 205

Copper alloys have been widely used in injection molds due to their high thermal conductivity. Copper has the unique cooling property to transfer heat, making an excellent plastics-to-water interface. However, copper has a lower resistance to wear than hardened tool steels. Previous research has measured the wear of coated and uncoated copper components in plastic injection molds. This project expanded and interpreted wear data sets for coated and uncoated copper alloy tool components, thus optimizing the wear of copper alloys in injection molding.

INVENTORY PLANNING AND PRODUCTION CONTROL SYSTEM: SUPPLIER TO POINT-OF-USE

by Joel Ebner, Tom Merkins, Sharon Murphy and Ai Ling Ngu
Sponsors: David Jerovsek and Jim Becker – Invensys Appliance Controls
Faculty Advisor: David Lyth
10:30 a.m. to 10:55 a.m., Room 205

Companies are attempting to lower inventory costs, increase productivity, and decrease time and costs associated with non-value-added activities through the techniques of lean manufacturing and Just-in-Time (JIT) philosophies. By taking a system view of the entire supply chain process of a manufacturer of electronic components, an inventory planning and production control system was developed. Computer simulation was used to test and evaluate the model's effect. This resulted in a more effective and efficient production process and a smoother flow of material from supplier to point-of-use.

MODULAR PACKAGING FOR A SUB SHOP

by Jonathan J. Cook, Chooi Yiang Keh, William D. Lintz III and Kon Oh
Sponsor: James Tomlinson – The Galley Submarine Sandwich Shop
Faculty Advisor: Colleen Phillips
11:00 a.m. to 11:25 a.m., Room 205

A local sub and sandwich shop was interested in expanding their current customer base. The management saw an opportunity to deliver their products to consumers in alternate locations. Expansion ideas included delivering their product to both customers in residential and business areas across the United States. These ideas are a result of a customer-driven interest to receive sub and sandwich shop products at their convenience. The sub and sandwich shop was provided with a consistent means of packaging and delivering fresh products on time to their customers. Market research and a financial analysis were performed to determine cost effectiveness.

IMPLEMENTING LEAN MANUFACTURING IN THE AUTOMOTIVE INDUSTRY

by Josh Delbarker, Steven Parker, Richard Stanton and Wataru Tsutsui
Sponsor: Scott Eisen – Benteler Industries
Faculty Advisor: Larry Mallak
11:30 a.m. to 11:55 a.m., Room 205

A west Michigan company was interested in implementing lean manufacturing in order to create a smoother process flow within one of its manufacturing lines. Lean manufacturing is a concept involving the removal of waste from every step within a production line, including energy, motion, time, and resources. Measurements were taken for each operation within the production line in order to look for areas to be improved upon. These measurements were then analyzed and standard work instructions were written for each operation to maintain acceptable levels of work in process (WIP) and reduce the total processing time.

INDUSTRIAL DESIGN

Session Chair – David Middleton
Room 242

CONNECTING THE CAMPUSES

by Daniel Alexander VanDerAue
Sponsor: John Sellars, V.P. – Titan Global Technologies, Ltd.
Faculty Advisor: David Middleton
11:00 a.m. to 11:25 a.m., Room 242

The new engineering campus will be 3.5 miles from main campus. In order to transport students to the new campus, a permanent tram system using magnetic propulsion technology was proposed. The project entailed interior and exterior vehicle design, overall systems layout, environmental design, and civil engineering. A safe, cost effective and environmentally friendly solution was developed.

SCAPULAR FUSION HARNESS

by Michael Kahwaji
Faculty Advisors: David Middleton and Roman Rabiej
11:30 a.m. to 11:55 a.m., Room 242

The invention of the scapular fusion harness eliminates the need for surgery for Facioscapularhumero muscular dystrophy patients. Muscular dystrophy (MD) is a well known disease that affects our society. The wasting of muscle mass causes loss of dexterity in the limbs of the affected patients. In some cases surgery can be performed to bypass the affects of MD. The surgery, however, is irreversible and involves high health risks to the patient. Surgery does not arrest the progress of MD thus making it impossible to foresee future implications. The scapular harness functions as an external immobilization device that secures the scapula in place and allows MD patients to gain mobility of their arms. The scapular harness functions in the same way as the surgery except that it can be removed in times of discomfort. The development of the harness involved intensive research with affected patients and their doctors.

GOLF PRO GOLF CART

by Steven Clifford and Cory Herbst
Faculty Advisor: Roman Rabiej
1:00 p.m. to 1:25 p.m., Room 242

Golf carts have remained similar and conservative throughout past decades. Golf carts have potentially much more to offer than just a ride through the links. The cart can become an important part of lowering one's handicap and adding comfort to the recreational user's outing. Comfort was increased through the use of new materials and ergonomic design. Function was added through the use of recent technological advances, such as range finders and digital recording capability. These new features will allow the golfer to analyze and improve his/her game throughout the round, versus throughout the season.

READY-TO-ASSEMBLE STUDENT WORKSTATION

by Kimberly Page and Tricia Shapland
Sponsor: Andis Dimants – Tenex Corporation
Facutly Advisor: David Middleton
1:30 p.m. to 1:55 p.m., Room 242

The Ready-to-Assemble Workstation is lightweight, compact, and adjustable. The workstation offers the college student or young professional maximum use of limited space. Because the target market has a restricted income, quality, low cost materials and assembly methods were emphasized. The result was an extremely high value versatile unit that accommodates the ever-changing needs of the individual.

COMPACT PERSONAL TRANSPORTATION VEHICLE

by Andre Carnevale and Erik J. Moses
Faculty Advisor: David Middleton
2:00 p.m. to 2:25 p.m., Room 242

The compact personal transportation vehicle minimizes negative impact on the environment. With today's population growth, the need for space is becoming more of a factor. Congestion on the roadways and pollution are major problems in today's society. Research based on alternative fuels and physical size of a vehicle guided the project solution. Consumer market, as well as ergonomic and engineering factors, led to the design of a vehicle that best suits the target market of environmentally aware individuals.

CORPORATE JET AIRCRAFT INTERIOR SYSTEMS

by Sherry Collin and Rex Cruz
Sponsor: Shelley Ewalt – Duncan Aviation
Faculty Advisor: David Middleton
2:30 p.m. to 2:55 p.m., Room 242

Today, more people than ever are flying for both business and pleasure. Due to rising dissatisfaction with commercial flights, companies are opting for an innovation known as fractional ownership. Rather than owning an entire jet, a company buys a share, sometimes as small as one-sixteenth. A versatile interior system that will satisfy the diverse needs of the user was designed.

MODULAR/PLASTIC VEHICLE

by Jonathan Klautky and Adam Matthew Nine
Faculty Advisor: David Middleton
3:00 p.m. to 3:25 p.m., Room 242

There are many problems in the design and production of an automobile. These problems arise in such areas as manufacturing, materials, machining, cost, number of parts and the one that totally goes unnoticed is the interaction of an Industrial Designer and an Engineer. Part of the solution is to design a modular or plastic vehicle and break it down into as few parts as possible with the use of state of the art technologies and materials in production and manufacturing. The second part of the solution is to bridge the communication gap between the Industrial Designer and the Engineer.

MATERIALS ENGINEERING

Session Chair – Pnina Ari-Gur
Room 242

ELECTRODEPOSITED NANO-COMPOSITE COATINGS

by Doug Hren
Faculty Advisor: Pnina Ari-Gur
9:00 a.m. to 9:25 a.m., Room 242

Coatings of nickel, nickel with SiC, PEEK and MoS_2 were electrodeposited on separate substrates of A1 2024-T3 to test the mechanical properties of the coated specimens for wear and elastic modulus. These were compared to untreated specimens. Wear testing was performed using pin-on-disk method, and tensile testing provided elastic modulus values. The concentration of nano-particles in the coatings was determined using scanning electron microscopy. Surface characteristics were examined using atomic force microscopy. The thickness of the coatings in relation to current and time of immersal was also determined. Applications for research include reduction of wear in engine components and increased stiffness for materials with a low elastic modulus.

MECHANICAL AND AERONAUTICAL ENGINEERING A-I

Session Chair – Jerry Hamelink
Room 157

SAMPLE COOLER

by Steve DeBat and Nick Evanoff
Sponsor: Harry Nielsen – Armstrong International, Inc.
Faculty Advisor: Christopher Cho
9:00 a.m. to 9:25 a.m., Room 157

A local manufacturing company has requested a design of a prototype steam condenser. In order to test the steam from a boiler, a sample cooler or heat exchanger is needed to condense the discharged sample to a safe measurable temperature. The current market of sample coolers was researched. A model was drafted using important factors of design, such as temperature, pressure, heat transfer coefficient, and mass flow rate. Materials were chosen based on the ASME pressure vessel code. The model was assembled, and preliminary tests of the prototype were conducted.

GAUGE DESIGN FOR SPIDER ASSEMBLY

by Matthew Hargis and Azadeh Narimissa
Sponsor: Darrell Telgenhoff – American Axle and Manufacturing
Faculty Advisor: Jerry Hamelink
9:30 a.m. to 9:55 a.m., Room 157

A local manufacturer needed a gauge to measure the distance between the bearing cups on a spider assembly. This measurement is a critical dimension for the application of the assembly. An accurate measurement technique was required. A consistent location of the bearing cups on the assembly was essential for each measurement reading. Statistical methods were used to evaluate the current measuring technique. A force analysis was conducted to determine the required parameters for the designed gauge. The designed gauge offers the repeatability and reproducibility needed to obtain accurate measurements. The design of the gauge is compliant with industry standards and is easy to operate. The local manufacturer also saved research and design costs.

ANALYSIS OF A VIBRATORY FINISHING MACHINE

by Michael R. Gose and Richard D. Shaver, Jr.
Sponsor: Charlie Casson – Hammond Machinery/Roto-Finish, Inc.
Faculty Advisor: Jerry Hamelink
10:00 a.m. to 10:25 a.m., Room 157

A local finishing company requested an experimental investigation of factors that influence the removal of material from small parts. The finishing is accomplished by means of forced vibrations using a variety of abrasive media. The media and parts move in a circular tumbling motion and the work is done when the media impinge upon the part. An improved tub design was proposed to determine if this would produce significant results over the conventional tub design. Conventional tub designs have the tub resting on springs whereas this design implemented springs to hang the tub. Testing was carried out on a scale model of current vibratory tubs. A design of experiments was employed to determine the optimal configuration for a corner breaking operation. Both a partial and a full factorial were done using controlling variables.

DESIGN OF ADJUSTMENT FIXTURE FOR HYDRAULIC VALVE

by J. Ryan Fletcher and Ed Leither
Sponsor: Fema Corp.
Faculty Advisor: Dennis VandenBrink
10:30 a.m. to 10:55 a.m., Room 157

A fixture was designed to adjust an electrically controlled hydraulic valve for production purposes. Testing was done on a sample of these valves to determine the force needed to press an orifice into the bore of the valve. After selecting a stepper motor, the mechanical structure was then designed such that the valve can be inserted easily and removed quickly. This structure was analyzed using FEA software to ensure proper strength as well as optimize for mass. A feedback system was also incorporated into the fixture to give an exact position of the orifice. The fixture was then built and tested.

STABILIZER OPTIMIZATION FOR AUTO RACING APPLICATIONS

by Jeffrey Peitzsch and James Smith
Sponsor: Dunnigan Racing
Faculty Advisor: Iskender Sahin
11:00 a.m. to 11:25 a.m., Room 157

A racing company required an optimized stabilizing system for one of its racecars. The key component of this system is an inverted wing, which produces negative lift at racing speeds. By increasing down-force and reducing drag, the improved design allows the vehicle to corner at higher speeds. The design process took into account such variables as geometry of the wing, surface effects, and proximity to the ground and other vehicle components. Simulation software and factorial experimentation were used to determine the optimum design.

DATE CODE APPLICATION DEVICE

by Jiunn Hau, Wally Kloosterman and Todd Moran
Sponsors Wen Han Teoh and James Lockwood – Total Logistic Control, Inc.
Faculty Advisor: Iskender Sahin
11:30 a.m. to 11:55 a.m., Room 157

A local packaging company needed an automatic date stamping device to replace its old manual method. The Date Code Application Device was designed, built, and evaluated to suit the given specification. This device utilizes a purely mechanical approach and does not have any electronic components. The device is portable and can be attached to a variety of packaging machines. Installation of this product is very convenient and also reduces the company's labor costs.

FEASIBILITY OF A COMPOSITE FRAME IN THE WMU SOLAR CAR

by Ethan Featherly, Jeffrey Scheuren and Matthew Waldschmidt
Faculty Advisor: Koorosh Naghshineh
1:00 p.m. to 1:25 p.m., Room 157

Composite materials are pound for pound much stronger than metals. This lead to the idea of utilizing composite materials for the frame of a solar car, where low weight is desired. Through testing of previous WMU solar cars, a set of constraints for the 2001 solar car frame was established. These constraints include torsional stiffness, bending strength and weight. The feasibility of using composites as a frame material was determined using Finite Element Analysis.

NOISE REDUCTION OF AN ACME-GRIDLEY MULTI-SPINDLE BAR MACHINE

by Julie M. Earle and Gregory M. Steffen
Sponsor: Tom Noyes – Parker Hannifin Corporation
Faculty Advisor: Koorosh Naghshineh
1:30 p.m. to 1:55 p.m., Room 157

The Acme-Gridley multi-spindle bar machine is a widely used six-spindle lathe used throughout the industry. This machine is extremely loud and produces a large amount of performance restricting vibrations. This project began with extensive research of noise and vibration reduction techniques. Next, tests were performed that pinpointed the sources of vibration. This data was analyzed to aid in the design and building of several vibration absorbing devices. These devices were implemented and resulting noise and vibration reduction measured.

REDESIGN OF AN ORTHOPEDIC SHAVER

by Kevin Engemann and Ross Thelen
Sponsors: Jason Allen and Drew Gant – Styrker Instruments
Faculty Advisor: Koorosh Naghshineh
2:00 p.m. to 2:25 p.m., Room 157

A local surgical instrument manufacturer was looking for a way to reduce the excessive noise levels of a 72,000 RPM motor used in an Orthopedic Shaver. A design of experiments was performed to examine the source of the excessive noise within the motor. Modifications were made to the rotor to improve the interface between the motor and the gear train. Further design changes were investigated that reduce motor speed but retain functional specifications.

PRESSURE SEAL DOOR FOR A WASHING MACHINE

by Joe Barker, Mark Christensen and Randy Rozema
Sponsor: Daniel Conrad, Brian May, Christina Underly, Tremitchell Wright and David Stankiewicz – Whirlpool Corporation
Faculty Advisor: Koorosh Naghshineh
2:30 p.m. to 2:55 p.m., room 157

A pressure sealed access assembly was required for a nontraditional washing machine. Pressure vessels, seals, and latching mechanisms were researched to determine their relevance to the access assembly. This assembly was required to withstand 200 psi of positive pressure, a vacuum, and a temperature up to 150 degrees Celsius. The results of the research were analyzed to determine whether the specified design standards were satisfied.

MECHANICAL AND AERONAUTICAL ENGINEERING B-I

Session Chair – Daniel Kujawski
Room 158

BIAXIAL EXTENSOMETER

by Rickey Jackson and Jasbir Singh
Sponsor: Daniel Kujawski – Western Michigan University
Faculty Advisor: Daniel Kujawski
9:00 a.m. to 9:25 a.m., Room 158

Behavior of materials is a branch of mechanics dealing with materials subjected to stress and strains caused by external forces. Machine components are often subjected to combined loading. Biaxial extensometers are devices used to measure strains in combined loading conditions. The objective of this project was to design and build a biaxial extensometer to measure axial, and torsional strains in hollow and solid test specimens under cyclic loading conditions. The biaxial extensometer was structurally optimized using finite analysis and has the ability to facilitate test specimens between .5 and 2 inch diameters.

IMPROVED WEAR IN COMMERCIAL BALL JOINT APPLICATION

by Jerome F. Beck and Craig M. Fedewa
Sponsor: Ryan Irrer – TRW Commercial Steering Division
Faculty Advisor: Daniel Kujawski
9:30 a.m. to 9:55 a.m., Room 158

Ball joints are used to connect several key components in the steering system of commercial vehicles. In an attempt to produce a ball joint capable of competing in a global market, several improvements were needed on the current products. The focus of this project was to improve the wear characteristics of current production parts. After investigating the wear patterns of current parts, modifications to the ball socket were recommended to reduce friction and wear.

BUCKLING PHENOMENA TESTING APPARATUS

by Hoa Tan Cao, Paul Dang and Hoang Nguyen
Faculty Advisor: Daniel Kujawski
10:00 a.m. to 10:25 a.m., Room 158

A small apparatus that allows student involvement in experiments was needed to be able to investigate a buckling phenomenon. The device consists of a base, two vertical columns, and a horizontal beam with a "hanging load". Two cables were connected from the top of each column to the base to prevent collapsing if the maximum load (25-30 lbs.) was exceeded. A simple, table-top device was built that provides a precise, safe, and easy way to conduct experiments without supervision.

MODIFICATION OF ROBOTIC EXTRACTOR ARM

by Yasir Khogali and Gary Thomas
Faculty Advisor: Daniel Kujawski
10:30 a.m. to 10:55 a.m., Room 158

A robotic extractor used to automate the part removal process in the die-cast industry was modified in order to increase its reach (up to 72 inches) and handle larger loads (up to 50 lbs.). Following analysis of the previous machine, a new machine was designed. Using finite element analysis, solid models of the design were generated and critical parts of the machine were analyzed for internal forces, deflection, and stresses. Various vendors were contacted in order to determine which parts should be purchased and which were to be manufactured. Finally, production drawings were generated in order to begin manufacture.

COLLAPSIBLE AIRFOIL MOUNTING MECHANISM

by John Goodell and Matt Gromek
Faculty Advisor: Richard Hathaway
11:00 a.m. to 11:25 a.m., Room 158

A device for mounting a component of a newly developed vehicle drag reduction system was designed and analyzed. The device enabled attachment of an airfoil to the rear of a semi-truck trailer. The mounting mechanism created was collapsible and self-operating. Swinging doors with multiple hinge configurations was the primary target of the mounting mechanism. Drag forces and acceleration forces were incorporated into the design of the mounting mechanism to enable durability throughout everyday road conditions. Finite Element analysis and optimization procedures were performed to minimize weight and cost.

FLUID TRACTION TESTING MACHINE

by Anne Godwin, David Gould and Deborah Wilde
Faculty Advisor: Philip Guichelaar
11:30 a.m. to 11:55 a.m., Room 158

Lubricant films that separate moving surfaces exert traction forces at those surfaces. The stresses associated with these traction forces can be high enough to cause micro-fracturing in carbon-graphite, a phenomenon known as blistering. The viscosity and the composition of the lubricant film change the magnitude of the traction forces. A test machine was designed to measure traction forces of the types of mineral oils and synthetic oils that are commonly in contact with mechanical face seals. The test machine can also be used to assess the rheological properties of the fluids used in variable ratio traction drives for automobiles.

MECHANICAL AND AERONAUTICAL ENGINEERING C-I

Session Chair – William Liou
Room 159

AN AERODYNAMIC STUDY AND REDESIGN OF LANDING GEAR FAIRINGS

by Gregory Gromaski
Faculty Advisor: Arthur Hoadley
9:00 a.m. to 9:25 a.m., Room 159

Aircraft without retractable landing gear have a greater aerodynamic drag than aircraft with retractable gear. This causes a reduction in the useful load, or a diminishing of the speed at which the aircraft is able to cruise. To reduce the drag contribution, aircraft with fixed landing gear must install aerodynamic fairings around each wheel. This project tested several fairing designs and studied the effect the shape of the fore and the aft bodies had on the fairing's aerodynamics. Using a factorial analysis and wind tunnel tests, a final design was built. The design has given considerably favorable results as compared to gear with no fairings.

OVERHEAD PROJECTOR WIND TUNNEL

by Desmond Ong Boo Ann, Chin Ket Loh and Kong Siah Tee
Faculty Advisor: William Liou
9:30 a.m. to 9:55 a.m., Room 159

An easy way to demonstrate, in a classroom setting, types of airflow, turbulence or laminar, produced by a wind tunnel was needed. The Reynolds number was the basic parameter considered in the design of the solution. The solution was a small-scale wind tunnel coupled to an overhead projector unit that allowed visualization of flow patterns.

AIRFLOW SIMULATION OF COMPRESSOR VALVES

by Jen Vun Ng and Eng Guan Yap
Sponsors: Choon Yin Fung and Arthur Kung – Gast Manufacturing, Inc.
Faculty Advisor: William Liou
10:00 a.m. to 10:25 a.m., Room 159

A local manufacturing company required analysis of two compressor valves that have two different noise levels. The airflow pattern in the two valves was compared using FLUENT Computational Fluid Dynamics (CFD) software. Design modifications were recommended based on analysis of pressure loss, flow distribution, and mixing rates.

AIR FLOW MEASUREMENT FOR A SURGICAL HELMET

by David Bol and Daniel Gillay
Sponsor: Jason Allen – Stryker Instruments
Faculty Advisor: William Liou
10:30 a.m. to 10:55 a.m., Room 159

A medical instrument manufacturer had the need for an improved method to measure the airflow produced by a surgical helmet. The current method was extremely slow and user dependent. A second method that had been explored was extremely expensive and not practical for large quantity testing. This project focused on the development of a third method using a simple flow box that can accommodate large-scale testing and benchmarking. A feasibility study and comparison to previous methods were also performed.

FEASIBILITY STUDY ON ALTERNATE ENERGY SYSTEMS FOR THE PROPOSED COLLEGE OF ENGINEERING

by Nathan Bauer and Will Childs
Faculty Advisor: Randy Newsome
11:00 a.m. to 11:25 a.m., Room 159

New technologies have arisen in regards to the design and daily energy use of buildings. The growing focus on Earth friendly systems had increased interest in these emerging technologies. Research was done on the feasibility of alternate or "green" systems for the new College of Engineering. Emphasis was placed on those technologies that raise the overall operating efficiency of the building while minimizing the payback period. Systems were evaluated on the basis of cost effectiveness and durability.

ALTERNATIVE HOUSEHOLD POWER GENERATOR

by Vinh Hoa Bao, SoonHwa Ho and Alex Sung Kok Yoong
Faculty Advisor: Randy Newsome
11:30 a.m. to 11:55 a.m., Room 159

A power generator was designed to generate electricity without using conventional methods. This device provided an alternative source of power supply to an average household consumer. Detailed study of possible methods was conducted and a simple yet reliable mechanism was the choice for the design. The human was the major source of energy input to this system. This potential energy was converted into electric power through use of a gear transmission and a motor.

PAPER AND PRINTING SCIENCE AND ENGINEERING

Session Chair – Peter Parker
Room 215

HAPTICS METHODOLOGY AND PHYSICAL CHARACTERISTICS OF TISSUE

by Nat Reeder
Faculty Advisor: Peter Parker
9:00 a.m. to 9:25 a.m., Room 215

The mechanical properties of tissue products can be characterized by physical testing and measurement. These properties can be related to softness and strength through breaking strength, bulk flexibility, surface smoothness, and the coefficient of friction. The use of haptics methodology can help predict which characteristics will impart a higher human tactile response among user groups. The perception of tissue softness is believed to be a major decision factor in product choice for consumers.

WEB-BASED INTERFACE TO ENHANCE ADVANCED LEARNING

by Sara M. Mattson
Sponsors: Kanematsu USA, Inc. and Industrial Systems Monitoring
Faculty Advisor: Peter Parker
9:30 a.m. to 9:55 a.m., Room 215

Distance education using web-based instruction is a promising tool for lowering the cost and increasing the accessibility of advanced learning. Much of engineering is difficult to move into this new paradigm due to the need for hands-on experimentation. Web-based experimentation is in its infancy. The use of a simple programmable logic controller (PLC) coupled with a dedicated web adapter brings the experiment to the web. A Java-Bean based application allows the user to run the experiment via his/her web browser. This developing tool holds promise for extended distance engineering education.

THE EFFECT OF TALC ON THE COF OF LWC-ROTOGRAVURE

by Thomas L. David, Jr.
Sponsor: David Willoughby – Luzenac America, Inc.
Faculty Advisor: Margaret Joyce
10:00 a.m. to 10:25 a.m., Room 215

Coefficient of friction (COF) is an important property of paper as it affects runnability in finishing and converting processes. This study determined the effect of talc as a coating pigment on the COF of a lightweight-coated (LWC) grade. This was accomplished by running four formulations on a cylindrical laboratory coater (CLC) at 4, 6 and 8 lbs./3000 ft^2 on one side. The formulations contained different pigment ratios of talc, delaminated clay, and ground calcium carbonate (GCC). The coated paper was then calendered and tested for COF using a horizontal plane type instrument.

HOT MELT INKS FOR THE GRAVURE PROCESS

by Joseph M. Dolson
Faculty Advisor: Alexandra Pekarovicova
10:30 a.m. to 10:55 a.m., Room 215

This study was based on the formulation of a new type of ink that does not have any negative environmental effects, including zero Volatile Organic Compounds (VOC's). These inks are solid at ambient temperature and liquid when heated at the moment of printing. The ink was formulated for the gravure printing process. It was delivered to the substrate in a viscous state at the printing nip and solidified, or dried, by cooling at such a rate that created solid printed areas without the "screening" effect.

THANK YOU

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