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**College of Engineering
and Applied Sciences**

WESTERN MICHIGAN UNIVERSITY



Engineering
Senior Design
Conference

**April 17, 2018
8 am - 4 pm**

Conference on Senior Engineering Design Project



You are invited to attend the sixty-second Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., **Tuesday, April 17, 2018** at the College of Engineering and Applied Sciences on the Parkview Campus of Western Michigan University.

The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry. The conference is free and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

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

Parking is available in the ramps behind the College of Engineering and Applied Sciences (See: 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:

| | | | |
|---|-------|-------------------------|--------|
| Chemical and Paper Engineering | D-208 | 8:30 a.m. to 4:00 p.m. | pg. 6 |
| Chemical and Paper Engineering | D-210 | 9:00 a.m. to 3:30 p.m. | pg. 11 |
| Civil and Construction Engineering | D-115 | 9:00 a.m. to 11:00 a.m. | pg. 15 |
| Computer Science | D-202 | 9:00 a.m. to 2:00 p.m. | pg. 17 |
| Electrical and Computer Engineering | D-204 | 9:00 a.m. to 4:00 p.m. | pg. 21 |
| Engineering Design, Manufacturing, and Management Systems | D-201 | 8:30 a.m. to 2:00 p.m. | pg. 26 |
| Industrial and Entrepreneurial Engineering & Engineering Management | D-206 | 9:00 a.m. to 12:00 p.m. | pg. 30 |
| Mechanical and Aerospace Engineering A | D-109 | 8:30 a.m. to 4:00 p.m. | pg. 33 |
| Mechanical and Aerospace Engineering B | D-212 | 8:30 a.m. to 4:00 p.m. | pg. 38 |

A lunch break is scheduled from 12 p.m. to 1 p.m. There is a café available on site.

For more information about the conference, call Tamara Bergman at (269) 276-3248.

Brochure available electronically at:

<http://www.wmich.edu/engineer/news/seniors>

| TIME | ROOM/DEPARTMENT | | TOPIC |
|--------------|------------------------|-------|--|
| 8:30 | D-208 | ChP | INCREASE OF PULP PRODUCTION FOR SOUTHERN MILL STANDARDIZING THE RECEIVING PROCESS AT STRYKER FIXED ALTITUDE AND FLIGHT TERMINATION SYSTEM REDUCING AERODYNAMIC NOISE OF WIND TURBINES |
| | D-201 | EDMMS | |
| | D-109 | MAE A | |
| | D-212 | MAE B | |
| 9:00 | D-208 | ChP | ASH REMOVAL AND REPURPOSING IMPROVING SECONDARY FIBERS THROUGH ENZYME MODIFICATION KALAMAZOO RIVER'S EDGE ROUNDABOUT DESIGN TICKET MANAGEMENT PORTAL AUTONOMOUS BRAKING SYSTEM FOR REMOTE CONTROL CARS COST OF SUPPLIER QUALITY DASHBOARD TEETH WHITENING STRIP PACKAGING LINE OPTIMIZATION DESIGN, BUILD AND TESTING OF A LOW RATE HOLLOW CATHODE FOR WMU AEROSPACE LABORATORY FOR PLASMA DYNAMICS DESIGN OF A BIOGAS SEPARATOR AS A THREE-STAGE RADIAL COMPRESSOR |
| | D-210 | ChP | |
| | D-115 | CCE | |
| | D-202 | CS | |
| | D-204 | ECE | |
| | D-201 | EDMMS | |
| | D-206 | IEE | |
| | D-109 | MAE A | |
| | D-212 | MAE B | |
| 9:30 | D-208 | ChP | REDUCING BIOLOGICAL OXYGEN DEMAND IN PAPER MILL PROCESS WATER KUBELKA-MUNK STUDY OF CALCIUM CARBONATE AND CLAY PIGMENTS IN CONJUNCTION WITH NATURAL AND SYNTHETIC BINDERS STATE STREET RECONSTRUCTION CANINE VISUAL ACUITY TESTING APPARATUS REAL-TIME NEURON MEMBRANE VOLTAGE CONTROLLER FRUIT FLY TRAP DESIGN OPTIMIZATION OF JOB & TRADESMEN SCHEDULING DESIGN OF POWER CONVERSION AND TRANSMISSION SYSTEM FOR OSCILLATING WING UNIT (OWU) LAND, AIR, SEA, ROVER (LASR) – UNMANNED VEHICLE |
| | D-210 | ChP | |
| | D-115 | CCE | |
| | D-202 | CS | |
| | D-204 | ECE | |
| | D-201 | EDMMS | |
| | D-206 | IEE | |
| | D-109 | MAE A | |
| | D-212 | MAE B | |
| 10:00 | D-208 | ChP | SIMULATION MODELING OF THE CHARACTERISTICS OF GREEN SOLVENTS THE ENHANCEMENT OF AKD SIZING UTILIZING CATIONIC STARCH BAY CITY SEWER SEPARATION STUDY HABITAT FOR HUMANITY RAMP DESIGNER MUSIC KEYBOARD BASED ON FLEXIBLE HYBRID ELECTRONICS GOING GREEN AT GREEN DOOR DISTILLING CO. MATERIAL HANDLING WORK CELL OPTIMIZATION DESIGN OF AN ELECTRIC PROPULSION THRUSTER BREAKOUT BOX SYSTEM PORTABLE BIOGAS SEPARATOR-HEAT EXCHANGER 2 |
| | D-210 | ChP | |
| | D-115 | CCE | |
| | D-202 | CS | |
| | D-204 | ECE | |
| | D-201 | EDMMS | |
| | D-206 | IEE | |
| | D-109 | MAE A | |
| | D-212 | MAE B | |
| 10:30 | D-208 | ChP | OPTIMIZING WATER USAGE IN A COOLING SYSTEM MOISTURE SENSOR ON SBS BOARD COATED WITH GLUCOMANNAN BARRIER COATING PENTWATER – HART BIKE TRAIL WMU LEE HONORS COLLEGE MOBILE APPLICATION SCALED DOWN IMPULSE GENERATOR |
| | D-210 | ChP | |
| | D-115 | CCE | |
| | D-202 | CS | |
| | D-204 | ECE | |
| | | | |

| | | | |
|-------|-------|-------|---|
| | D-201 | EDMMS | AUTOMATION AND MEASUREMENT STUDY OF A WHITE LIGHT SCANNER |
| | D-206 | IEE | STRATEGIC EXPANSION PLAN FOR CANDLE MANUFACTURER |
| | D-109 | MAE A | AGET CYCLONE PERFORMANCE OPTIMIZATION |
| | D-212 | MAE B | DEVELOPMENT OF ATTITUDE DETERMINATION AND CONTROL SYSTEM FOR THE WALI SATELLITE |
| 11:00 | D-208 | ChP | IMPLEMENTATION OF A SOLVENT TANK FARM VAPOR RECOVERY SYSTEM |
| | D-210 | ChP | INVESTIGATE SUSTAINABLE ALTERNATIVES TO PETROCHEMICAL BASED MOISTURE BARRIER COATINGS |
| | D-202 | CS | INFRASTRUCTURE AS CODE: HOST MANAGEMENT THROUGH SOFTWARE |
| | D-204 | ECE | OPTIMIZED KNN IMPLEMENTATION ON A FPGA CLUSTER |
| | D-201 | EDMMS | AUTOMATED DIE CASTING IN A BOX |
| | D-206 | IEE | PACK PROCESS IMPROVEMENT |
| | D-109 | MAE A | EMERGENCY VOR CDI FOR GENERAL AVIATION |
| | D-212 | MAE B | FORCE VERSUS DISPLACEMENT TEST STAND |
| 11:30 | D-208 | ChP | SUBSTANTIATE PERCENT YIELD WITHIN PERSONAL CARE MANUFACTURING PLANT |
| | D-210 | ChP | NATURAL POLYMER BARRIER COATINGS FOR OIL AND GREASE RESISTANCE |
| | D-202 | CS | WRANGLR FOR NHANES |
| | D-204 | ECE | DESIGN OF A WITRICITY-BASED CHARGER OPTIMIZED FOR IMPLANTABLE MEDICAL DEVICES |
| | D-201 | EDMMS | HYDRAULIC MONOWHEEL |
| | D-206 | IEE | COMPRESSED AIR SYSTEMS EVALUATION AND IMPROVEMENT |
| | D-109 | MAE A | SINUSOIDAL COOLING GROOVE |
| | D-212 | MAE B | GAS TURBINE ACTIVE DEBRIS PROTECTION |
| 1:00 | D-208 | ChP | OPTIMIZATION OF A GAS PROCESSING PLANT |
| | D-210 | ChP | OBSERVING ZINC OXIDE'S IMPACT ON LIGHTFASTNESS FOR INKJET COATED PAPERS |
| | D-202 | CS | CAMPUS TOURS |
| | D-204 | ECE | MEDICAL DEVICE HAND SWITCH TESTER |
| | D-201 | EDMMS | LITTLE FREE LIBRARIES |
| | D-109 | MAE A | EXHAUST WASTE HEAT RECOVERY BY THERMOELECTRIC GENERATORS |
| | D-212 | MAE B | LOW COST CONTROL SYSTEMS LAB: GANTRY CRANE |
| 1:30 | D-208 | ChP | OPTIMIZING FROSTED MINI-WHEATS' FINISHED FOOD COOLING PROCESS |
| | D-210 | ChP | RECYCLING OF SILVER FROM PRINTED ELECTRONICS |
| | D-202 | CS | LOCAL BUSINESS WEB DEVELOPMENT |
| | D-204 | ECE | DESIGN AND CONTROL OF A NANOGRIID |
| | D-201 | EDMMS | UPGRADING PLASTIC SHEET EXTRUSION EQUIPMENT |
| | D-109 | MAE A | DEVELOPMENT OF A VALIDATED ENGINE SIMULATOR FOR HARDWARE-IN-THE-LOOP |
| | D-212 | MAE B | STRUCTURAL REINFORCEMENT OF STREAMLINE TUBING |
| 2:00 | D-208 | ChP | TOASTER PASTRY ICING PREPARATION AND APPLICATION OPTIMIZATION |

| | | | |
|------|-------|-------|--|
| | D-210 | ChP | SUBSTITUTION FOR A CELLULOSE INSULATION PROCESS |
| | D-202 | CS | HAENICKE INSTITUTE FOR GLOBAL EDUCATION GRANT MANAGEMENT SYSTEM |
| | D-204 | ECE | ROCKING, SENSING, SOOTHING |
| | D-109 | MAE A | CONFORMAL COOLING DESIGN |
| | D-212 | MAE B | AUTOMATED UTENSIL WRAPPER |
| 2:30 | D-208 | ChP | DISTILLATION OPTIMIZATION IN THE PHARMACEUTICAL INDUSTRY |
| | D-210 | ChP | KENAF: ALTERNATIVE FIBER SUBSTITUTE UTILIZED IN THE KRAFT PULPING PROCESS |
| | D-204 | ECE | SUGAR CONTENT AND TEMP SENSOR FOR HOME-BREWING |
| | D-109 | MAE A | FLAT SPRING CHECK VALVE |
| | D-212 | MAE B | POWERING STEEL CONVEYOR ROLLERS |
| 3:00 | D-208 | ChP | DESIGN OF WASTE WATER TREATMENT PLANT AERATION SYSTEM |
| | D-210 | ChP | THE EFFICACY OF CORN COB HEMICELLULOSE AS A STRENGTH AND OXYGEN BARRIER COATING |
| | D-204 | ECE | UAVs FOR ELECTRIC UTILITY INSPECTIONS |
| | D-109 | MAE A | DESIGN OF A TEST TO MEASURE FLOWABILITY OF GREEN FOUNDRY SAND |
| | D-212 | MAE B | ELECTROMAGNETIC RADIATION SHIELD FOR SPACECRAFT |
| 3:30 | D-208 | ChP | DESIGN AND EVALUATION OF A LARGE-SCALE BIOSENSOR MANUFACTURING PROCESS |
| | D-204 | ECE | SOLAR CELL MANUFACTURING DESIGN PROCESS |
| | D-109 | MAE A | MODEL BASED ENTERPRISE SOLUTION FOR MACHINE & TOOL |
| | D-212 | MAE B | REINFORCED TAILGATE HINGE FOR JEEP WRANGLER |
| 4:00 | D-204 | ECE | SOLID STATE LIGHTING CONVERSION |
| | D-109 | MAE A | RESEARCH AND DEVELOPMENT OF A LOW-VACUUM-MOISTURE-REMOVAL (LVMR) SYSTEM FOR A MEDICAL MATTRESS |
| | D-212 | MAE B | CUSTOMIZABLE WHEELCHAIR BRACKET |

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 2018. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

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CHEMICAL AND PAPER ENGINEERING

Session Chair – Dania Alsaid, Ph.D.

Room D-208

INCREASE OF PULP PRODUCTION FOR SOUTHERN MILL

by: Taylor Baranski, Eric Baudouin, Collin Conrad, Christine Dowdy, and Tyler Rheinhardt

Sponsor: None

Faculty Advisor: Said Abubakr, Ph.D.

8:30 a.m. – 8:55 a.m.

A pulp mill in the southern U.S. produces fully bleached Kraft pulp from pine wood. It is desired to increase production of unbleached pulp to fully utilize site capacity. This project required assessment of the current production rate in order to implement modifications of existing equipment to achieve maximum increase of pulp production. Investigation and material analysis of the system digesters, heat exchangers, and chemical usage and recovery operations were performed to determine the most effective solution. Capital investment and return on investment were obtained to reflect the recommended expenses and increase to pulp production.

ASH REMOVAL AND REPURPOSING

by: Alexis Blakley, Matthew Klimasz, and Ryan Melbow

Sponsors: United States, Gypsum Corporation Otsego Paper

Eric Bock, Henry Krell, and Tom Oldham

Faculty Advisor: Dania Alsaid, Ph.D.

9:00 a.m. – 9:25 a.m.

Paper mill sludge is a major economic and environmental problem for the paper industry. Sludge, specifically produced in the liner pulp production process, consists of a high percentage of ash which affects the quality of the sludge and reduces its usefulness. A process was designed to separate the ash so that it can be used for beneficial purposes.

REDUCING BIOLOGICAL OXYGEN DEMAND IN PAPER MILL PROCESS WATER

by: Travis Garlock, Matthew Muhs, and Joseph Taylor

Sponsor: Graphic Packaging International

Ana Perez

Faculty Advisor: Richard Edwards

9:30 a.m. – 9:55 a.m.

Biological oxygen demand (BOD) is a measure that largely contributes to increasing effluent costs for recycled paperboard mills. Research was conducted on methods to reduce biological oxygen demand in mill process water. The proposed methods should reduce BOD levels without affecting the quality of product or performance of the paper machines. These methods will treat effluent wastewater delivered to the municipal treatment facility with the potential to significantly reduce costs incurred by the mill from elevated BOD.

SIMULATION MODELING OF THE CHARACTERISTICS OF GREEN SOLVENTS

by: Meghan Jackson, Jinq Jia Lim, Bethany Neybert, and Jeremy Williams

Sponsor: Kalsec, Inc.

John White

Faculty Advisor: Dania Alsaïd, Ph.D.

10:00 a.m. – 10:25 a.m.

In recent years, there has been a push for food manufactures to use green solvents in their extracting processes. The ability to predict the solubility behavior of bioactives in the selected green solvents is of foremost importance. Both group contribution theory and molecular thermodynamics were incorporated to estimate Hansen solubility parameters. Computer modeling software was used along with these parameters to develop a simulation that predicts this behavior. Extraction parameters were determined to optimize the extract quality, concentration, and yield of the desired bioactive component(s) using this model.

OPTIMIZING WATER USAGE IN A COOLING SYSTEM

by: Suhyb Albetairi, Abdulelah Aljameel, Alexander Maurer, and Ricardo Sanchez

Sponsor: Kalsec Inc.

Jason Buero, Stephen Kuhnert, and David Gordon

Faculty Advisor: Dania Alsaïd, Ph.D.

10:30 a.m. – 10:55 a.m.

Well water is used in the cooling of various processes at Kalsec Inc. Due to continued growth and process additions, over a period of time, the well has reached its maximum capacity before system pressure loss. This loss has caused scheduling issues in the production lines. While this poses an economical concern, there is also a sustainability and environmental concern to reaching the well's capacity. The main focus was to reduce well water usage to increase facility capacity and reduce its environmental impact.

IMPLEMENTATION OF A SOLVENT TANK FARM VAPOR RECOVERY SYSTEM

by: Aqeal Al Ramel, Paul Brown, and Garrett Parzynski

Sponsor: None

Faculty Advisor: Dania Alsaïd, Ph.D.

11:00 a.m. – 11:25 a.m.

Controlling solvent usage and loss is important in extraction companies. These solvents are separated and stored in tank farms. The continuous addition and removal of solvents to tank farm systems result in solvents loss. Reducing transfer losses in the tanks, a solution was proposed to collect the vapor lost during transfer. Different solvent recovery methods were compared in efficiency and cost. A detailed economic analysis was completed to assess the viability of implementing the proposed system.

SUBSTANTIATE PERCENT YIELD WITHIN PERSONAL CARE MANUFACTURING PLANT

by: Devin Dunn, Fatimah Ghallab, Mikelyn Hokenmaier, and Brian Peterson

Sponsor: Amway

Bret Nordland, Nancy Beard, and Bruce Neely

Faculty Advisor: Richard Edwards

11:30 a.m. – 11:55 a.m.

The Personal Care Manufacturing Plant produces a variety of products with each designated to a specific production line. Finished product travels from the mix vessel to the individual package using multiple transfer systems varying in size and length. Throughout the process, scrap rates vary for different equipment types and capabilities based on the products' properties. Engineering studies were conducted at various areas on a single production line to identify opportunities for improvement. Actual yields were determined to compute and verify scrap loss at each area. The team will report on the analysis techniques that were used to establish the optimal system changes.

OPTIMIZATION OF A GAS PROCESSING PLANT

by: Fatimah Al Abudulaziz, Taibah Albeloushi, and Marcus Kong

Sponsor: None

Faculty Advisors: Dania Alsaïd, Ph.D. and Richard Edwards

1:00 p.m. – 1:25 p.m.

Natural gas is gathered from wells and transported by a pipeline to a turbo-expander type gas processing plant. The plant utilizes two main distillation columns: A demethanizer column and a deethanizer column. This project optimized the gas processing plant to recover ethane. Changes to the process were made to maximize product streams value as well as to minimize energy consumption. Final recommendations were based on a comprehensive economic analysis of the whole proposed changes.

OPTIMIZING FROSTED MINI-WHEATS' FINISHED FOOD COOLING PROCESS

by: Jean Richard Jn Baptiste, Jessica Graves, Brady Hostetler, and Abdullah Sulais

Sponsor: Kellogg Company

Terry Andren, Joseph Cwiakala, and Nicole Remily

Faculty Advisor: Richard Edwards

1:30 p.m. – 1:55 p.m.

Analyzing energy intensive processes in industry is crucial for improving sustainability, lowering costs, and increasing profit margins on products. Material and energy balances were performed to identify process losses in the cooling of Frosted Mini-Wheats. Existing cooling technology was compared to alternate technology available on the market, and a cost analysis was performed to compare all options explored. Recommendations were made to the system to potentially reduce the line's energy usage and downtime, with the objective of creating a more sustainable and efficient process.

TOASTER PASTRY ICING PREPARATION AND APPLICATION OPTIMIZATION

by: Beatrice Pei Wen Chai, Cornellius Marcello, Rebecca Martus, and Robert Repke

Sponsor: Kellogg Company

Nicole Remily, Greg Stevens, and Joey Carroll

Faculty Advisor: Richard Edwards

2:00 p.m. – 2:25 p.m.

The Kellogg Company is interested in optimizing the way the icing for a baked good is prepared and applied during production. The current method has not been significantly changed since the item was first introduced over 50 years ago. A new process was developed to make a more efficient preparation and application of the icing operation. New equipment was identified based on established methods in the food industry. The new equipment and process were verified after the mass and energy balances were calculated. A capital and operating cost analysis was performed to determine if the introduction of the new process would be a worthwhile investment.

DISTILLATION OPTIMIZATION IN THE PHARMACEUTICAL INDUSTRY

by: Osamah Alghamdi, Clayton Carter, Jacob Cipich, and Daniel VanZweden

Sponsor: Pfizer Inc.

Nicholas Muller, Zachary Wolf, and Eric Smith

Faculty Advisor: Dania Alsaïd, Ph.D.

2:30 p.m. – 2:55 p.m.

Distillations are commonly used throughout industry to perform separations by phase change, producing a liquid phase and vapor distillate. However, the process of distilling can be slow and energy intensive, providing a limitation in the production process. Possible improvements to current distillation systems were considered on the basis of thermal efficiency, material throughput (cycle time), and material tolerance. Consideration was given to ensure maintenance is straightforward and relatively quick, as fouling, contamination and tank utilization were concerns. Economic viability of the improvements was completed to determine the project benefit. The optimized design offers increased efficiency for production lines.

DESIGN OF WASTE WATER TREATMENT PLANT AERATION SYSTEM

by: Garrett Fisher, Nolan Speer, Luke Tavares, and Chris Weizeorick

Sponsor: None

Faculty Advisor: Richard Edwards

3:00 p.m. – 3:25 p.m.

Maintaining sufficient levels of dissolved oxygen in bio-sludge waste water treatment is critical for the success of the microorganisms in the process. The current process of aerating waste water basins involved in the secondary treatment of activated sludge utilizes equipment and techniques that are labor intensive, energy inefficient, and require frequent part replacement. New technologies in oxygen delivery were investigated to find a system capable of meeting the same oxygen demand with less energy input. Greater system life expectancy was also established to significantly reduce the cost of aeration processes at a waste water treatment plant.

DESIGN AND EVALUATION OF A LARGE-SCALE BIOSENSOR MANUFACTURING PROCESS

by: Logan Hughey, and Alexander Maldonado

Sponsor: None

Faculty Advisor: Brian Young, Ph.D.

3:30 p.m. – 3:55 p.m.

In vitro diagnostics play a critical role in disease prognosis and monitoring. Advancement in the design and manufacture of immunoassays – a subset of in vitro diagnostics- will extend the reach of medical technology to allow in-field testing with point-of-use biosensors that respond to specific antigens. A process and facility for monoclonal antibody production and subsequent biosensor manufacturing was designed for the fabrication of a novel immunoassay platform. The production facility was economically evaluated to determine construction, operation, and product costs. This design also provides a framework which could facilitate the laboratory-to-industry translation of current biosensor research.



CHEMICAL AND PAPER ENGINEERING

Session Chair – Kecheng Li, Ph.D.

Room – D-210

IMPROVING SECONDARY FIBERS THROUGH ENZYME MODIFICATION

by: Thomas Anderson

Sponsor: None

Faculty Advisor: Kecheng Li, Ph.D.

9:00 a.m. – 9:25 a.m.

The recycled paper industry spends a large percentage of its money attempting to strike the right balance between drainage rate and internal bonding strength to make a quality sheet while managing costs in the drying stage. A series of enzyme treatments were done on recycled pulp, following which various internal bonding tests were conducted to determine the overall impact of the enzymes on the fibers. These tests can be administered to determine if a specific enzyme will have a positive impact on the environmental renewability, strength properties, and end cost to the mill.

KUBELKA-MUNK STUDY OF CALCIUM CARBONATE AND CLAY PIGMENTS IN CONJUNCTION WITH NATURAL AND SYNTHETIC BINDERS

by: Evan Ericson

Sponsor: WMU-Pilot Plant

Matthew Stoops

Faculty Advisor: Matthew Stoops

9:30 a.m. – 9:55 a.m.

The Kubelka-Munk theory was used to determine a coating formulation that is low cost, recyclable, and environmentally friendly with comparable Kubelka-Munk values. The Kubelka-Munk theory is often used to predict optical properties of a coating applied to a paper substrate. Kubelka-Munk is the ratio of absorption coefficient to the scattering coefficient of light, known as the theory of reflectance. A coating formulation consists largely of pigments and binders. When compared, different pigments such as Calcium Carbonate and Kaolin Clay, gave a credible overview as to which formulation had the best Kubelka-Munk value. Additionally, this lab compared how natural and synthetic binders affected the Kubelka-Munk values to find the recyclability of a coating formulation.

THE ENHANCEMENT OF AKD SIZING UTILIZING CATIONIC STARCH

by: Garrett Fisher

Sponsor: None

Faculty Advisor: Qiang Yang, Ph.D.

10:00 a.m. – 10:25 a.m.

The usage of alkyl ketene dimer (AKD) for many years within the paper industry has revealed problems associated with its' use including: poor retention mechanisms, high rate of hydrolysis, backwater contamination, inability to obtain curing temperatures in dryers, and size reversion. The similarity of starch's chemical structure to that of cellulose within the paper web created a high affinity between the two compounds. Thus, sizing retention/efficiency may be improved by varying levels of cationic wet end starch mixed with AKD prior to sheet addition. Using Minitab DOE and TAPPI standards; a high efficiency retention system was developed within the lab.

MOISTURE SENSOR ON SBS BOARD COATED WITH GLUCOMANNAN BARRIER COATING

by: Darah Fitch, and Ruoxi Ma

Sponsor: None

Faculty advisor: Alexandra Pekarovicova, Ph.D.

10:30 a.m. – 10:55 a.m.

The need for functional biodegradable coatings in the paper industry is expanding in efforts to become more sustainable. For these coatings to become standard, a way of testing for their moisture control properties is crucial to ensure their performance. Using a dispersion casting method, a biodegradable coating was formed using Glucomannan and was applied to SBS board. A moisture sensor was then screen printed on the Glucomannan coating using silver based conductive ink in order to test performance. This sensor will be important in determining the time for moisture to penetrate coated board and the rate of transmission following breakthrough.

INVESTIGATE SUSTAINABLE ALTERNATIVES TO PETROCHEMICAL BASED MOISTURE BARRIER COATINGS

by: Alex Fleck

Sponsor: None

Faculty Advisor: Matthew Stoops

11:00 a.m. – 11:25 a.m.

Current moisture vapor barrier coatings employ polyethylene as the functional film former due to its superb water resistance and low production cost. However, polyethylene possesses a very poor biodegradation rate which contributes to the accumulation of over 25 tons of mixed plastics in landfills annually. This experiment sought to investigate water-based biopolymers to achieve a "green" barrier coating. Cross linked starch (via oxidized sucrose) and a prevulcanized natural rubber latex and modified lignin blend are the primary specimens for investigation. The properties used to quantify the barrier films were water vapor transmission rate (WVTR), water absorbency, contact angle, permeability, and blocking potential.

NATURAL POLYMER BARRIER COATINGS FOR OIL AND GREASE RESISTANCE

by: Andrew Kathan

Sponsor: None

Faculty Advisor: Matthew Stoops

11:30 a.m. – 11:55 a.m.

Many barrier coating formulations currently used for oil and grease resistance development in the paper industry have issues with sustainability, biodegradability, or have health concerns associated with them. This project aims to test polymers, namely starch, as barrier coatings to develop oil and grease resistance for food grade packaging sheets and draw conclusions on their feasibility for use in the paper industry. Two modified starches identified through research were cooked and applied at varying coat weights to handsheets of varying porosities. These handsheets were extensively tested and compared to conventional food grade packaging for analysis.

OBSERVING ZINC OXIDE'S IMPACT ON LIGHTFASTNESS FOR INKJET COATED PAPERS

by: Jonathan Mayoros

Sponsor: None

Faculty Advisor: Matthew Stoops

1:00 p.m. – 1:25 p.m.

Ultraviolet absorbers are used in photographic papers to prevent the paper's color and brightness from degrading by absorbing ultraviolet light. Titanium dioxide is the most common ultraviolet absorber, yet it is one of the most expensive additives for coating paper. Zinc oxide is similar to titanium dioxide, however zinc oxide can absorb a wider range of ultraviolet light and is cheaper. Zinc oxide was used to replace various amounts of titanium dioxide in a coating in order to reduce the cost of manufacturing inkjet coated papers and to evaluate if zinc oxide will absorb more ultraviolet light than titanium dioxide.

RECYCLING OF SILVER FROM PRINTED ELECTRONICS

by: Ryan Melbow

Sponsor: None

Faculty Advisor: Sasha Pekarovicova, Ph.D.

1:30 p.m. – 1:55 p.m.

Printed electronics have the potential to become a multimillion dollar industry. One of the hurdles of the industry is the high material cost of the silver inks used for the circuit boards. To make this industry economically viable, a method to recycle these precious metals from inks was developed. This study explored the possibility of using enzymes followed by electrolytic floatation to extract silver from the printed circuit boards.

SUBSTITUTION FOR A CELLULOSE INSULATION PROCESS

by: Tyler Muscott

Sponsor: None

Faculty Advisor: Andro Mondala, Ph.D.

2:00 p.m. – 2:25 p.m.

The cellulose insulation process relies heavily on newsprint as its main resource, but the supply of this resource is running very low. Research to find new materials that can be used was done. Wool fibers and container boards were chosen to be tested. In the lab the runnability of these materials were tested to see if there will be enough absorbance in the material to absorb insulation chemicals necessary for the product. The new isolated material was then tested compared to the insulation mixture that uses newsprint as its main material.

KENAF: ALTERNATIVE FIBER SUBSTITUTE UTILIZED IN THE KRAFT PULPING PROCESS

by: Troy Taormina

Sponsors: WMU-Qiang Yang, Ph.D. and Said Abubakr, Ph.D.

Faculty Advisor: Qiang Yang, Ph.D.

2:30 p.m. – 2:55 p.m.

In recent years there has been a substantial push for positive sustainability in manufacturing industries. Within the paper industry, mills have been incorporating more broke/recycle in the furnish, using more environmentally safe chemicals and utilizing different sources of raw materials to achieve positive sustainability. Utilizing kenaf as a potential softwood substitute (either as a blended ratio or complete substitute) in the Kraft pulping process will help promote positive sustainability due to the extremely short cultivation turnover rate of ready-to-use fibers. The study is designed to see compare kenaf fibers to a control softwood fiber source pulped under the same parameters. The study will consist of three separate cooks, changing the maximum cooking temperature and time of the cook, analyzing the cooking liquors before and after the cook, and calculate the screened and unscreened yields, along with reject percentage. The experiment will be performed in the Pulping Laboratory at Western Michigan University, utilizing the lab digester and chemicals necessary to conduct this study.

THE EFFICACY OF CORN COB HEMICELLULOSE AS A STRENGTH AND OXYGEN BARRIER COATING

by: Zachary Witherspoon

Sponsor: None

Faculty Advisor: Alexandra Pekarovicova, Ph.D.

3:00 p.m. – 3:25 p.m.

Linerboard is the outermost layer in cardboard packaging, and currently many petroleum-derived chemicals are applied to it to add strength, water, oxygen, or grease resistance. In an effort to create a more sustainable oxygen barrier and strength coating, hemicellulose that was extracted from corn cobs was used and made more effective by crosslinking with citric acid. The coating adds an oxygen barrier and physical strength to the linerboard while staying completely compostable or recyclable, which is often impossible when petrochemical-derived barriers are used. Results were determined from TAPPI standards tests and analyzed for statistical significance.



CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – Decker Haines, Ph.D.

Room D-115

KALAMAZOO RIVER'S EDGE ROUNDABOUT DESIGN

by: Matthew Amstutz, Zachariah Culbert, and Maxwell Murray

Sponsor: Wrightman & Associates

Alan Smaka and Frank Renaldi

Faculty Advisors: Decker Hains, Ph.D. and Valerian Kwigizile, Ph.D.

9:00 a.m. – 9:25 a.m.

The intersection of Gull Road at Harrison Street and Ransom Street in City of Kalamazoo (COK) posed transportation and environmental challenges due to unique geometries, ununiformed traffic volumes and patterns, and rehabilitation of critical wastewater/water/storm water infrastructure. The project entailed engineering disciplines involving evaluating the best transportation (conventional intersection design, signalization, different roundabout configurations) and utility routing alternatives, developing cost estimates and life-cycles analysis of the proposed alternatives and their varying material selections/operation and maintenance costs, modeling of the transportation configurations, and ultimately the design and development of construction drawings in accordance with AASHTO standards.

STATE STREET RECONSTRUCTION

by: Gabriel Ferreras, and Marco Sanchez

Sponsor: Fleis & VandenBrink Engineering

Jeffrey Wingard, P.E.

Faculty Advisor: Decker Hains, Ph.D.

9:30 a.m. – 9:55 a.m.

State Street Reconstruction Project is located in the City of Hillsdale. The project consisted in the repaving of a section in State Street and solving the standing water dilemma in Wolcott Street. The solution to the problem was provided by designing and constructing a storm sewer with a detention basin and repaving the section of State Street. Now, along with the sewer, the section of State Street includes a concrete curb and gutter and a sidewalk. This helped create communication between downtown Hillsdale and the county's park. Now, State Street is ready for its high vehicular volume with the addition of a pedestrian sidewalk.

BAY CITY SEWER SEPARATION STUDY

by: Hamad Albalawi, Dennis Banazak, and Haoran Li

Sponsor: The City of Bay City

Sharron Cooper, Wastewater Superintendent

Faculty Advisor: Decker Hains, Ph.D.

10:00 a.m. – 10:25 a.m.

The possibility that MDEQ may require sewers to be separated in the future in the City of Bay City provided the opportunity to conduct a cost study for such a project. Quantities were taken for sanitary sewer, water main-including lead service lead replacement, drive approaches, curb and gutter, and roadway reconstruction. Sidewalk replacement was included as an option. Material and cross section alternatives were investigated and Complete Streets design based on the City's Non-Motorized Plan was followed. Three options were provided for millage costs based on 20 ,30 and 40-year bond periods for the City's consideration.

PENTWATER – HART BIKE TRAIL

by: Jarret Geering, Matthew Looby, Eric VanSpronsen, and Kristopher Warner

Sponsor: Pentwater – Hart Bike Trail Committee

John Wilson

Faculty Advisor: Decker Hains, Ph.D.

10:30 a.m. – 10:55 a.m.

The Hart-Montague bike trail ran 22 miles between the City of Hart and the City of Montague. However, it was in dire need of addition due to the high traffic volumes. The trail has been extended to reach the south end of the Village of Pentwater. Many options were presented for the path of the trail between the Village of Pentwater and the existing trail head, which were evaluated. By adding to the trail, the Village of Pentwater will gain economic benefit from the additional tourism.



COMPUTER SCIENCE ENGINEERING

Session Chair ~ John Kapenga, Ph.D.

Room: D-202

TICKET MANAGEMENT PORTAL

by: Parker Loomis, Brennan Muir, and Brandon Seager

Sponsor: Midwest Realty Group, LLC.

Rick DeKam, CCIM

Faculty Advisor: John Kapenga, Ph.D.

9:00 a.m. – 9:25 a.m.

The Ticket Management Portal allows the management and employees to seamlessly and quickly track issues submitted by customers, as well as internal projects. Tenants can log in with unique credentials and submit a ticket for their property. Any problems they require, from repairs to maintenance, can be handled through the portal. Tickets are then received by management and delegated to employees to handle. Within the ticket, employees can add comments, upload documents, and even track time spent on each ticket. Time spent from ticket creation to closure is greatly reduced and better managed.

CANINE VISUAL ACUITY TESTING APPARATUS

by: Alex Ewert, Brandon Grothe, Samuel Lewis, and Chandler Miller

Sponsor: AcuiSee LLC

Dillon Burton

Faculty Advisor: John Kapenga, Ph.D.

9:30 a.m. – 9:55 a.m.

Canine cognitive and vision research is an area lacking in innovation as current methods are mostly performed by hand. With modern technology, testing procedures can be automated and devoid of human elements. With the use of microcomputers and touchscreens, an apparatus has been created that automates vision testing for small to midsize canines. This will be in combination with a backend database that will store and provide research information to research teams. This apparatus and software combination will help an area lacking in modern automation.

HABITAT FOR HUMANITY RAMP DESIGNER

by: Bishop and Cade Gillem

Sponsor: Battle Creek Area Habitat for Humanity

Justin Byrd

Faculty Advisor: John Kapenga, Ph.D.

10:00 a.m. – 10:25 a.m.

People with physical disabilities often have trouble entering and leaving their homes. An open source software was created in order to expedite the processes of design, obtaining building permits, and construction of complex multi-level ramps. The Java-based software receives measurements input by a user and uses this information to generate a properly annotated diagram. Parameters include the maximum height of the ramp, the shape of the ramp, and the length of each section. The software is designed to be user-friendly and may be used on-site, without an internet connection, on a Windows-based tablet or laptop.

WMU LEE HONORS COLLEGE MOBILE APPLICATION

by: Benjamin Campbell, Peter Shutt, and James Ward

Sponsor: WMU Lee Honors College

Katie Fox

Faculty Advisor: John Kapenga, Ph.D.

10:30 a.m. – 10:55 a.m.

Members of WMU's Lee Honors College do not have an efficient way to obtain the college's information from their smartphone. A mobile application has been developed with the React Native framework for both iOS and Android platforms. The app will include a newsfeed filled with the latest college information. It will also contain building hours, events, contacts and announcements. The mobile application will now be used by members of the Lee Honors College to view college information in an effective manner from their smartphone.

INFRASTRUCTURE AS CODE: HOST MANAGEMENT THROUGH SOFTWARE

by: Justen Pacsai, Jonathan Pennington, and Steven Steffey

Sponsor: WMU Department of Computer Science

Colin MacCreery

Faculty Advisor: John Kapenga, Ph.D.

11:00 a.m. – 11:25 a.m.

Efficient management of software applications and configurations over a large number of hosts is a commonly sought-after goal for system administrators. The software utility Ansible is used in the development of a framework for software deployment and host configuration. The framework enables a system administrator to quickly deploy a number of essential services and to accomplish numerous tasks across multiple hosts with ease.

WRANGLR FOR NHANES

by: Jacob Darling, Apolinar Ortega, and Antonio Ruiz

Sponsor: WMU Department of Statistics

Joseph McKean, Ph.D.

Faculty Advisor: John Kapenga, Ph.D.

11:30 a.m. – 11:55 a.m.

Plenty of research relies on the vast collection of studies provided by the National Health and Nutrition Examination Survey (NHANES). Wrangling the data to get the desired data frames for analysis can easily get complicated and become a time-consuming process. An interface in the form of a web application has been developed, which allows users from any platform to access the NHANES data sets. The application was developed using the R scripting language and utilizes the RShiny library for creating web applications. The new solution provides a simple method for accessing the desired data.

CAMPUS TOURS

by: Nick Pawlawski and Ken Rivard

Sponsor: WMU CEAS

Scot Conant

Faculty Advisor: John Kapenga, Ph.D.

1:00 p.m. – 1:25 p.m.

A: Campus Tours is a website for the college of engineering and applied sciences. The campus offers daily tours for prospective and returning students. The campus tours software allows these students to register for a tour. The software also provides the college with a way to manage the tours while providing the college with analytics about the tours that take place. The software is being built with the web framework Laravel and uses standard development methodologies used by professionals today.

LOCAL BUSINESS WEB DEVELOPMENT

by: Rawan Alfaraj and John Harvey

Sponsor: None

Faculty Advisor: Samantha Parker

1:30 p.m. – 1:55 p.m.

Local businesses with no online presence are very common, especially small and older ones who operate mostly on paper. A web application used for hosting information and operational management was developed using Ruby on Rails. A PostgreSQL database management system allows customers to access account information through a user dashboard and manage purchases. Both customers and staff will benefit from this web application due to its ease of access and readily available information.

HAENICKE INSTITUTE FOR GLOBAL EDUCATION GRANT MANAGEMENT SYSTEM

by: Alan Alvarez-Mares, Samuel Kison, and Omar Santana

Sponsor: Haenicke Institute for Global Education

Jon Collier, Kevin Haynes, and Michelle Metro-Roland, Ph.D.

Faculty Advisor: John Kapenga, Ph.D.

2:00 p.m. – 2:25 p.m.

The International Education Faculty Development Fund (IEFDF) is a grant which allows faculty to travel internationally at a reduced cost. Current administration of the fund is cumbersome; most of it handled manually and takes days or weeks of staff hours to facilitate each cycle. To reduce this problem, a website was developed which allows faculty to apply for grant online and streamlines the grant approval process. The site utilizes the Central Authentication Service so the faculty can login without creating new accounts. The completed site organizes an otherwise unwieldy process and saves a significant amount of unnecessary labor.



ELECTRICAL AND COMPUTER ENGINEERING

Session Chair ~ Steve Durbin, Ph.D.

Room: D-204

AUTONOMOUS BRAKING SYSTEM FOR REMOTE CONTROL CARS

by: Jacob Killman, Nicholas Pappas, and Jaren Pashak

Sponsor: WMU ECE Department

Faculty Advisor: Steven Durbin, Ph.D.

9:00 a.m. – 9:25 a.m.

Autonomous braking systems are being manufactured and installed in numerous brands of vehicles all over the world. These braking systems allow the operator to have full control of the vehicle while adding the safety feature of automatically stopping before hitting an unexpected object. The project converted a pair of remote control cars to add an autonomous braking system to each. This enables students, or guests of Floyd Hall, to race against each other in a safe manner, especially during open house events.

REAL-TIME NEURON MEMBRANE VOLTAGE CONTROLLER

by: Lucas Essenburg, Robert Saltzman, and Joshua White

Sponsor: Neurobiology Engineering Laboratory

Faculty Advisor: Damon Miller, Ph.D.

9:30 a.m. – 9:55 a.m.

The WMU Neurobiology Engineering Laboratory explores efficient stimulation of biological neurons using control theory. Previous experimental work utilizes a WPI DUO-773 electrometer to evoke and measure neuron membrane voltage responses. Stimulation current waveforms are pre-computed in MATLAB®, generated by a USB-6211 data acquisition device, and sent to the DUO-773 using a computer-based LabView® application. The computer is also used for data logging. Applications of this technique to medical devices require real-time performance. Thus, a self-contained device capable of estimating and applying an optimal stimulation current to a biological neuron and measuring the neuron response in real-time was developed.

MUSIC KEYBOARD BASED ON FLEXIBLE HYBRID ELECTRONICS

by: Jesse Echtenaw, Tony Hanson, and Kyle Mann

Sponsor: Massood Atashbar, Ph.D.

Faculty Advisor: Massood Atashbar, Ph.D.

10:00 a.m. – 10:25 a.m.

Flexible Hybrid Electronics (FHE) is an emerging technology and has high potential in consumer electronic applications. A musical keyboard is a bulky instrument. FHE can be implemented to vastly improve portability of the musical keyboard. The flexible keyboard allows the user to play a full octave of notes, and adjust volume output while minimizing size. The core of this flexible keyboard is an array of capacitive sensors located within each key.

SCALED DOWN IMPULSE GENERATOR

by: Andrew Covell, Esther Mawi, and Jeremy Smith

Sponsor: WMU ECE Dept.

Pablo Gomez, Ph.D.

Faculty Advisor: Pablo Gomez, Ph.D.

10:30 a.m. – 10:55 a.m.

The impulse test is a crucial test to assess the dielectric performance of different power system components. This test uses an impulse generator to produce a high voltage, with a fast rising pulse, to emulate the impact of a lightning or switching condition on the power device. The scaled-down impulse generator that has been constructed shows a safe demonstration of the impulse test in order to study wave propagation along power devices.

OPTIMIZED KNN IMPLEMENTATION ON A FPGA CLUSTER

by: Andrew Farran, Grant Fettig, and Daniel McKee

Sponsor: Lina Sawalha, Ph.D.

Faculty Advisor: Lina Sawalha, Ph.D.

11:00 a.m. – 11:25 a.m.

With machine learning being used over a large span of industries and studies, there is a need to further optimize its use. One instance of machine learning is the K-Nearest Neighbor algorithm. The algorithm's performance was accelerated by implementing a Verilog architecture design on a Zynq™ Board (ZYBO). Further optimization was achieved by parallelizing the algorithm to work on a cluster of Field Programmable Gate Arrays (FPGA). Multiple FPGAs communicating via Ethernet reduces execution time by leveraging parallel operations without a drastic increase in energy consumption. This is compared to other hardware solutions such as Graphical Processing Units (GPU).

WIRELESS CHARGER FOR MEDICAL DEVICES

by: Azam Albiebi, Hussain Alowa, and Mohammad Alqasim

Sponsor: Pablo Gomez, Ph.D.

Faculty Advisor: Pablo Gomez, Ph.D.

11:30 a.m. – 11:55 a.m.

WiTricity is based on coupled electromagnetic resonant coils for efficient power transfer without wires. Since its conception, it has been successfully applied in a wide range of industrial, commercial and residential devices. A very significant application is related to improving the experience and quality of life of medical patients. WiTricity technology enables efficient recharging of essential medical devices such as pacemakers, defibrillators or ventricular assist devices implanted deeply within the body cavity, several centimeters from the skin. This eliminates the risks associated with the use of charging drive lines or surgical procedures to replace batteries. In the project, an electric charger based on WiTricity technology was designed and built specifically for medical applications.

MEDICAL DEVICE HAND SWITCH TESTER

by: Hussain Alzayer, Thomas Harker, and Ryan Maniwczak

Sponsor: Stryker Instruments

Faculty Advisor: Dean Johnson, Ph.D.

1:00 p.m. – 1:25 p.m.

Current designs for hand switch testers (HST) are purely analog, require daily calibration checks, and an operator to make a judgment if the switch passes or fails. A new HST has been designed to be used by Stryker Corp. in their surgical instrument plant to verify the functionality of hand switches. The new HST is computer automated and provides documented results of tests such as pass or fail results. Switches need to be tested before they can be sent to hospitals for use. It's important that the results of testing the switches can be trusted.

DESIGN AND CONTROL OF A NANOGRID

by: Abdulilah Alaknah, Firas Alotaiby, and Mohammed Boshlibi

Sponsor: Rick Meyer, Ph.D.

Faculty Advisor: Pablo Gomez, Ph.D.

1:30 p.m. – 1:55 p.m.

The purpose of this project is to design a desktop size DC nanogrid that includes renewable energy from a photovoltaic panel, an energy storage system and fossil fuel-sourced energy provided by rectified wall power. The nanogrid is monitored and controlled by an Arduino microprocessor that is programmed to manage the operation of the nanogrid between island mode and grid mode depending on the generation, storage and load conditions in order to ensure the continuity of power to the load. The completed design serves to showcase the operation of a microgrid at a lower scale for educational purposes related to class demonstrations, lab projects, or research purposes.

ROCKING, SENSING, SOOTHING

by: Paige Coffeen, Nicholas Neppach, and Jordan Wagner

Sponsor: Ikhlas Abdel-Qader, Ph.D.

Faculty Advisor: Bradley Bazuin, Ph.D.

2:00 p.m. – 2:25 p.m.

A device has been designed that can monitor, detect, and sooth autistic children during sensory overload. The device is comprised of a vest containing a microcontroller and a 9-axis IMU (inertial measurement unit) to detect repetitive motions. These motions can be trained to the vest so that a detected pattern triggers output vibration in strategic locations on the body. This stimulates the nervous system to calm the child. A smart phone application has been developed that interfaces with the vest for caretaker monitoring, notification, and control. The device provides a tool for caretakers to help soothe autistic children with no emotional outlet in stressful social situations.

SUGAR CONTENT AND TEMP SENSOR FOR HOME-BREWING

by: Izat Dahger, David Gipe, and Brandon Robbins

Sponsor: Blichmann Engineering

John Blichmann

Faculty Advisor: Janos Grantner, Ph.D.

2:30 p.m. – 2:55 p.m.

Since the late 4th century the process of measuring the alcohol content in beer has remain unchanged. A device called a “Hydrometer” is floated in the solution, and the sugar consumption (i.e. alcohol) can be calculated. Using ultrasonic and temperature sensors, a submersible device was developed that monitors the changing density of the beer during fermentation. The device uses this data to calculate the Specific Gravity, and transmit it via Bluetooth to a phone or PC. The user then uses this information to calculate alcohol content. This device is the first of its kind, and can modernize the brewing process.

UAVs FOR ELECTRIC UTILITY INSPECTIONS

by: Sarah Gill, Nathan Richardson, and Kyle Schittenhelm

Sponsor: Consumers Energy

Nathan Washburn

Faculty Advisor: Ralph Tanner, Ph.D.

3:00 p.m. – 3:25 p.m.

Inspections of electrical distribution lines are necessary to prevent unwanted and costly power outages to customers, locate safety hazards, find damages to equipment, and conform to the law. Though necessary, the current process for power distribution line inspections is slow and labor intensive. An unmanned aerial vehicle and light detection and ranging camera were used to automate the inspection process, cutting down on the labor costs. By better automating the inspection process, inspections can be completed faster, thus improving the reliability of electric distribution assets.

SOLAR CELL MANUFACTURING DESIGN PROCESS

by: Dylan Gritzmaker, Evan Luoma, and Joshua Mead

Sponsor: Steven Durbin, Ph.D.

Faculty Advisor: Steven Durbin, Ph.D.

3:30 p.m. – 3:55 p.m.

Design and fabrication of silicon solar cells using spin-on doping technique and screen printing was performed to produce functioning solar cells on campus. A one-dimensional solar cell simulation code (ADEPT) was used to design the structure, and process modeling was performed using SUPREM.

SOLID STATE LIGHTING CONVERSION

by: Dipesh Jha, Jumana Turkistani, and Albert Wright

Sponsor: None

Faculty Advisor: Steven Durbin, Ph.D.

4:00 p.m. – 4:25 p.m.

Floyd Hall has outdated fluorescent lighting devices in the classroom, which fail often and do not dim properly. A mock-up was designed to replicate a standard classroom environment of Floyd Hall with improvements to correct this issue. The new lighting system was modified and updated from Compact Fluorescent Lights to more cost-efficient light emitting diodes. The lighting zones were reconfigured for easier user layout and improved light viewing capabilities. New controls and increased functionality were added for better color temperature ranges and dimability to meet standard classroom settings.



ENGINEERING DESIGN, MANUFACTURING, AND MANAGEMENT SYSTEMS

Session Chair – Betsy Aller, Ph.D.

Room D-201

STANDARDIZING THE RECEIVING PROCESS AT STRYKER

by: Ben Holewinski, Audi Matvekas, and Brandon Weber

Sponsor: Stryker Instruments

Shelby Rhein

Faculty Advisor: Larry Mallak, Ph.D.

8:30 a.m. – 8:55 a.m.

A local manufacturer of medical instruments sought new ideas for standardizing and making their returns receiving process more efficient. Hospitals and other medical facilities need their repaired units delivered on time. With that in mind, the overall goal was to reduce the total time it takes units returned for repair to travel throughout this process. Analysis of the current process and use of time studies, interviews, identifying bottleneck areas, and 5-S methodology led to proposed solutions. These included a new process flow chart and a redesigned floor plan of the returns receiving process. These proposed solutions will lead to the returns receiving process operating at a reduced total cycle time.

COST OF SUPPLIER QUALITY DASHBOARD

by: Kendry Bautista Mosquea, William Bonam, David Gushee, and Michael O'Dell

Sponsor: BENTELEER Automotive

Jim Hall

Faculty Advisor: David Lyth, Ph.D.

9:00 a.m. – 9:25 a.m.

Poor product quality in a manufacturing environment leads to higher production costs. A local automotive supplier of metal frame and chassis components has a system to track the cost associated with poor supplier quality. This system produces a database that stores information of bad quality parts in relation to their suppliers, defects, and other associated costs. To allow upper management to make use of these data, a dashboard was developed that integrates costs, quality, and parts supplied. This dashboard also allows quality engineers and purchasing to rank suppliers. Use of these tools will allow the company to track supplier-related costs with respect to supplier ratings and possibly renegotiate supplier prices.

FRUIT FLY TRAP DESIGN

by: Austin Bieri, Blake Holzgen, Connor Morency, and Dan Trelenberg

Sponsor: Karen Smoots

Faculty Advisor: Jorge Rodriguez, Ph.D.

9:30 a.m. – 9:55 a.m.

The infestation of fruit flies is a common household problem in the summer and fall months. An effective trap was designed to capture and exterminate fruit flies in an eco-friendly fashion. The design process was followed throughout the entire project. Testing was conducted to determine the most effective design for the model. The final design was created in a 3D CAD software, yielding a 3D printed prototype. This design includes an injection molded body with a removable top, and can be cleaned and re-used. This fruit fly trap can effectively eliminate the common household fruit fly problem.

GOING GREEN AT GREEN DOOR DISTILLING COMPANY

by: Sai Myint, and Silas Wolff

Sponsor: Green Door Distilling Company

Jon Good

Faculty Advisor: Betsy Aller, Ph.D.

10:00 a.m. – 10:25 a.m.

Water usage and conservation is of concern to all industries, and particularly to beverage producers. A local distillery uses water as a cooling element but does not currently reuse or reduce its water use. Research on typical and creative methods of distilling processes and measurements of the current processes that use water led to the selection of the appropriate design to reduce the water use. Measurement of current water usage was performed using a volumetric flow analysis. Cost analysis tools were used to distinguish options of equipment, process upgrades, and system limitations. The implemented design will provide a sustainable and cost-effective alternative to current methods and allow the distillery future production growth.

AUTOMATION AND MEASUREMENT STUDY OF A WHITE LIGHT SCANNER

by: Lucas Baffi, Austin Lovins, and Christopher Moore

Sponsor: None

Faculty Advisor: Mitchel Keil, Ph.D.

10:30 a.m. – 10:55 a.m.

The automation of 3D white light scanning technologies has increased the consistency of on-the-line checks, and has also decreased cycle times in the inspection room. Coupling the automated white light scanner with an automated turntable has increased the consistency and repeatability of 3D scanning. The measurement capability of the automated white light scanner and turntable was compared to that of manual scanning by inspecting multiple simple geometric shapes with known dimensions. The resultant measurement capability for both automated and manual scanners has shown an increase in repeatability of automated scanning. This comparison of automated white light scanners to manual scanners will assist future students' research, as well as help companies make educated equipment purchases.

AUTOMATED DIE CASTING IN A BOX

by: Kevin Bors, Jack Gibson, and Yadira Reyes

Sponsor: North American Die Casting Association

Steve Wiegerink

Faculty Advisor: Sam Ramrattan, Ph.D.

11:00 a.m. – 11:25 a.m.

Metal casting is a major industry that is underrepresented in the STEM field. To address this, a scaled down press was designed to demonstrate the die casting process on a small scale. To allow the machine to automatically cycle parts, a melt system was designed, fabricated, and installed to continuously supply molten metal. The die casting in a box machine was automated by integrating a PLC and shot monitoring system along with guards and a part handling system to safely automate castings. The completed machine allows for a portable demonstration of an automated die casting process to students and faculty in the STEM field.

HYDRAULIC MONOWHEEL

by: Corey Smith and Cameron Tschupp

Sponsor: National Fluid Power Association

Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriguez, Ph.D.

11:30 a.m. – 11:55 a.m.

With the ongoing demand for greener energy, hybrid power sources are increasingly sought after. A nationwide engineering challenge was presented to create a human-powered vehicle with a hydraulic system. A concept for this vehicle was created in Solidworks, a 3D solid modelling program, and the hydraulic circuitry was tested using Automation Studio. An original vehicle was fabricated, assembled, and tested in house; and it participated in the competition. The vehicle represents hydraulic principles that can be applied to consumer vehicles to aid in the next generation of green energy.

LITTLE FREE LIBRARIES

by: Geoff Burns, Brian Fulkerson, Andre Ly, Jack Ruggless, and Ozella Wooley

Sponsor: David Middleton, MFS, and Betsy Aller, Ph.D.

Faculty Advisors: David Middleton, MFS, and Betsy Aller, Ph.D.

1:00 p.m. – 1:25 p.m.

Since 2009, the Little Free Libraries organization has been spreading knowledge in communities worldwide. Their “take a book, leave a book” mantra empowers neighborhoods by offering a free source of literature that changes with each new user. Little Free Libraries were designed and built for two Kalamazoo homes. The designs drew inspiration from the aesthetics of the neighborhoods in which they will reside. One is a craftsman style library for placement in the West Main historic district and is a model suitable for purchase as a kit. The second is influenced by mid-century architecture. It is a DIY or short run production requiring basic carpentry skills with the addition of exterior seating. Both installations were designed using Solidworks and Creo CAD systems. Our goal is to not only provide interesting and useful products, but aid in the enrichment of our city as well.

UPGRADING PLASTIC SHEET EXTRUSION EQUIPMENT

by: Patrick Gagne, Clare Jaquish, and Megan Van Aartsen

Sponsor: None

Faculty Advisor: Paul Engelmann, EdD

1:30 p.m. – 1:55 p.m.

Western Michigan University's plastic sheet extrusion line needed to be made capable of producing thermoformable sheet. Four main issues were identified after a thorough evaluation of the equipment. First, the die manufacturer was consulted for methods to control the extrudate width. Second, thermolators were installed to provide thermal control of the sheet take-off system. Third, programmable logic controllers and a host of safety equipment brought the equipment into compliance with ANSI and OSHA safety guidelines. Finally, a detailed processing manual was made for students. After extensive equipment modifications, the sheet extrusion line can now safely be operated by students to recycle scrap plastic into new thermoformable sheet.



INDUSTRIAL AND ENTREPRENEURIAL ENGINEERING & ENGINEERING MANAGEMENT

Session Chair – Dana Hammond

Room D-206

TEETH WHITENING STRIP PACKAGING LINE OPTIMIZATION

by: Amber Johnson, Nicholas Roe, and Austin Tarhanich

Sponsor: Ranir LLC

David Berkemeier and Nicholas Teopas

Faculty Advisor: David Meade, Ph.D.

9:00 a.m. – 9:25 a.m.

To meet increasing demands, a packaging facility can increase staff, increase machinery, or decrease line inefficiencies. Through the use of time studies, statistical analysis, ergonomics, and simulations, the packaging line was analyzed for areas of opportunity. The largest opportunities in the system were determined to be line balancing and rework frequencies. Recommendations were made in these problem areas to decrease cycle time to increase throughput to meet expanding demand.

OPTIMIZATION OF JOB & TRADESMEN SCHEDULING

by: Brandon Cole and Steven Mohny

Sponsor: The Austin Company

Steve VanWorner, Brian Green, and Sam Sheets

Faculty Advisor: Dana Hammond

9:30 a.m. – 9:55 a.m.

Failure to properly prioritize and schedule jobs within the construction industry leads to low resource utilization and workforce imbalances. A scheduling system was developed to minimize inefficiencies by standardizing job prioritization and optimizing resource allocation. Lean principles, cost analysis, and statistics were utilized to exceed client's expectations by effectively and efficiently completing jobs.

MATERIAL HANDLING WORK CELL OPTIMIZATION

by: Omar Bajamal, Abdulelah Bajammal, and Allison Knepple

Sponsor: FEMA Corporation

Carlee Gruizinga

Faculty Advisor: Lee Wells, Ph.D. and Dana Hammond

10:00 a.m. – 10:25 a.m.

Work space design plays a significant role in manufacturing efficiency and safety in the workplace. In this project, an optimized material handling work cell was designed to support the customer's new washing process for hydraulic components. While this study focused on generating work cell designs, an ergonomic risk assessment of the system was also performed. Potential designs were evaluated with respect to cost, safety, and overall cell performance.

STRATEGIC EXPANSION PLAN FOR CANDLE MANUFACTURER

by: Eric Carlo, David Haruza, and Sara Rodriguez

Sponsor: Kalamazoo Candle Company

Adam McFarlin

Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.

10:30 a.m. – 10:55 a.m.

Due to the rapid growth in demand, a local candle manufacturing facility sought to improve their process to address quality defects and production inefficiencies. The current state of the candle company was analyzed and evaluated using industrial engineering tools, including product design, cost analysis, and facility planning and design. Based on this analysis, a five-year strategic plan was developed to determine capacity, future expansion milestones, and help the company meet projected growth.

PACK PROCESS IMPROVEMENT

by: Jennifer Komorowski, Anna Konstant, and Alexander Moorer

Sponsor: Pridgeon & Clay, Inc.

Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.

11:00 a.m. – 11:25 a.m.

The packing rate of a high demand exhaust shield was below the anticipated rate when the part was quoted. Therefore, the packing process was investigated using simulation, cost benefit analysis, facility planning, and ergonomic workstation design principles to develop the most cost-effective solution. This analysis resulted in recommendations to achieve higher pack rates, development of a comprehensive packaging cost model, and improvements in ergonomics of the workstation.

COMPRESSED AIR SYSTEMS EVALUATION AND IMPROVEMENT

by: Sam Goldschmeding and Lukas Swoboda

Sponsor: Parker Hannifin

Anil Verma

Faculty Advisors: Tycho Fredericks, Ph.D., Steven Butt, Ph.D., and Dana Hammond

11:30 a.m. – 11:55 a.m.

Compressed air is commonly used in manufacturing plants to power machines. Several replacement plans for an aging air compressor system were created based off financial models, statistical and logistical analysis of air flow, and equipment demands. A full layout of the air compressor room was created, and visual management standards were applied to air and water pipelines. A final recommendation for air compressor replacement was provided.



MECHANICAL AND AEROSPACE ENGINEERING A

Session Chair – Judah Ari-Gur, Ph.D. and Kapseong Ro, Ph.D.

Room D-109

FIXED ALTITUDE AND FLIGHT TERMINATION SYSTEM

by: Kenneth Oliver-Brace Baker, Brandon Kammer, and Quentin Piaskowski

Sponsor: None

Faculty Advisor: Kristina Lemmer, Ph.D.

8:30 a.m. – 8:55 a.m.

Earth's atmosphere has become a focal point in studying the DNA and interactions of microbial communities. Obtaining accurate microbial samples using high altitude balloons is vital for a team of biology researchers. A previous sampling system was optimized by designing a helium valve system for the balloon and ballast system using SolidWorks. Flight terminations methods were enhanced using the valve system by discharging lifting gas upon sampling completion or stop commands. The valve/ballast system provided full vertical control of the balloon by releasing either helium or sand to maintain a required sampling altitude of 5000_m over six hours.

DESIGN, BUILD AND TESTING OF A LOW FLOW RATE HOLLOW CATHODE FOR WMU AEROSPACE LABORATORY FOR PLASMA DYNAMICS

by: Thomas Kerber, Margaret Mooney, and Sarah Roiniak

Sponsor: None

Faculty Advisor: Kristina Lemmer, Ph.D.

9:00 a.m. – 9:25 a.m.

Hall effect thrusters and gridded ion engines require hollow cathodes to both ionize the propellant and neutralize the ejected plasma plume. A hollow cathode was designed and constructed to be paired with the Western Hall thruster (WHT-44) and for further research conducted at the Aerospace Laboratory for Plasma Experiments at Western Michigan University. The cathode uses materials that are capable of withstanding high temperatures and vacuum conditions required for operation. The design allows different geometric configurations to be tested on the same cathode to help determine optimum performance characteristics. Research into electric propulsion systems is crucial to the continued exploration and understanding of the universe.

DESIGN OF POWER CONVERSION AND TRANSMISSION SYSTEM FOR OSCILLATING WING UNIT (OWU)

by: Nather Alassef, Choong Beng Lim, Muhammad Maulud, Bo Ching Wong

Sponsor: Talis Equity LLC

Brett Hungerford

Faculty Advisor: Tianshu Liu, Ph.D.

9:30 a.m. – 9:55 a.m.

Oscillating Wing Unit (OWU) for Power Generation is a non-conventional wind power generator. OWU converts the oscillation into rotation which can generate electricity stably. OWU has two wings at the tips of the model to extract torque created by the airflow with minimum speed of 1 m/s, where minimum operational speed of wind turbine is 5 m/s. The converter and gearbox are designed for converting the oscillation into electricity and varying the gears against different wind speeds respectively. These two systems implement OWU into practical usage and develop wind power potential globally.

DESIGN OF AN ELECTRIC PROPULSION THRUSTER BREAKOUT BOX SYSTEM

by: Ryan Powers, and Luke Wilkins

Sponsor: Kristina Lemmer, Ph.D.

Faculty Advisor: Kristina Lemmer, Ph.D.

10:00 a.m. – 10:25 a.m.

When performing experiments in the Aerospace Laboratory for Plasma Experiments (ALPE), creating test setups and working with electrical equipment can become dangerous and tedious. A breakout box was required that ensures the ability to troubleshoot electrical problems, decrease time needed to reconfigure equipment for an experiment, and decrease the potential for a safety hazard. The goal was to design a box that would house most of the equipment necessary to obtain current and voltage data from experiments in a safe, easy, reliable manner. A completed breakout box significantly improves the efficiency of ALPE experiments.

AGET CYCLONE PERFORMANCE OPTIMIZATION

by: Brian Erhart, George Norg Jr., and Dana Wyckoff

Sponsor: AGET Manufacturing Company

Rob DePierre

Faculty Advisor: William Liou, Ph.D.

10:30 a.m. – 10:55 a.m.

Many processes produce significant amounts of unwanted particles which can be harmful to humans, equipment, and facilities, and can also be the cause of spontaneous combustion if not properly collected and removed. Cyclone dust collectors have not been improved upon for nearly 40 years and thus there is much room for a redesign. A customized dust collector was used to collect CFM, ESP, velocity profiles, and horsepower data. This data was then compared to an analysis performed in ANSYS Fluent, whereupon a redesign of the dust collector was conceptualized and modeled on a small scale to demonstrate a more efficient and superior design.

EMERGENCY VOR CDI FOR GENERAL AVIATION

by: Quinten Bader, Alyssa Hartsig, Ross McMahan, and Ashley Rettich

Sponsor: None

Faculty Advisor: Peter Gustafson, Ph.D.

11:00 a.m. – 11:25 a.m.

A very high frequency omnidirectional range course deviation indicator (VOR CDI) is an aircraft instrument that helps a pilot navigate the airspace. The COR CDI is the predecessor to global positioning systems (GPS), but is still widely used in general aviation aircraft. Aircraft that use VOR CDI are equipped with two indicators; only one is required to fly. The Emergency VOR CDI for General Aviation is a low-cost, user-friendly, system that can help pilots navigate to safety in the event of a single VOR CDI failure. Integrating this system with a similarly built GPS (Stratux) would provide pilots with a complete low-cost emergency navigation system.

GAS TURBINE ACTIVE DEBRIS PROTECTION

by: Dillon Duquette, and Alifiya Josh

Sponsor: None

Faculty Advisor: William Liou, Ph.D.

11:30 a.m. – 11:55 a.m.

Gas Turbine engines have historically been susceptible to damage due to intake ingestion. Current solutions implement a passive design at the intake that degrades performance. An active intake protection uses sensors for frontal area scanning and an active barrier that deploys only in the case of oncoming debris. Performance analysis is done on a Jet Fuel Starter Turbine with a dynamometer and compared with open and passive intake protection solutions.

EXHAUST WASTE HEAT RECOVERY BY THERMOELECTRIC GENERATORS

by: Matthew Frank, and Matthew Habel

Sponsor: None

Faculty Advisor: HoSung Lee, Ph.D.

1:00 p.m. – 1:25 p.m.

The current cycle of the internal combustion engine has large amounts of exhaust waste heat. The goal of this project was to design and test a thermoelectric generator system to reclaim the waste exhaust heat energy created by a gasoline engine. A thermoelectric generator array was used in tandem to an optimized set of heat exchanger fin systems. The hot side heat exchanger fin system was designed to exploit conduction and convection to maximize the heat transfer. The cold side heat exchanger fin system was integrated with an auxiliary radiator and pump to optimize the heat transfer to increase the temperature difference across the thermoelectric array resulting in an optimized power output.

DEVELOPMENT OF A VALIDATED ENGINE SIMULATOR FOR HARDWARE-IN-THE-LOOP

by: Paul Schnitzenbaumer, and Bryan Shamasko

Sponsor: DENSO North American Foundation

Faculty Advisor: Claudia Fajardo-Hansford, Ph.D. and Richard Meyer, Ph.D.

1:30 p.m. – 1:55 p.m.

A high-fidelity engine simulation was developed for a 2015 Ford 5.0L Coyote engine utilizing GT-Power software. Testing equipment was researched while complex data acquisition was programmed and setup. The model was refined and correlated with benchmark data obtained from experimentation conducted in the WMU Automotive Systems Laboratory. This high-fidelity engine simulation will be used in both research optimization studies and as a learning tool for future undergraduate programs.

CONFORMAL COOLING DESIGN

by: Ethan Richards, and Robert Vella

Sponsor: DENSO Manufacturing Michigan Inc.

Joseph Worden

Faculty Advisors: Javier Montefort, Ph.D. and Jay Shoemaker

2:00 p.m. – 2:25 p.m.

Injection molding is the most common process used to produce plastic parts. The current conventional cooling design requires a relatively long cooling cycle time before the part can be ejected. 3D metal printing allows cooling channels to be designed parallel to the plastic allowing enhanced cooling in a shorter cycle time. A comparative analysis between actual molding conditions and Moldflow FEA predictions was done, and correlation was found. Based off this analysis, conformal cooling channels were designed using 3D CAD software and warp predictions at a shorter cycle time were made through FEA.

FLAT SPRING CHECK VALVE

by: Lauren Lamie, and Wesley Young

Sponsor: FEMA Corporation

Jerry Boza

Faculty Advisor: Peter Gustafson, Ph.D.

2:30 p.m. – 2:55 p.m.

The need for pressure control in the form of Check Valves and Relief Valves are important components in the design of hydraulic systems. However, for certain applications, size and flow constraints can create the need for alternative designs. For a customer specific design, restrictions and constraints were given and it was determined that a flat spring would be best utilized. After calculating the spring constant and orifice sizes, a flat spring check valve was designed and Finite Element Analysis (FEA) conducted. The design was then prototyped and tested and conclusions were made.

DESIGN OF A TEST TO MEASURE FLOWABILITY OF GREEN FOUNDRY SAND

by: Kyle Howland, Elly Nyambane, and Michael Shirley

Sponsor: WMU Foundry Casting

Sam Ramrattan, Ph.D.

Faculty Advisor: Sam Ramrattan, Ph.D.

3:00 p.m. – 3:25 p.m.

The America Foundry Society is seeking an appropriate technique to measure flowability of green sand used in foundries. Two identical “Ripple” test plates were designed using SolidWorks and then fabricated. Each intricate design consists of three parts with slots of different heights as the sections widen and become longer. The two Ripple plates developed are for one at the bottom of the sand specimen and the second for the top of the sand specimen. A test specimen was achieved by riddling a known mass of green sand into a plate followed by squeezing the top plate applying a known pressure. This will help to detect how well the sand specimen fills and packs. The ratio of filling and packing was used to determine a Flowability Index for green sand. Tests were performed using various green sand samples differing in sizes, shapes, and additives.

MODEL BASED ENTERPRISE SOLUTION FOR MACHINE & TOOL

by: Christopher Alexander, Dayland Bowser, and Travis Courtney

Sponsor: DENSO Manufacturing Michigan, Inc.

Brian Boylan

Faculty Advisor: Pavel Ikononov, Ph.D.

3:30 p.m. – 3:55 p.m.

Many design groups currently use 2D CAD drawings to share product information and specifications by creating 3D model within a modeling software, then exporting that data to a 2D space where dimensions and annotations are created, attempting to communicate the product manufacturing information. Future design practices involve defining and maintaining product manufacturing information in 3D space, i.e. Model Base Enterprise. Critical inefficiencies in the traditional 2D design standard warrant the transition to a Model Based Enterprise. Following ASME Y14.41, a design standard has been created and analyzed for a developing Model Based Enterprise.

RESEARCH AND DEVELOPMENT OF A LOW-VACUUM-MOISTURE-REMOVAL (LVMR) SYSTEM FOR A MEDICAL MATTRESS

by: Nathan Belson, Andrew Beltramo, and DeAngelo Haggen

Sponsor: None

Faculty Advisor: Parviz Merati, Ph.D.

4:00 p.m. – 4:30 p.m.

Bedsore prevention is an essential feature in the design of medical mattresses. Small pores in durable mattress clothes have imposed limited moisture vapor removal caused by lowered desirable flow rates and humidity using the current Low-Air-Loss system. A Low Vacuum Moisture Removal (LVMR) system that can endure the micro-climate of medical mattresses was designed and tested in the Fluid Dynamics Lab. Completion of tests and design of the system will aid in future investigations and the feasibility of durable clothes in medical bed production.



MECHANICAL AND AEROSPACE ENGINEERING B

Session Chair – Bade Shrestha, Ph.D. and Christopher Cho, Ph.D.

Room D-212

REDUCING AERODYNAMIC NOISE OF WIND TURBINES

by: Justin Diep, Paul McKnight, and Ravi Orlewicz

Sponsor: None

Faculty Advisor: Bade Shrestha, Ph.D.

8:30 a.m. – 8:55 a.m.

Wind turbines provide renewable, clean energy from a simple principle of winds turning its turbine blades around a rotor. Energy produced from this method is almost ideally perfect, however; one complication is the excessive aerodynamic noise produced. The noise generated can reach as far as a couple kilometers, and to mitigate the disruption, a new airfoil geometry of the wind turbine blade was designed and analyzed via SolidWorks and ANSYS Fluent software, respectively. Furthermore, a prototype of the airfoil was manufactured by using a 3D printer and subjected to testing in a wind tunnel environment to confirm our analysis.

DESIGN OF A BIOGAS SEPARATOR AS A THREE-STAGE RADIAL COMPRESSOR

by: Sterling Fulton, John Knuth, and Jacob Westhouse

Sponsor: None

Faculty Advisor: Bade Shrestha, Ph.D.

9:00 a.m. – 9:25 a.m.

Biogas is used in some countries as a fuel for cooking and other uses, but is limited in its economic value. Since biogas contains primarily methane and carbon dioxide, a need exists to separate and purify the methane component into natural gas. A design for a three-stage compressor of radial type was created and analyzed to determine its suitability to be manufactured and used in a biogas separator.

LAND, AIR, SEA, ROBER (LASR) – UNMANNED VEHICLE

by: Joshua Gudenau, Corey Lee, and Gabriel Prescinotti Vivan

Sponsor: None

Faculty Advisor: William Liou, Ph.D.

9:30 a.m. – 9:55 a.m.

The presence of drones in our daily lives has become increasingly popular in the past few years. They can be used for a variety of different missions, including search and rescue, research, educational, entertainment, commercial, and military purposes. The addition of operational capabilities to these aerial systems represents the next step in the development of drones. Through combining different propulsion and directional control systems, one single vehicle that can successfully operate in four different environments has been developed. This model will allow operations that previously required multiple vehicles to be performed using one system.

PORTABLE BIOGAS SEPARATOR-HEAT EXCHANGER 2

by: Jeremy Barr, Kyle Brady, and Tyler Huffman

Sponsor: None

Faculty Advisors: Bade Shrestha, Ph.D. and Anilkumar Kosna

10:00 a.m. – 10:25 a.m.

Creating a device that is able to separate the components of Biogas, methane and carbon dioxide, will allow underdeveloped countries easy access to cheap, renewable energy as well as create a job market for both the manufacturers and the operators such a device. A three-dimensional model of a heat exchanger contained within the device was constructed using SolidWorks. In addition, a thermal transfer simulation was created using Ansys Workbench. These models provided the necessary information to properly design a heat exchanger that met the requirements.

DEVELOPMENT OF ATTITUDE DETERMINATION AND CONTROL SYSTEM FOR THE WALI SATELLITE

by: John Maceri, and Jordan Ruterbusch

Sponsor: Jennifer Hudson, Ph.D.

Faculty Advisor: Jennifer Hudson, Ph.D.

10:30 a.m. – 10:55 a.m.

The goal of this project is to design and develop the attitude determination and control system for WALI (Western Aerospace Launch Initiative) satellite. The design presented will use magnetorquers to control the satellite's orientation for the duration of its mission. The mission being, to perform on-orbit electric propulsion device plasma plume diagnostics. A magnetorquer consists of electromagnetic coils that produce torque by interacting with the Earth's magnetic field. An Arduino microcontroller will be programmed to control the current passing through the magnetorquer coils. A "B-Dot" algorithm will be used to achieve initial satellite de-tumble upon orbit entry.

FORCE VERSUS DISPLACEMENT TEST STAND

by: Drew Arndt, Andrew Fritchley, and Fabian Venegas

Sponsor: Humphrey Products

David Phaneuf

Faculty Advisor: Muralidhar Ghantasala, Ph.D.

11:00 a.m.- 11:25 a.m.

Ensuring springs, solenoids, and friction forces meet design specifications is critical in many engineering environments. A lab test with high accuracy must be performed to provide this assurance. For this reason, a force vs. displacement measurement test stand was designed around a recycled frame. The design uses a strain-gauge load cell to measure force and a magnetic linear encoder to measure displacement. It allows operators to easily gather and store data for later use. Mechanical, electrical, and controls designs were completed, and the stand was built and qualified. The test stand allows engineers to validate their designs.

SINUSOIDAL COOLING GROOVE

by: Khyzar Tirmizi, and Zachariah Williams

Sponsor: Flowserve Co.

Erich Stuedemann

Faculty Advisor: Javier Montefort, Ph.D.

11:30 a.m. – 11:55 a.m.

A sinusoidal cooling groove is a feature that can be added to a mechanical seal to improve liquid circulation under the inboard primary seal of a dual inline seal arrangement. Models of a mechanical seal with and without a sinusoidal groove were created using Ansys engineering software. These software models were validated in experimental laboratory testing in the Kalamazoo, Flowserve R & D Labs. With the software simulation data populated in an Excel spread sheet, a calculator was created to determine the fluid temperature between the sleeve and the primary seal faces in given operating conditions. Engineers can now properly determine if a sinusoidal cooling groove will need to be added or can be left out of the final seal design.

LOW COST CONTROL SYSTEMS LAB: GANTRY CRANE

by: Adam Cruse, Brent Schneider, and Daniel Smith

Sponsor: None

Faculty Advisor: Richard Meyer, Ph.D.

1:00 p.m. – 1:25 p.m.

Premade control systems labs are expensive. To reduce costs, a gantry crane load position control lab was designed to take advantage of the 3D printing and Arduino control boards. To ensure low cost and for it to best fit any controls class, the lab was designed to be modular and use standard parts, allowing for inexpensive repairs and easy modifications. The resulting lab experiment requires the student to move the gantry and its hanging load from an initial position to a desired final load position. The lab hardware and control software allows students to demonstrate realistic position control using control method's taught in undergraduate and graduate classes.

STRUCTURAL REINFORCEMENT OF STREAMLINE TUBING

by: Peter Grohs, Chuyle Hang, and Ben Merchant

Sponsor: SC Enterprise

Scot Copeland

Faculty Advisors: Richard Hathaway, Ph.D. and Bade Shrestha, Ph.D.

1:30 p.m. – 1:55 p.m.

Structural integrity of suspension components is important to the safety and longevity of vehicles. Streamline tubing, an aerodynamically shaped material used for high performance vehicle suspension control arms, is prone to structural failure. The component was redesigned as a composite structure using modern materials to make a highly aerodynamic product lighter, stiffer, and stronger than a conventional all steel design. Finite element analysis was conducted and prototypes were constructed and tested. This method of maximizing component lightness and stiffness using the beneficial properties of each material contributed to a design which optimized costs while achieving set goals.

AUTOMATED UTENSIL WRAPPER

by: Austin Key, Alec Tussey, and Joshua Volk

Sponsor: SRS Pharmacy Systems

Jim Tussey

Faculty Advisor: Richard Meyer, Ph.D.

2:00 p.m. – 2:25 p.m.

The Automated Utensil Wrapper machine wraps utensils in napkins eliminating the need for hand wrapping utensils. The Automated Utensil Wrapper provides a solution to inefficient restaurant operations by automating the process and requiring only minimal time loading the machine. Restaurant owners say that the product will be competitive if the retail price stays below \$3,000 while the Automated Utensil Wrapper was designed and built for approximately \$800. Using Arduino robotics to automate the machine, the Automated Utensil Wrapper is capable of fulfilling the market need while being financially viable.

POWERING STEEL CONVEYOR ROLLERS

by: Jordan Boothby, and Daniel Karsten

Sponsor: None

Faculty Advisor: Jinseok Kim, Ph.D.

2:30 p.m. – 2:55 p.m.

Moving heavy objects by hands can cause joint or muscle injuries, even if the objects are on conveyor rollers to assist motion. A model system showing this was designed to prevent human injuries during conveying heavy objects. This system was then fitted with a way to power the rollers, without changing the interaction between the rollers and the objects. This was modeled in Solidworks as well as a physical prototype, each used for testing. The data gathered from the testing was used to project power/torque requirements needed at the rollers for varying object weight.

ELECTROMAGNETIC RADIATION SHIELD FOR SPACECRAFT

by: Robert Hallenbeck, and Oseas Benjamin Hudy-Velasco

Sponsor: None

Faculty Advisor: Kristina Lemmer, Ph.D.

3:00 p.m. – 3:25 p.m.

During space travel, astronauts are exposed to dangerous ambient radiation. An electromagnetic radiation shield was built using superconducting wire, simulated with the multi-physics software COMSOL, and validated with real-world tests. As electric current passes through the superconducting wire, it induces a strong magnetic field that deflects the high-energy charged particles that comprise the most dangerous radiation in space. The radiation shield will be used to protect astronauts from harmful radiation during long duration missions outside of the Earth's magnetic field. Radiation detectors placed behind the device recorded the amount of radiation that managed to penetrate the shield.

REINFORCED TAILGATE HINGE FOR JEEP WRANGLER

by: Sean Kade, Joseph Kalich, and Blair LaCross

Sponsor: SAGARIS GROUP INC

Alexandru Risca

Faculty Advisor: Daniel Kujawski, Ph.D.

3:30 p.m. – 3:55 p.m.

The Jeep Wrangler is a capable and popular vehicle used daily by a large number of people for off-road and on-road use. A common complaint that is noted by a large amount of Jeep Wrangler owners is the weak tailgate hinge. This hinge must support the weight of the spare tire, and often fails causing a loud rattle and an inability to utilize the tailgate. A prototype hinge was created which allows the owner to carry up to a 37" spare tire on the rear tailgate without additional modifications to the rear bumper.

CUSTOMIZABLE WHEELCHAIR BRACKET

by: Emily Gruss, Melissa Maher, and Alec Rossi

Sponsor: None

Faculty Advisor: Daniel Kujawski, Ph.D.

4:00 p.m. – 4:25 p.m.

Wheelchair accessories are a major market in the United States, including customizable features that increase the independence of wheelchair users. A universal bracket was designed to allow wheelchair users to quickly and easily change accessories depending on variable daily needs. The bracket system was designed using SolidWorks and a prototype was created to show the final look and feel of the product. Materials for the final product were selected to maintain structural stability and competitive pricing compared to existing wheelchair accessories. The final product is a practical and affordable solution to quickly and easily change accessories for any mobility-aiding chair.



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- Discover: advance knowledge and innovation through high-quality research, teaching, and student engagement;
- Inspire: prepare our learning community for lifelong excellence, ethical behavior, and professional leadership;
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