4-16-2019

64th Conference on Senior Engineering Design

College of Engineering and Applied Sciences

SENIOR DESIGN ENGINEERING CONFERENCE

APRIL 16, 2019 • 8 AM - 4 PM

College of Engineering and Applied Sciences

WESTERN MICHIGAN UNIVERSITY

Conference on Senior Engineering Design Project

You are invited to attend the sixty-fourth Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., **Tuesday, April 16, 2019** 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	8:00 a.m. to 3:30 p.m.	pg. 6
Chemical and Paper Engineering	C-122	8:00 a.m. to 3:00 p.m.	pg. 11
Civil and Construction Engineering	D-115	9:00 a.m. to 11:30 a.m.	pg. 15
Computer Science	D-202	9:00 a.m. to 2:30 p.m.	pg. 17
Electrical and Computer Engineering	D-204	9:00 a.m. to 3:30 p.m.	pg. 21
Engineering Design, Manufacturing, and Management Systems	D-201	9:00 a.m. to 2:00 p.m.	pg. 25
Industrial and Entrepreneurial Engineering & Engineering Management	D-210	9:30 a.m. to 12:00 p.m.	pg. 28
Mechanical and Aerospace Engineering A	D-109	9:00 a.m. to 4:00 p.m.	pg. 30
Mechanical and Aerospace Engineering B	D-212	9:00 a.m. to 3:30 p.m.	pg. 35
Mechanical and Aerospace Engineering C	D-206	9:00 a.m. to 3:30 p.m.	pg. 39

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
8:00	D-208	ChP	REDUCTION OF DOWNTIME VIA IMPROVEMENTS IN CLEANING PROCESSES
	C-122	ChP	CLARIFIER OPTIMIZATION USING COAGULANTS AND FLOCULANTS
8:30	D-208	ChP	LOW TEMPERATURE CHILLER & FLUID REPLACEMENT
	C-122	ChP	FIBER COST REDUCTION: INVESTIGATING SOFTWOOD-HEMP FIBER BLEND IN REGARD TO STRENGTH PROPERTIES
9:00	D-208	ChP	OPTIMIZATION OF COGENERATION FACILITY TO REDUCE WASTE HEAT
	C-122	ChP	IMPROVING COATED RECYCLE BOARD PRINT QUALITY
	D-115	CCE	2ND AVENUE BRIDGE RECONSTRUCTION OVER I-94
	D-202	CS	CAE CENTER FULL STACK WEB OVERHAUL
	D-204	ECE	SMALL-SCALE SOLAR GENERATION STATION
	D-201	EDMMS	SECOND GENERATION MODULAR OVEN ACCESSORY DEVELOPMENT
			CLOSED SESSION TO PUBLIC
	D-109	MAE A	QUANTIFYING & OPTIMIZING SKIN FRICTION
	D-212	MAE B	MEASUREMENTS ON AERODYNAMIC BODIES
	D-206	MAE C	NEED A LIFT? STANDING ASSISTANCE DEVICE DESIGN
			DUAL RATE ELECTRO-HYDRAULIC RELIEF VALVE
9:30	D-208	ChP	DESIGN OF FILTRATION PROCESSES FOR SOLVENT EXTRACTION
	C-122	ChP	ANALYSIS OF PAE WET-STRENGTH RESIN REPULPABILITY
	D-115	CCE	CD 12 LOT 9: FOUNDATION DESIGN
	D-202	CS	PET EPILEPSY TRACKER FOR iOS AND ANDROID
	D-204	ECE	VIRTUAL XYLOPHONE
	D-201	EDMMS	WESTERN MICHIGAN UNIVERSITY FOUNDRY: CASTING PROCESS ENHANCEMENT
	D-210	IEE	OPTIMIZATION OF IRREGULAR PACKAGE MOVEMENT
			CLOSED SESSION TO PUBLIC
	D-109	MAE A	THERMALLY OPTIMIZED PLA SHREDDER
	D-212	MAE B	DESIGN OF A BALLOON ALTITUDE AND FLIGHT TERMINATION SYSTEM
	D-206	MAE C	AERODYNAMIC EFFICIENCY OF THE LANDING GEAR IN THE VELOCITY XL WITH FIXED LANDING GEAR
10:00	D-208	ChP	PRE-GELATINIZATION OF RICE FLOUR
	C-122	ChP	REPLACEMENT OF THE TiO2 IN A COATING FORMULATION WITH MC25
	D-115	CCE	EAGLE LAKE FLOOD MANAGEMENT
	D-202	CS	PROPERTY MANAGEMENT SOFTWARE
	D-204	ECE	VIRTUAL HAND DRUM
	D-201	EDMMS	DESIGN OF INNOVATIVE NAIL POLISH COVER
	D-210	IEE	ASSEMBLY LINE OPTIMIZATION FOR PRODUCTIVITY IMPROVEMENT
	D-109	MAE A	A SMALL AIRCRAFT LANDING AND TAKEOFF SAFETY SYSTEM DEVELOPMENT
	D-212	MAE B	AUTOMATED ARMATURE AND POPPET PRESS FIXTURE
	D-206	MAE C	ALL-IN-ONE APPENDECTOMY DEVICE
			CLOSED SESSION TO PUBLIC
10:30	D-208	ChP	SYRUP PROCESS OPTIMIZATION

	C-122	ChP	MAXIMIZING FLOTATION CELL EFFICIENCY THROUGH OPTIMAL DOSAGES OF FLOCCULANTS AND COAGULANTS
	D-115	CCE	VERBURG PARK DESIGN
	D-202	CS	WMU COHORT SCHEDULING SYSTEM
	D-204	ECE	RETRO-TECH MIRROR
	D-201	EDMMS	CUSTOM UTILITY TRAILER DESIGN & FABRICATION
	D-210	IEE	WAREHOUSE AND PACKAGING EFFICIENCY
	D-109	MAE A	WIND TUNNEL
	D-212	MAE B	DESIGN OF A THRUST STAND FOR ELECTRIC PROPULSION DEVICES
	D-206	MAE C	BLUFF BODY AERODYNAMICS AND DRAG REDUCTION MECHANISMS
11:00	D-208	ChP	SEPARATION AND DISPOSAL OF WASTE REJECTS FROM OLD CORRUGATED CARDBOARD
	C-122	ChP	AN INVESTIGATION INTO STARCH RETROGRADATION
	D-115	CCE	THE URBAN DEVELOPMENT OF BRONSON CIRCLE
	D-202	CS	FUZZY RECORD LINKAGE
	D-204	ECE	HAND MOTION CONTROLLED CAR USING FLEXIBLE HYBRID ELECTRONICS
	D-201	EDMMS	AUTOMATION OF “DIE CASTING IN A BOX”
	D-210	IEE	IMPROVING EFFICIENCY OF MANUFACTURING CELLS
	D-109	MAE A	A STUDY OF WAVE PHENOMENA AND VIBRATION USING OPTICAL FLOW VISUALIZATION
	D-212	MAE B	ALTITUDE CONTROL TEST FIXTURE
	D-206	MAE C	ELECTRIC POWERBANK FOR HYBRID ENERGY SYSTEMS
11:30	D-208	ChP	GENERATING ELECTRICITY BY USING A NATURAL GAS POWER PLANT OR USING RENEWABLE ENERGY
	C-122	ChP	INTRODUCTION OF ETHYLENE SCAVENGING AGENTS INTO PRODUCE PACKAGING TO LENGTHEN SHELF LIFE
	D-202	CS	BPS TICKETING SYSTEM
	D-204	ECE	RESIDENTIAL OPEN NEUTRAL MONITORING DEVICE
	D-201	EDMMS	MODIFIED FLUID POWERED RECUMBENT TRIKE FOR FPVC COMPETITION
	D-210	IEE	EMERGENCY DEPARTMENT TRIAGE PROCESS IMPROVEMENT
	D-109	MAE A	OPTIMIZATION OF A ROOTS TYPE SUPERCHARGER
	D-212	MAE B	THE DESIGN OF A UAV TO FLY IN THE MARTIAN ATMOSPHERE
	D-206	MAE C	AUTOMATED HYDRAULIC DEAERATOR
1:00	D-208	ChP	PETROLEUM REFINERY POWER PLANT
	D-202	CS	THE STANDARDS PROJECT
	D-204	ECE	NEXT-GENERATION LIGHT BOARD
	D-201	EDMMS	ELITE OBSTACLE DESIGN AND BUILD FOR THE KALAMAZOO MUD RUN
	D-109	MAE A	BIOGAS SEPARATION
	D-212	MAE B	MODULAR WATER MODELING FOR MANUFACTURING
	D-206	MAE C	DESIGN, CONSTRUCTION, AND EVALUATION OF AN ULTRASONIC WELDER
1:30	D-208	ChP	MONOCLONAL ANTIBODY PRODUCTION FOR REOPRO™ SYNTHESIS
	C-122	ChP	NANO-CELLULOSE CONTAINING COATING: IMPACT ON OIL AND GREASE RESISTANCE
	D-202	CS	CODING TUTORIAL

	D-204	ECE	PHOTOVOLTAIC PANEL EMULATOR
	D-201	EDMMS	YWCA CHILDREN'S CENTER PLAYGROUND AND GARDEN RENOVATION
	D-109	MAE A	TURBO-OPTIMIZED INTAKE MANIFOLD
	D-212	MAE B	TITAN INVESTIGATOR: TOURING A NEW WORLD
	D-206	MAE C	PONTOON CLEANER
2:00	D-208	ChP	REPLACEMENT OF A LIQUID FILLING SYSTEM FOR CORROSIVE MATERIALS
	C-122	ChP	ENZYME-ASSISTED REFINING OF SECONDARY FIBERS
	D-202	CS	CTF-SETTING UP A SECURITY WEB APPLICATION FOR WMU
	D-204	ECE	COMMUNICATIONS DEBUGGING PLATFORM
	D-109	MAE A	SMOKE ALARM ACTIVATED DOOR CLOSING MECHANSIM
	D-212	MAE B	THERMAL ADAPTATION OF A VACUUM CHAMBER
	D-206	MAE C	UTILIZING EXISTING STRUCTURES IN THE IMPLEMENTATION OF WIND TURBINES
2:30	D-208	ChP	DISTILLATION OPTIMIZATION
	C-122	ChP	IMPROVING STRENGTH PROPERTIES OF RECYCLED PAPERBOARD THROUGH ENZYME-AIDED PULP REFINING
	D-202	CS	SERVER ROOM TEMPERATURE SENSOR
	D-204	ECE	DEVICE FOR CLEANING PV PANELS
	D-109	MAE A	ECONOMIC FEASIBILITY OF PRODUCING ELECTRICITY FROM A GAS TURBINE
	D-212	MAE B	HANDS- FREE WHITE CANE
	D-206	MAE C	3D PRINTING ROBOTIC ARM ON LINEAR RAILS
3:00	D-208	ChP	MODERNIZATION OF AN ACTIVE PHARMACEUTICAL INGREDIENT PRODUCTION FACILITY
	D-204	ECE	SOLAR PANEL COOLING SYSTEM
	D-109	MAE A	WELD COOLING OPTIMIZATION
	D-212	MAE B	DESIGN OF A SOLAR DRONE
	D-206	MAE C	INTERGRATED AND AUTOMATED PUNCH SKIN BIOPSY DEVICE
			CLOSED SESSION TO PUBLIC
3:30	D-109	MAE A	A RADIO CONTROLLED HYBRID DESIGN FOR A SUSTAINED STEADY FLIGHT

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 2019. 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 – James Springstead, Ph.D.
Room D-208

REDUCTION OF DOWNTIME VIA IMPROVEMENTS IN CLEANING PROCESSES

by: Brian Bartley, Francisco Palomo, Melanie Mitchell, and Nicholas Willey
Sponsor: Bret Nordland, Amway
Faculty Advisors: James Springstead, Ph.D. and Qingliu Wu, Ph.D.
8:00 a.m. – 8:25 a.m.

Extensive and excessive cleaning of manufacturing lines decreases available production time and increases the costs of running a plant. Improvements to previous cleaning processes were developed using material transfer principles and chemical data. To ensure the adjustments to the processes and equipment were satisfactory, cleaning validations and engineering studies were performed. The adjustments in procedures and recommendations of new, reliable cleaning equipment were made to reduce production time lost due to cleaning, and increase the capacity of production on the manufacturing lines.

LOW TEMPERATURE CHILLER & FLUID REPLACEMENT

by: Shawn Fillenworth, Sean Lawrence, Dan Michael, and Stephen Miller
Sponsor: Jason Buero
Faculty Advisor: Qingliu Wu, Ph.D.
8:30 a.m. – 8:55 a.m.

Average life expectancy of an industrial Chiller is 20 years. One company's chiller is 33 years old and experiences frequent breakdowns during production. With production rising, the following objectives were given: Design a new chiller, implement a water-cooling tower system, suggest new cooling media, and propose automation. Calculations were performed to determine the load requirements for the plant's chilled processes. After a design was developed, communications were made with chiller and cooling media manufacturers. A matrix of components, quotes, and cooling media was developed for cost analysis. The chiller design was delivered to the company for further review and consideration.

OPTIMIZATION OF COGENERATION FACILITY TO REDUCE WASTE HEAT
by: Carla Castillo, Geoffrey Mallet, Brian Oostema, and John Smith
Sponsor: Otsego Paper, Inc.
Eric Bock, Dave Misner, Tom Benchina, and Zach Phipps
Faculty Advisors: Peter Parker, Ph.D. and James Springstead, Ph.D.
9:00 a.m. – 9:25 a.m.

USG Otsego's Paper Mill utilizes a cogeneration facility to generate the mills steam and electricity required for paper production. This facility operates two natural gas turbines for electrical production with associated waste heat recovery steam generation units for steam production to meet the demand requirements of paper production. The goal of this project is to evaluate the cogeneration system and develop optimization recommendations for operating conditions and additional equipment that could be installed to reduce the recovery of waste heat and reduce the annual operating cost of USG's facility.

DESIGN OF FILTRATION PROCESSES FOR SOLVENT EXTRACTION
by: Ali Alabbad, Ammar Alawami, Jonathon Fitch, and Hali Kunst
Sponsor: None
Faculty Advisors: Peter Parker, Ph.D. and James Springstead, Ph.D.
9:30 a.m. – 9: 55 a.m.

Filtration of extraction solvents is a common industry practice in order to minimize additional production costs. An evaluation of a current filtration system was completed which allowed for understanding as well as identification of strong and weak areas of the process. Using this evaluation, multiple filtration processes and their cost models were developed in order to minimize operator exposure and increased automation of the process. Using the knowledge gathered throughout the research of filtration units, a filter selection guide was developed to increase efficiency in future projects that may call for a filter replacement.

PRE-GELATINIZATION OF RICE FLOUR
by: Rene Herrera, Spencer Leist, Adrian Luna, and Hunter Mauk
Sponsor: Kellogg
Brad Lintner, Nancy Marks, and Jeff Feneley
Faculty Advisors: James Springstead, Ph.D. and Qiang Yang, Ph.D.
10:00 a.m. – 10:25 a.m.

Purchased raw materials can often experience supply issues and unplanned cost fluctuations as they are unique to the desired product. A way around this is to produce this raw material at your own facility. A purchased pre-gelatinized rice flour was used in a unique cracker and experienced these same supply issues. Research and understanding of the typical gelatinization processes allowed the successful testing and replication of the desired product. A process was designed to produce the material at the demanded scale and the required equipment supply was researched upon. Extensive economic analysis was performed to assess the feasibility in producing this material.

SYRUP PROCESS OPTIMIZATION
by: Daisy Barreto, Michael Boyd, Anelis Chiluisa, and Lluis Guardiola
Sponsor: Kellogg
Brian Walesh, Terry Andren, and Greg Stevens
Faculty Advisors: James Springstead, Ph.D. and Qiang Yang, Ph.D.
10:30 a.m. – 10:55 a.m.

Every year, millions around the world enjoy sweet treats made with some form of syrup or filling. To keep these products affordable, optimization of the individual components needs to be done to lower labor, operating, and maintenance cost. Traditionally syrup is made by a batch process using Kettles. Switching to a continuous production has the potential to save on time and labor costs and make a more consistent product. This project will define the requirements for improved process flow consistency and increased throughputs.

SEPARATION AND DISPOSAL OF WASTE REJECTS FROM OLD CORRUGATED CARDBOARD
by: Trenton Bartsch, Brandon Gould, Justin Guisinger, and Bailey Papes
Sponsor: New-Indy Containerboard Ontario Mills
Lance McCauley, Kimet Lansing, and Eden Nicodimos
Faculty Advisor: James Springstead, Ph.D.
11:00 a.m. – 11:25 a.m.

The search for new environmentally friendly waste disposal is becoming more prudent as landfill disposal costs increase. Old corrugated cardboard has a mix of metals, plastics, and other waste that cannot be used in the paper making process and create a septic environment before it is shipped to landfill. Water removal and separation of usable materials with a shredder and magnet allows for them to be recycled and sold for profit. The blend of plastics is then utilized in fuel blending processes. This process will not only save money but also reduce companies' environmental footprints.

GENERATING ELECTRICITY BY USING A NATURAL GAS POWER PLANT OR USING RENEWABLE ENERGY
by: Abdulhakim Alanazi, Mohammed Alkhammas, Mohammed Al Mayasi, Ahmed Alshaheen, and Dylan Bosco
Sponsor: Beam Power Plant
Kevin Bridges and George Jarvis
Faculty Advisor: Said Abubakr, Ph.D.
11:30 a.m. – 11:55 a.m.

A small petroleum refinery consumes 100 million KW-hr and buys electricity from a local nuclear plant at $0.16 per KW-hr. The local nuclear power plant will be closed in 3 to 4 years. Supplying electricity will be important for the petroleum refinery. It will be important to diversify energy resources in the future. Different options of generating electricity are available such as natural gas power plant along with the choices of renewable sources of energy such as solar or wind.

PETROLEUM REFINERY POWER PLANT
by: Ahmad Alshammari, Almujtaba Alshanqtiy, Jorge Curiel, Alexandris Matos and Gabriela Munoz
Sponsor: Beam Power Plant
Kevin Bridges and George Jarvis
Faculty Advisor: Said Abubakr, Ph.D.
1:00 p.m. – 1:25 p.m.

Small petroleum refinery uses about 100 million KW-hr and purchases electricity from local nuclear plant at $0.16 per kilowatt-hr. The nuclear power plant recently announced that they will close the plant in 3-4 years. We need to generate our own electricity by either traditional natural gas power plant or using renewable energy such as wind or solar, conduct plant design and economic feasibility studies and make preliminary recommendation for the most viable option to move forward.

MONOCLONAL ANTIBODY PRODUCTION FOR REOPRO™ SYNTHESIS
by: Paul Alba, Alex Grosso, Stephen Hunter, and Mwenda Righa
Sponsor: None
Faculty Advisor: James Springstead, Ph.D.
1:30 p.m. – 1:55 p.m.

Fab fragments of monoclonal antibodies have many applications in medicine and are valuable tools in structural biology. They are currently being used as therapeutic agents in patients with macular degeneration, cardiovascular diseases, and candidates that are pending approval for treatment of Chron's disease and breast cancer. A manufacturing plant that produced these fab fragments of the chimeric human-murine monoclonal antibody, C7E3 was developed to produce the drug known as ReoPro™. An economic analysis was performed to determine if the plant was economically feasible.

REPLACEMENT OF A LIQUID FILLING SYSTEM FOR CORROSIVE MATERIALS
by: Nathan Beuschel, William Breining, Denise Lubitz, and Naomi Van Dien
Sponsor: Thermo Fisher Scientific
Larry Kwapis and Garrett Maybee
Faculty Advisor: James Springstead, Ph.D.
2:00 p.m. – 2:25 p.m.

An aging liquid filling system in contact with highly corrosive materials required replacement. The current system was investigated to identify areas where efficiency, safety, and productivity could be improved. Several competing solutions, including fillers and bulk chemical storage, were determined along with the corresponding economic and safety studies. The completed study provides information for filler and storage options and provides the necessary legwork for purchase of a replacement system.

DISTILLATION OPTIMIZATION

by: Abdulaziz Alqernas, Abdulaziz Alsaad, Mohammed Alzaher, and Mojtaba Raiyn
Sponsor: Carter Cole, Kalsec Inc.
Faculty Advisor: Peter Parker, Ph.D.
2:30 a.m. – 2:55 a.m.

A distillation column used for fractionating water off solvent recovered from a solvent leaching operation had to be modeled and optimized. The column was randomly packed with pall rings and had two feeds. One feed was a vapor stream. The other was a waste stream from a decant tank fed to the column reboiler. A simulation was developed using Aspen to model the column, and optimum operating parameters were selected for the distillate condenser, reflux ratio, and reboiler temperature to achieve the highest purity distillate, and the solvent loss was minimized in the column bottoms.

MODERNIZATION OF AN ACTIVE PHARMACEUTICAL INGREDIENT PRODUCTION FACILITY

by: Paige Race, Zachary Marentette, Dennis Miller, and Foster Zabel
Sponsor: Zach Wolf, Nick Muller, Emma Lipscomb, and Eric Smith
Pfizer
Faculty Advisor: James Springstead, Ph.D.
3:00 p.m. – 3:25 p.m.

Active Pharmaceutical Ingredients are an every-changing product with diversifying chemistries. The use of modern technologies to automate, optimize, and manufacture the process is a must in a competitive market. Modern reactors and heat exchangers have been designed for the company, which are constructed with state-of-the-art process control and instrumentation to maximize yield and quality. This design will increase modularity for new and upcoming chemistries, which allows new drug product to enter the market more rapidly.

CHEMICAL AND PAPER ENGINEERING
Session Chair – Kecheng Li, Ph.D.
Room C-122

CLARIFIER OPTIMIZATION USING COAGULANTS AND FLOCULANTS
by: Richard Waite
Sponsor: None
Faculty Advisor: Andrew Kline, Ph.D.
8:00 a.m. – 8:25 a.m.

Primary settling clarifiers are commonly the most cost-effective way to physically separate solids and other contaminants within wastewater. Efficient operation of these clarifiers is needed to prevent downstream issues in the mill caused from whitewater or environmental risks of discharge water. A system for optimizing the clarifier through coagulant and flocculant addition can be implemented to help drive overall efficincy and effluent quality. This research investigated clarifier operation using process data such as charge and settleability to optimize clarfier settling through coagulant and flocculant dosing.

FIBER COST REDUCTION: INVESTIGATING SOFTWOOD-HEMP FIBER BLEND IN REGARD TO STRENGTH PROPERTIES
by: Rielle Veronica Ruthann Walker
Sponsor: None
Faculty Advisor: Qiang Yang Ph.D.
8:30 a.m. – 8:55 a.m.

The most expensive input to the paper making process is fiber, particulary softwood fiber. Hemp bagasse fibers were investigated as a more economical alternative to softwood fibers. Hemp fibers were pulped in 5.0% sodium hydroxide and 3.0% sodium hydroxide solutions. The resulting hemp pulps were blended with varying levels of softwood pulp. The physical strength of the softwood-hemp fiber sheets was tested fro their burst, tensile, tear, and fold indexes and compared to a 100% softwood control.

IMPROVING COATED RECYCLE BOARD PRINT QUALITY
by: Brennan Augst
Sponsor: Trinseo LLC, Greg Welsch
Faculty Advisors: Matthew Stoops and Alexandria Pekarovicova, Ph.D.
9:00 a.m. – 9:25 a.m.

In the world today there is a push to make things greener and more environmentally friendly. This project looked at various base coat formulations on Coated Recycle Board to improve the print quality of the product. The Coated Recycled Board was tested against a Coated Solid Bleach Sulfate sample for print quality of various industry printing processes. Also, the base sheet properties that are important in the printing process were compared. Coated Recycle Board as a product keeps more paper out of landfills and uses less chemicals in the production process than Coated Solid Bleach Sulfate Board.

ANALYSIS OF PAE WET-STRENGTH RESIN REPULPABILITY
by: Stephen Bussa
Sponsor: Novel Industrial Solutions, LLC
Faculty Advisor: Matthew Stoops
9:30 a.m. – 9:55 a.m.

Polyamide-epichlorohydrin (PAE) resins add permanent wet-strength to a variety of papers; however, they have drawbacks including difficult repulpability properties, carcinogenic chemical byproducts, and environmental hazards. In recent years, polyamide-epichlorohydrin resins have been made more sustainable by introdcuing new generations with reduced 1,3-diocloropropanol and 3-monochloropropane-1,3-diol byproducts. The repulpability of these new generations have not been compared. Greater repulpability properties add value to products and could be a key factor in choosing a wet-strength resin.

REPLACEMNT OF THE TiO2 IN A COATING FORMULATION WITH MC25
by: Austin Gray
Sponsor: None
Faculty Advisor: Matthew Stoops
10:00 a.m. – 10:25 a.m.

Titanium dioxide is widely used in the paper industry as an opacifier, yet it is very expensive. Finding a replacement that functions at a similar capacity could save a large sum of money for mills that use the chemical. Coatings were made up testing melamine cyanurate as a replacement for the titanium dioxide. Opacity was tested for along side brightness and porostiy to observe the properties of the melamine cyanurate. Finding these properties would prove beneficial as the cost of melamine cyanurate is declining at the moment and this could save money for paper mills in the future.

MAXIMIZING FLOTATION CELL EFFICIENCY THROUGH OPTIMAL DOSAGES OF FLOCCULANTS AND COAGULANTS
by: Jonathon Fitch
Sponsor: None
Faculty Advisor: Dan Fleming, Ph.D.
10:30 a.m. – 10:55 a.m.

The paper industry uses a significant amount of water in the manufacture of fiber products. In the process of papermaking, water becomes dirty and contaminated. As water becomes a more scarce and valuable resource, it is increasingly important to implement processes that allow the paper industry to remain a sustainable manufacturing practice. The use of polymer chemistries for waste water treatment can aid in removal of solids and contaminants and greatly reduce the fresh water required for paper production. This study explores different polymer chemistries to determine optimal usuage for maximum solids and contaminant removal from paper mill waste and water streams.

AN INVESTIGATION INTO STARCH RETROGRADATION
by: Tyler Jones
Sponsor: Western Michigan University Department of Chemical and Paper Engineering
Faculty Advisors: Matthew Stoops, Raja Aravamuthan, Ph.D., and Kecheng Li, Ph.D.
11:00 a.m. – 11:25 a.m.

The application of starch at the size press in paper manufacturing requires specific film forming properites to achieve desireable properties in the final product. Starch retrogradation is the process of amylose and amylopectin chains in modified starch compounds reassociating to form agglomerations throughout the sample. Gelatinized starch samples were tested in a two-level factorial experiment comparing the physical properites of starch after simulating industrial storage conditions, including heating and reheating the gelatinized starc hsamples. The completed research provides optimal storage conditions of gelatinized starch in an industrial setting and provide an efficient method of analyzing rates of retrogradation.

INTRODUCTION OF ETHYLENE SCAVENGING AGENTS INTO PRODUCE PACKAGING TO LENGTHEN SHELF LIFE
by: Tyler MacFarland
Sponsor: None
Faculty Advisor: Matthew Stoops
11:30 a.m. – 11:55 a.m.

When produce ripens it releases ethylene which causes the produce to ripen at a faster rate. This project looks at introducing materials, namely activated carbon, into produce packaging paper grades that will work as an ethylene scavenging agents. Activated carbon is a processed carbon that has small pores that greatly increase its surface area. This surface area will grab hold of the ethylene so that it is no longer found in the environment around the produce. This agent will adsorb some of the ethylene produced which will increase the shelf life of the produce, reduce, waste, and encourage moving packaging from plastic based to paper based.

NANO-CELLULOSE CONTAINING COATING: IMPACT ON OIL AND GREASE RESISTANCE
by: Nathan Rozegnal
Sponsor: Graphic Packaging International Battle Creek Mill
Chad Longcore
Faculty Advisor: Matthew Stoops
1:30 p.m. – 1:55 p.m.

Many types of barrier coatings are used for oil and grease resistance in the paper industry today but have problems with biodegradability and sustainability as well as negative health impacts associated with them. This research focused on developing and testing a nano-cellulose containing coating for use with food grade packaging in order to create an oil and grease resistant package. Nano-cellulose is nano scale structure contained in the fiber of every living plant on earth and has the possibility to be produced on a massive scale due to its abundance in nature as well as having the potential to be recycled and reused, driving increased sustainability.

ENZYME-ASSISTED REFINING OF SECONDARY FIBERS
by: Michaela Schnell
Sponsor: WestRock Company
Faculty Advisor: Kecheng Li, Ph.D.
2:00 p.m. – 2:25 p.m.

During paper recycling, fibers undergo a structure modification process called mechanical refining for improving physical strength, however this refining process inadvertently reduces the drainage rate of a pulp suspension on a paper machine. Incorporating enzymes alongside mechanical action tested the viability of turning to chemical refining methods as a solution for improving drainage rates. Various enzymatic dosage rates were compared to determine optimal quantity required for maximum efficiency. Increased drainage directly correlates to increased manufacturing capacity, improving recycling production rates to meet growing industry demand.

IMPROVING STRENGTH PROPERTIES OF RECYCLED PAPERBOARD THROUGH ENZYME-AIDED PULP REFINING
by: Geoffrey Mallet
Sponsor: WestRock Company, Eaton Mill
Tim Hagenbuch
Faculty Advisor: Kecheng Li, Ph.D.
2:30 p.m. – 2:55 p.m.

New advances in paper converting technology have required recycled paperboard manufacturers to produce paper with higher strength properties. Many facilities have struggled to meet these new strength requirements because of limitiations in the manufacturing process and the poor paper quality supplied to them by recycling centers. There are ways to increase the strength of paper fibers, but this requires significant energy input into the process and often lowers the production capabilities of the facility. This project investigated the impact that enzyme treament of recycled paper fibers prior to formation of the finished product has on its final strength properties.

CIVIL AND CONSTRUCTION ENGINEERING

Session Chair – Decker Haines, Ph.D., P.E., PMP
Room D-115

2ND AVENUE BRIDGE RECONSTRUCTION OVER I-94

by: Jeff English, Drew Michaels, and Ryan Younker
Sponsors: Mike LaViolette, PE; HDR and John Belcher, PE; Michigan Department of Transportation
Faculty Advisor: Upul Attanayake, Ph.D.
9:00 a.m. – 9:25 a.m.

The 2nd Avenue bridge over I-94 located in Detroit, Michigan requires a complete reconstruction due to the significant deterioration of the superstructure. An unbraced network arch bridge was chosen as the design for the replacement. Accelerated Bridge Construction (ABC) is being considered as a construction method due to the amount of daily traffic on I-94. ABC and on-site construction costs were compared as alternatives. The foundation was designed, and a quantity takeoff and cost estimate were completed. The completed bridge will be a signature structure to connect the community to the campus of Wayne State University.

CD 12 LOT 9: FOUNDATION DESIGN

by: Jacob Meyer, Euponine Sara Pierre, Paloma Serrano Pena, and Piper Nicole Simmons
Sponsor: Tim Mitchell, Soil and Materials Engineers, SME
Faculty Advisor: Xiaoyun Shao, Ph.D.
9:30 a.m. – 9:55 a.m.

CD 12 Lot 9 is a multi-use seven-story building to be built in downtown Kalamazoo. The building will consist of an educational entity, surface parking, residential space, and office space. Due to downtown Kalamazoo still developing, the existence of this building will positively transform lives and provide opportunities for thousands of people who live, work, and visit Kalamazoo. Three different aspects of civil and construction engineering will be considered including geotechnical and structural analysis and design as well as and construction management. Alternatives on the designs will be analyzed prioritizing sustainability and durability.

EAGLE LAKE FLOOD MANAGEMENT
by: Darek Ditto, Scott Fulmer, Brandon McKibbin, and Nathan Sturtevant
Sponsors: Tom Wheat and Michael Schwartz, Prein & Newhof
Faculty Advisor: Decker Hains, Ph.D., P.E., PMP
10:00 a.m. – 10:25 a.m.

Residents in the Charter Township of Texas, Michigan have experienced severe flooding in the Eagle and Crooked Lake areas due to significant rainfall in the Midwest region. A permanent solution was selected by analyzing several alternatives for a culvert connecting the two lakes to allow water to travel east to Bass Lake. Using the watershed modeling program WMS 10.1 and hydraulic analysis tool HY-8, the proposed drainage system design will provide an outlet for excess water to reduce the flooding of residential properties in the area.

VERBURG PARK DESGIN
by: Aaron Balkema, Kevin Callow, Kyle Owen, and Andrew Woloszyk
Sponsor: Patrick McVerry, City of Kalamazoo Parks and Recreation Department
Faculty Advisor: Decker Hains, Ph.D., P.E., PMP
10:30 a.m. – 10:55 a.m.

Parks used for recreational activities must be designed to fit the needs of the surrounding community. These spaces must also be engineered to confirm with the specifications of the local agency overseeing the park. Boat launch improvements for Verburg Park were designed with special considerations for its ideal location on the Kalamazoo River. The design includes the addition of recreational spaces, as well as multi-use sports fields and basketball courts to address the interests of the people in the surrounding neighborhoods. A detailed cost analysis ensures construction will not exceed the budget for the project. This redesigned space provides a perfect recreational area for Kalamazoo.

THE URBAN DEVELOPMENT OF BRONSON CIRCLE
by: Nathanael Gommesen, Matthew Moulton, Samuel Nordquist, and William Westrick
Sponsor: James Baker, City of Kalamazoo
Faculty Advisor: Haluk Aktan, Ph.D.
11:00 a.m. -11:25 a.m.

Many suburban streets, and specifically Bronson Circle, in the city of Kalamazoo are in poor condition and in need of repair. Along with a new pavement design and additional drainage considerations, a complete redesign of the street's cross-section with the concept of complete streets was created. A redesign of the lighting, sidewalks and utilities were completed in order to lessen the street's impact on the environment and make it more user friendly for all modes of transportation. This complete street design can be adjusted for terrain and used for any comparable suburban street.

COMPUTER SCIENCE

Session Chair - John Kapenga, Ph.D.

Room: D-202

CAE CENTER FULL STACK WEB OVERHAUL

by: Steven Johnson, Brandon Rodriguez, and Joshua Sziede

Sponsor: None

Faculty Advisor: John Kapenga, Ph.D.

9:00 a.m. – 9:25 a.m.

As departments within large organizations expand, they tend to acquire additional responsibilities and workloads. This can lead to some growing pains, particularly regarding technology, and Western Michigan University's Computer Aided Engineering (CAE) Center is no exception. As part of an ongoing effort to transform the CAE Center's many individual websites and projects into one cohesive and interdependent system, the CAE Center Full Stack Web Overhaul rebuilds core systems from the ground up using the Python-based web framework Django along with MySQL and the React JavaScript library. These systems include employee scheduling, shift management, room attendant oversight, and more.

PET EPILEPSY TRACKER FOR iOS AND ANDROID

by: James Eckler and Joshua Peterson

Sponsor: None

Faculty Advisor: John Kapenga, Ph.D.

9:30 a.m. – 9:55 a.m.

Seizures are one of the most frequently reported neurological conditions in pets, but obtaining accurate medical accounts to properly diagnose them can be difficult. Using React Native, a JavaScript framework for writing natively rendered mobile applications, an application for iOS and Android was created that can quickly log epileptic events such as seizures. The application allows pet owners to quickly log and transfer medical data directly to their veterinarians using their phones, as well as providing a framework for veterinarians to receive more accurate and timely information from pet owners. With this easy access to detailed logs, veterinarians can further individualize the care of epileptic animals and enhance the quality of treatment.

PROPERTY MANAGEMENT SOFTWARE
by: Christopher Carlson, Mariam Ghali, and Oscar Vander-Horst
Sponsor: Midwest Realty Group
Scott Rumley, Barb Uildriks, and Dan Wiegand
Faculty Advisor: John Kapenga, Ph.D.
10:00 a.m. – 10:25 a.m.

A complete property management suite was built with AngularJS. This is a full stack software solution for commercial property management. In order to smooth and integrate daily business operations into a single application, this program provides an online portal for tenants, company employees, and company managers. Tenants can submit tickets for property work requests, employees can enter and track their work hours, and managers can integrate this data with internal workflows like payroll, billing, and issue tracking with a flexible administrative data dashboard.

WMU COHORT SCHEDULING SYSTEM
by: Grant Farnsworth, Jacob Kampf, and Alex Markules
Sponsor: None
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. – 10:55 a.m.

Freshman students at the College of Engineering and Applied Science at Western Michigan University are grouped into groups called cohorts who they share a class schedule with. The process of creating these schedules was originally done by hand and took weeks to plan out. This project allows the user to specify the classes which are needed by cohorts and generate class schedules for them using a stochastic optimization model. Users can edit requirements and view results in a simple web application.

FUZZY RECORD LINKAGE
by: Gregory Smith and Axel Solano
Sponsor: SalesPage Technologies, Warren Fitzpatrick
Faculty Advisor: John Kapenga, Ph.D.
11:00 a.m. – 11:25 a.m.

A frequent challenge master data management platforms face is matching records together without unique identifiers and removing duplicates. Utilizing Java, a multi-threaded record linkage program was created to evaluate records in various data sets. Similarity between record pairs is calculated with Levenshtein distance to identify matches and potential matches between data sets. The program provides a flexible and scalable solution to improve data-driven insights.

BPS TICKETING SYSTEM
by: Kenny Birge, Crue Martin, Harley Misner, and Corey Oldenberg
Sponsor: None
Faculty Advisor: John Kapenga, Ph.D.
11:30 a.m. – 11:55 a.m.

Centralizing multiple sources of information is imperative to any field of work. The IT world is no different. A single website was created using HTML, Node JS, and Handlebars as. The BPS Ticketing System organizes all information pertaining to build request tickets and offers a live view of statuses for those with elevated access. The model allows different levels of user-specified access for viewing and updating specific information while ensuring security of confidential data. The completed site provides a unified system that will automate multiple processes and improve overall workflow.

THE STANDARDS PROJECT
by: Mitchell Hobner, Dustin Robbins, and Shahbaaz Singh
Sponsor: None
Faculty Advisor: John Kapenga, Ph.D.
1:00 p.m. – 1:25 p.m.

Nation-wide, public school teachers work to help their students meet state educational standards. The infrastructure of a learning management system was developed using Laravel, a PHP web framework. This learning management system conducts general education through online modules and gives instructors the ability to issue struggling students remedial "interventions" at their discretion. The completed learning management system will greatly aid instructors in making their students suitably proficient in any and all desired subjects.

CODING TUTORIAL
by: Tim Curry II, Daniel Darcy, and Stephen Fedele
Sponsors: John Kapenga, Ph.D. and Colin MacCreery
Faculty Advisor: John Kapenga, Ph.D.
1:30 p.m. – 1:55 p.m.

Introductory programming tutorials are best when access to modifying and executing actual code can be provided, which can be problematic. Providing this on mobile devices is even more challenging, as the code may have to be executed on a remote server. A framework was developed that combines: no installation on the mobile device, execution on most recent browsers, a JavaScript editor that can support numerous computer languages, a container that runs on the server for protection, easy to manage mathematical notation on the display and support for simple quizzes.

CTF- SETTING UP A SECURITY WEB APPLICATION FOR WMU

by: Dakota Grant, Safwan Kadir, and David Moussalli

Sponsor: Western Michigan University, Department of Computer Science
Colin MacCreery

Faculty Advisor: John Kapenga, Ph.D. and Colin MacCreery

2:00 p.m. – 2:25 p.m.

The Western Michigan University (WMU) Capture The Flag (CTF) class operated with no website for their cyber security learning and CTF challenges and was in desperate need of one. CTFd, a CTF framework, was used in helping to set up a website on WMU's servers. The various subtopics of CTFs were studied to provide CTF challenges that have been set up on the website. This has helped the WMU CTF class in providing the basis for developing their own cyber security challenges in the future and will help in being an instructional method for the CTF class.

SERVER ROOM TEMPERATURE SENSOR

by: Britain Cooke, Grant Gannon, and Oliver Sanchez

Sponsor: John Kapenga, Ph.D.

Faculty Advisor: John Kapenga, Ph.D.

2:30 p.m. – 2:55 p.m.

Servers are an integral part of modern day network infrastructure. To maintain constant uptime and help increase longevity, maintaining the server's temperature is essential. The Server Room Temperature Sensor allows server administrators to monitor temperatures and be alerted when servers reach critical temperatures. Although similar solutions already exist, the Serve Room Temperature Sensor provides a more cost effective, easy to use, and scalable system than previously available.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - Daniel Litynski, Ph.D.
Room: D-204

SMALL-SCALE SOLAR GENERATION STATION
by: An Nguyen, Blake Ryan, and Steven Spannagel
Sponsor: Jesse Jackson, Consumers Energy
Faculty Advisor: Pablo Gomez, Ph.D.
9:00 a.m. – 9:25 a.m.

A scaled-down solar generation garden has been designed and implemented to demonstrate the performance effects of modifications to the PV layout. Irradiance, shading, tilt angle, and spacing between panel arrays are a few examples. The station integrates a graphical human interface that allows an interactive experience.

VIRTUAL XYLOPHONE
by: Gabriel Allen, Christopher Leblang, and Bradley Scott
Sponsor: Steve Durbin, Ph.D.
Faculty Advisor: Steve Durbin, Ph.D.
9:30 a.m. – 9:55 a.m.

The virtual xylophone is a device that utilizes infrared sensors and accelerometers to detect the motion, position, and force of a mallet strike. The collected information is then used by an algorithm to play the corresponding note at the correct intensity level. The target end-users are prospective students attending engineering outreach activities at Western Michigan University with a goal being to encourage students to consider electrical and computer engineering majors.

VIRTUAL HAND DRUM
by: Cameron Hartman, Ross Kmet, and Gagandeep Singh
Sponsor: None
Faculty Advisor: Steve Durbin, Ph.D.
10:00 a.m. – 10:25 a.m.

The Virtual Hand Drum system consists of two wirelessly enabled gloves and accompanying Windows software and tutorial series, intended to be used as an educational and promotional tool for the Department of Electrical and Computer Engineering. They allow the user to play a percussive instrument by striking a region in space, which is determined by an augmented reality and position tracking system utilizing a pair of cameras.

RETRO-TECH MIRROR
by: Connor Hughes, Stephen Peterson, and Hannah Phommavongsa
Sponsor: Matt Fox, Gentex Corporation
Faculty Advisor: Damon Miller, Ph.D.
10:30 a.m. – 10:55 a.m.

A common feature in modern vehicles is the display of compass heading and outside temperature in the rearview mirror. The Retro-Tech Mirror is a wireless, plug and play device that replaces mirrors without these capabilities. The replacement mirror features a long-lasting battery charged by solar panels. The mirror relies on separate sensors that provide compass heading and outside air temperature and then displays the information to the driver.

HAND MOTION CONTROLLED CAR USING FLEXIBLE HYBRID ELECTRONICS
by: Devin Birchfield, Xavier Jackson, and Thomas Pasternak
Sponsor: None
Faculty Advisor: Massood Atashbar, Ph.D.
11:00 a.m. – 11:25 a.m.

Flexible Hybrid Electronics (FHE) is an emerging field of interest in today's market. Flexible strain sensors were manufactured using laser carbonization, a new printing method, of flexible polydimethylsiloxane (PDMS) material. These sensors were then implemented into a glove designed to control an RC car wirelessly, based on finger movements. The model provided research into a new printing method that will be utilized in the Center for Advanced Smart Sensors and Structures (CASSS) Lab in the future and provided a real-world application for FHE's. Additionally, the model can be used to study future FHE applications at Western Michigan University.

RESIDENTIAL OPEN NEUTRAL MONITORING DEVICE
by: Yara Mahmoud, Anna Nichols, and Kent Simpson
Sponsor: Jason McPherson
Faculty Advisor: Damon Miller, Ph.D.
11:30 a.m. – 11:55 a.m.

The condition of the neutral connection in a residential electrical system is essential for safe operation. An open neutral can lead to excessive voltages or overcurrents resulting in personal injury or property damage including electrical fires. A device to monitor line to neutral voltages and to alert the consumer of a hazardous neutral connection was developed and validated.

NEXT-GENERATION LIGHT BOARD
by: Mohamed Iskandar, Joshua Jimenez, and Linden Waling
Sponsors: Timothy Greene, Ph.D. and John Mackenzie
Faculty Advisor: Dean Johnson, Ph.D.
1:00 p.m. – 1:25 p.m.

A next-gen lightboard (NGLB) designed to improve the usability of current lightboard technology has been developed and evaluated. The NGLB implements a "One button start" mechanism to achieve a quick, user-friendly interface. This mechanism powers and initializes all components of NGLB into a record-ready state. This allows a presenter to use the device within a short period of time, without extensive knowledge of lightboard technology or equipment operation. The NGLB is designed to help a presenter easily record lessons for online education. In addition, the NGLB optimizes mobility, cost, and simplicity to allow for large scale use by universities.

PHOTOVOLTAIC PANEL EMULATOR
by: Henri Cousino and David Zemariam
Sponsor: Jesse Jackson, Consumers Energy
Faculty Advisor: Pablo Gomez, Ph.D.
1:30 p.m. – 1:55 p.m.

This device emulates the voltage-current characteristics of different photovoltaic panels to assist in the research of renewable energy resources in the Power Lab at Western Michigan University. Some of the features of this device include low cost, low power demand, transportable size, and accessibility for modifications. The photovoltaic emulator utilizes a light sensor to transform light irradiance into the expected amount of power produced by different solar panels.

COMMUNICATIONS DEBUGGING PLATFORM
by: Scott Batzer, Husam Beitello, and John Ross
Sponsor: Alex Bodurka, Stryker Medical Research and Development
Faculty Advisor: Janos Grantner, Ph.D.
2:00 p.m. – 2:25 p.m.

More and more products rely on electronic means of communication to function, creating a demand for debugging tools to facilitate their development. A compact, modular tool and smartphone application were developed to provide a powerful, portable, communications debugging platform. This debugging platform provides easy testing, verification, and debugging of products relying on any desired form of communication, with an early-development emphasis on Bluetooth and infrared wireless communications. The platform supports the addition of communication protocols, without modifying existing functionality, and is intended to be used with medical technology.

DEVICE FOR CLEANING PV PANELS
by: Hamad Algussayir, Yazeed Alotaibi, and Abdulmajeed Sabr
Sponsor: None
Faculty Advisor: Daniel Litynski, Ph.D.
2:30 p.m. – 2:55 p.m.

Accumulation of dust on the surface of a solar panel decreases the amount of sunlight reaching the solar cells underneath. Thus the efficiency of the solar panel in terms of the energy harvesting from the solar energy is severely reduced. A solar panel cleaning device is designed and implemented that cleans the solar panel autonomously without any external human operator when dust is detected on its surface. This device has the potential to improve the efficiency of the solar panel and can be integrated with commercially available solar panels in the future to boost their performance.

SOLAR PANEL COOLING SYSTEM
by: Firas Alhelal, Abdulrahman Alkharisi, and Omar Alqasem
Sponsor: None
Faculty Advisor: Daniel Litynski, Ph.D.
3:00 p.m. – 3:25 p.m.

A photovoltaic panel converts solar energy into electrical energy. However, solar radiation increases the temperature of the panel which decreases its efficiency. Decreasing the temperature of the photovoltaic panel increases its efficiency. This device measures the temperature of the photovoltaic panel and automatically uses water spraying to decrease its operating temperature when it reaches a certain point. The system includes a microcontroller, water pump, temperature sensor, and uses power from either the solar panel or a backup battery.

ENGINEERING DESIGN, MANUFACTURING, AND MANAGEMENT SYSTEMS

Session Chair – Betsy Aller, Ph.D.

Room D-201

SECOND GENERATION MODULAR OVEN ACCESSORY DEVELOPMENT

by: Adam Kidder, Brandon Reis, Luke Schuman, Dylan Scott, Rene Tuyishime, and Zac Ward

Sponsor: Whirlpool Corporation

Zachary Bruin-Slot and Michele Harping Johnson

Faculty Advisor: David Middleton

9:00 a.m. – 9:25 a.m.

CLOSED SESSION TO PUBLIC

Standard household convection ovens have a limited number of capabilities for preparing food. Whirlpool has completed a first generation of modular oven attachments. Given the success of the last generation of attachments, further expansion was requested. Using an existing built-in oven platform, CAD analysis was performed. After many CAD designs, prototypes were built and extensive testing was completed. The result of these efforts was a detailed product concept for Whirlpool to refine and integrate into their next generation modular attachments.

WESTERN MICHIGAN UNIVERSITY FOUNDRY: CASTING PROCESS ENHANCEMENT

by: Justin Benjamin, Jared Bradley-Rousch, Will Johnson, and Nick Smith

Sponsor: None

Faculty Advisor: Joe Licavoli, Ph.D.

9:30 a.m. – 9:55 a.m.

The Western Michigan University foundry is focused on creating high quality castings. To accomplish this, several key improvements had to be made to the foundry. Research of foundry processes and equipment was conducted, and designs for the casting equipment were drawn up using SolidWorks. The designs were then implemented and tested to ensure casting quality and consistency. Once the designs were agreed upon, AutoCad was used to create a new layout for the foundry. The new designs and foundry layout will increase the casting quality and consistency while also improving the foundry experience for students.

DESIGN OF INNOVATIVE NAIL POLISH COVER
by: Eric Collins, Audrey Oswalt, Rodeo Slack, and Yuhui Zeng
Sponsor: KMS Designs, Karen Smoots
Faculty Advisor: Jorge Rodriguez, Ph.D.
10:00 a.m. – 10:25 a.m.

A need exists for a lightweight, durable, one-size-fits-all, domestically-produced nail polish cover that allows the user to resume everyday tasks without smudging freshly polished nails. Research was conducted on current nail cover patents, materials, markets, and necessary characteristics. A decision matrix and cost analysis of materials determined the overall production cost, desired characteristics, and improvements. The design process regulated the creation of sketches, product-specific testing methods, 3D-printed prototypes, CAD models, and documentation to fabricate a properly-ventilated nail protector.

CUSTOM UTILITY TRAILER DESIGN & FABRICATION
by: Eamon Cary, Timothy Cieslinski, Michael Graziano, and Ahmad Shammas
Sponsor: Jay Shoemaker
Faculty Advisor: Jay Shoemaker
10:30 a.m. – 10:55 a.m.

Existing utility trailers available for sale to consumers lack user-driven design and functionality. Using Autodesk Fusion 360 to design and simulate loads placed on the trailer, the team designed a utility trailer, based on customer needs, while minimizing build costs. The utility trailer design includes a load capacity of 3000 lb., a bed sized to carry a sheet of plywood, a long-lasting paint finish, a custom cover, and accessories needed for safe and convenient cargo hauling. Trailer fabrication was done using facilities at Western Michigan University.

AUTOMATION OF "DIE CASTING IN A BOX"
by: Bryan Chase, James Helm, and Jake Johnstone
Sponsor: None
Faculty Advisor: Sam Ramrattan, Ph.D.
11:00 a.m. – 11:25 a.m.

The automotive industry purchases approximately 80% of all die casted parts made around the world, but some parts have high production costs. One way to dramatically reduce cost is to take advantage of process automation. The previous "Die Casting in a Box" machine was a die casting mold that required the user to hand-pour material into the shot cavity. Using 3D CAD software and machinery, the machine set-up was altered to incorporate the new dosing system. The previous PLC was also modified in order to have the "Die Casting in a Box" machine become fully automated. The DCIB machine will be used as a training tool in industry for people with little to no prior experience. Automation of die casting will also reduce the price of parts, greatly impacting the automotive industry.

MODIFIED FLUID POWERED RECUMBENT TRIKE FOR FPVC COMPETITION
by: Nathan Browder, Zachary Hall, Van Bawi Lal, David Maawma, and Hayden Staub
Sponsor: National Fluid Power Association
Stephanie Scaccianoce
Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriguez, Ph.D.
11:30 a.m. – 11:55 a.m.

Due to the demand for more environmentally friendly and energy efficient transportation, a "greener" vehicle is a need for consumers. A recumbent trike was modified with a hydraulic power system to maximize energy output and efficiency of this human-powered vehicle. Initial concepts and modeling of the modified trike were created using SolidWorks, and the hydraulic circuit was designed and tested using Automation Studios. The vehicle was fabricated, assembled, and tested at WMU's engineering campus; the finished trike competed in the National Fluid Powered Vehicle competition.

ELITE OBSTACLE DESIGN AND BUILD FOR THE KALAMAZOO MUD RUN
by: Kyler Castro, Jordan Horvath, Chance Owens, and Julian Striggles
Sponsor: Kalamazoo Mud Run, Joel Eisinger
Faculty Advisor: Dr. Paul Engelmann
1:00 p.m. – 1:25 p.m.

A local Kalamazoo non-profit organization needed a new obstacle to bring avid runners to their mud run to support their cause of getting clean water to those who need it. After defining the parameters of the project, research was conducted on materials and obstacle courses across the country. AutoCAD software was used to design 2D models, and Inventor was used for 3D modeling. Product testing then allowed for a creative, safe, and durable obstacle. The final built obstacle will be in place for years to come and should be an icon of the obstacle course due to its challenging nature.

YWCA CHILDREN'S CENTER PLAYGROUND AND GARDEN RENOVATION
by: Melissa Badovinac, Jordan Strong, Arnett Turner, and Ryan Winkler
Sponsor: YWCA Kalamazoo, Nichole Blum
Faculty Advisor: Betsy Aller, Ph.D.
1:30 p.m. – 1:55 p.m.

The Young Women's Christian Association (YWCA)'s Children's Center focuses on using age-appropriate playground equipment that correlates with each child's specific needs and skills. The existing playground was outdated and did not allow opportunities to include the children's classroom learning in their outdoor play. The engineering design process was followed, beginning with problem definition, extensive research, and multiple design options. New equipment, a playscape, and a gazebo were then modeled on PTC Creo Parametric and Revit, with a nature-based theme. In collaboration with YWCA teachers, staff, and volunteers, equipment was built and implemented. The renovated playground is now an extension of the classroom, supporting learning and allowing the children to develop at their own pace in a sustainable, engaging, and appealing children's play and garden area.

INDUSTRIAL AND ENTREPRENEURIAL ENGINEERING & ENGINEERING MANAGEMENT
Session Chair – Dana Hammond
Room D-210

OPTIMIZATION OF IRREGULAR PACKAGE MOVEMENT
by: Evan Ganzer, Sarah Jozwiak, and Matthew Pajk
Sponsor: Ben Meehan, United Parcel Service
Faculty Advisor: Jim Burns, Ph.D.
9:30 a.m. – 9:55 a.m.
CLOSED SESSION TO PUBLIC

Irregular packages are those that require special handling and resources due to their shape, size, or material. This type of package is the most expensive and fastest growing by percent volume per year to move and handle for this major distribution center. Time studies, forecasting, and facilities layout analysis were used to develop recommendations to improve the current handling system and account for future growth.

ASSEMBLY LINE OPTIMIZATION FOR PRODUCTIVITY IMPROVEMENT
by: Ameer Alabri, Sabrina Alshidhani, and Suhayb Alhariqi
Sponsor: Ewing Tiong, BENTELER Automotive Corporation
Faculty Advisor: Lee Wells, Ph.D.
10:00 a.m. – 10:25 a.m.

A local tier I automotive supplier is currently unable to meet demand and had identified low production in their assembly line as a possible cause. Historical production data for the assembly line suggests that productivity could be improved to meet current demand. Therefore, the assembly line was evaluated to identify possible sources for improvement through the use of the following IEE tools: value stream mapping, process, statistical and cost analyses. From these analyses, alternative assembly line designs and procedures were developed as short and long term recommendations to help the company meet current and future demand.

WAREHOUSE AND PACKAGING EFFICIENCY
by: Jaser Alruwaili, Joshua Johnson, Colton Pnacek, and Evan Semrau
Sponsor: Mike Smith, DENSO Manufacturing Michigan
Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.
10:30 a.m. – 10:55 a.m.

A local warehouse supplying automotive service parts has insufficient storage capacity and concern for employee safety. Single-use shipping containers were analyzed through the potential purchase of a packaging production machine. Forklift operations were investigated by exploring other vehicles' options and the storage rack layout. With industrial engineering tools such as facility layout, material flow, and simulation, these needs were addressed to redesign the storage rack layout, receiving bay layout, and the implementation of a cardboard packaging machine. This will increase the profitability of the company while increasing the safety of their employees.

IMPROVING EFFICIENCY OF MANUFACTURING CELLS
by: Conner Deneen, Casey Scharrer, and Evan Sulpar
Sponsor: Dan Kempisty, Mann + Hummel USA, Inc.
Faculty Advisor: Dana Hammond
11:00 a.m. – 11:25 a.m.

Standard work ensures that all operations are done according to the current best practice. Failure to reevaluate these times on a regular basis leads to decreased production rates and increased operational costs. The current state of an assembly cell producing air intake manifolds for a local Tier 1 automotive supplier was analyzed and evaluated using time studies, cost analysis, and facilities planning and design. The major opportunities in the system were determined to be line balancing and rework frequencies. Recommendations were made with respect to cost, safety, and overall cell performance.

EMERGENCY DEPARTMENT TRIAGE PROCESS IMPROVEMENT
by: Denise Azcui, Meghan Burt, and Tessa Williams
Sponsor: Larry Carpenter and Raechel Rowland, Ascension Borgess Hospital
Faculty Advisors: Tycho Fredericks, Ph.D. and Steven Butt, Ph.D.
11:30 a.m. – 11:55 a.m.

Efficiency in a hospital emergency department is crucial to a patient's treatment outcomes. This is especially true for high acuity patients with time dependent conditions. A simulation was created to test different patient evaluation procedures, known as triage. Streamlined procedures were developed for hospital staff, as well as recommendations for improved triage flow. Implementation of these methods are key to reducing patient wait times, the number of people who leave without being seen, and increasing overall efficiency of the triage process.

MECHANICAL AND AEROSPACE ENGINEERING A
Session Chair – Judah Ari-Gur, Ph.D. and Jinseok Kim, Ph.D.
Room D-109

QUANTIFYING & OPTIMIZING SKIN FRICTION MEASUREMENTS ON AERODYNAMIC BODIES
by: Aisosa Asemota, Michael Magin, and Derek Schira
Sponsor: None
Faculty Advisor: Tianshu Liu, Ph.D.
9:00 a.m. – 9:25 a.m.

Delta Wings largely find their application in high speed flight; at supersonic speeds, the characteristic low thickness of delta profiles aids to diminish wave drag which is the quantitative result of shockwaves formed in compressible fluid. However, in subsonic flight, vortices tend to develop on the upper surface at high angles of attack. These vortices energize the flow, thereby, enhancing lift and allowing a greater stall angle, but all at the cost of increased drag. Using Global Luminescent Oil Film (GLOF) Methodology, the primary objectives are to create a visualization of the skin friction field, quantify the skin friction developed, distinguish flow separation lines and determine time and distance between separation for different variations of the major-minor axes of the delta profile's conic base.

THERMALLY OPTIMIZED PLA SHREDDER
by: Denver Kuehl, Luke Rotarius, Anna Sitar, and Evan Steele
Sponsor: Fabri-Kal
Faculty Advisor: Christopher Cho, Ph.D.
9:30 a.m. – 9:55 a.m.

A modern concern for manufacturing companies is to be environmentally friendly. One way to accomplish this is to compost unused or wasted material from production processes instead of sending it to a landfill. A PLA plastic shredder was designed and fabricated to assist in the composting process. The shredder was designed using SolidWorks, a three-dimensional modeling software package. Multiple designs were conceptualized and examined, with one design being chosen. This design allows for the plastic to be effectively shredded: converting large, slow-composting PLA Purge patties into smaller pieces, which will reduce the time of decomposition from decades to months.

A SMALL AIRCRAFT LANDING AND TAKEOFF SAFETY SYSTEM DEVELOPMENT
by: Hussein Alfilfil and Paras Mehta
Sponsor: None
Faculty Advisor: Bade Shrestha, Ph.D.
10:00 a.m. – 10:25 a.m.

Small personal aircraft vehicles are being utilized in an increasing demand for personal/professional air transport taxi systems and short-range travel. Current parachute safety systems limit low altitude deployment speeds. A fast and reliable, emergency takeoff and landing system configuration was designed with pilot activated controls. Once control switch is activated, a redesigned ballistic-umbrella parachute system now launches quicker at altitudes below 500 ft. Afterward, a solid rocket (black powder based), is automatically activated when altitudes drops below 200 ft., until completion. Final vertical landing velocity is estimated at 7 m/s, thus saving passenger lives.

WIND TUNNEL
by: Molly Bowers, Trenton Holmen, and Jacob Smith
Sponsor: None
Faculty Advisors: Bade Shrestha, Ph.D. and Hussein Khudhayer Mohammad Mohammad
10:30 a.m. – 10:55 a.m.

Wind tunnels are used in many industries to test the effects of air flow around an object. Scale model prototypes are often tested to determine how a proposed design will behave under actual conditions. A scale model wind tunnel was designed and optimized using SolidWorks, ANSYS, and MATLAB software. These were used for modeling, fluid flow simulation and computational optimization. The model will aid in future testing of noise effects of turbine blade shapes.

CYMATICS-A STUDY OF WAVE PHENOMENA AND VIBRATION USING OPTICAL FLOW VISUALIZATION
by: Saravana Alagasan, Frederick Dukhie, and YeeSeng Toh
Sponsor: WMU Noise and Vibration Lab
Faculty Advisor: Tianshu Liu, Ph.D.
11:00 a.m. – 11:25 a.m.

The purpose of this project was to analyze the formation of different waveforms that occur through the science of Cymatics using OpenOpticalFlow. OpenOpticalFlow, an open source optical flow program in MATLAB was used to gather different high-resolution velocity fields from patterns that were formed as a result of vibrations at different frequencies. A mechanical vibrator was coupled to a Chladni plate onto which Silica based salt was placed. At different frequencies, different patterns were formed. A high-speed camera was set-up to capture these changes and was then analyzed using the MATLAB code. This method could be applied to determine the velocity as part of fluid mechanics in order to understand the physics of complex flows.

OPTIMIZATION OF A ROOTS TYPE SUPERCHARGER
by: Robert Beneteau, Alex Brunk, and Devin Singer
Sponsor: Nathan DeVille, Ali Merat, and Andrew Meyers; Eaton Corporation
Faculty Advisor: Tianshu Liu, Ph.D.
11:30-11:55 a.m.

Forced induction for combustion engines are becoming more and more popular as vehicle emissions standards become stricter, thus the use of superchargers and turbochargers has increased. For best performance and efficiency of an engine, the efficiency of the supercharger was maximized using a set of determined equations, confirmed by using accurate solid models from SolidWorks and CFD analysis and ANSYS Fluent. The set of equations allows for user-specific modifications corresponding to a desired set of parameters. The completed equations and modeling will provide the ability to better optimize future supercharges and further increase fuel efficiency of vehicles.

BIOGAS SEPARATION
by: Jesse Mantyla and Gavin Towery
Sponsor: Himalaya Michigan Energy
Faculty Advisor: Bade Shrestha, Ph.D.
1:00 p.m. – 1:25 p.m.

There is currently no means of separating biogas on a small scale, such as for household anaerobic digesters. Two methods were looked at for the best design of a portable biogas separator, flash method and membrane method. For flash method a simulation was created in Aspen HYSYS and Aspen Plus. From the values found in the simulation prototype was designed for the flash method. To compare the cost and effectiveness of flash method and membrane method a membrane was purchased and tested as well.

TURBO-OPTIMIZED INTAKE MANIFOLD
by: Matthew Greer
Sponsor: None
Faculty Advisor: Zachary Asher, Ph.D.
1:30 p.m. – 1:55 p.m.

There are not many intake manifolds on the market strictly optimized for high performance turbo engines, that are supported with traditional engineering procedures for simulations and testing. In addition to providing that unique approach, included are design features to maximize power and performance, such as dual fuel delivery system capabilities. Using CAD modeling and Computational Fluid Dynamics software, accompanied by traditional engineering analysis, this team has designed an intake manifold that will give their competitor's a run for their money when put to the test on the track.

SMOKE ALARM ACTIVATED DOOR CLOSING MECHANISM
by: Mark Aiello, Zachary Florek, and Tristan Waters
Sponsor: Craig Stouffer
Faculty Advisor: Zachary Asher, Ph.D.
2:00 p.m. – 2:25 p.m.

The number of deaths, in house fires, from smoke inhalation has increased significantly due to cheaper building materials. Simply sleeping with bedroom doors closed can buy people up to twenty extra minutes, however, this can be an issue for parents trying to check on their children during the night. A door hinge pin was designed to encompass two lever arms, an actuator, a microcontroller, and power supply. The design was modeled and constructed using both 3D printed and consumer parts. The microcontroller detects the sound of a smoke alarm and activates the actuator to release the lever arms closing a door. This mechanism can easily be installed on residential doors to help increase the chance of survivability during a fire.

ECONOMIC FEASIBILITY OF PRODUCING ELECTRICITY FROM A GAS TURBINE
by: Talal Arshad, Johnathon Goetz, and Devon Thompson
Sponsor: William Widman, Thermal Tech Engineering
Faculty Advisor: Christopher Cho, Ph.D.
2:30 p.m. – 2:55 p.m.

The demand for power has been increasing over time. Recently, the price of gas has been steadily decreasing while electric power has risen in price. A financial model takes in multiple variables such as the input energy prices, power required, size of generator, and uses of waste heat to provide an estimate of potential savings. The model calculates financial and sustainability benefits of using a gas turbine generator coupled with heat recovery. The model indicates if it is economically feasible to install a CHP device to produce power at a particular facility.

WELD COOLING OPTIMIZATION
by: Jordan Brookhouse and Cory Buchholz
Sponsor: None
Faculty Advisor: Christopher Cho, Ph.D.
3:00 p.m. – 3:25 p.m.

Quality and efficiency are two of the most important features that an assembly line can offer. Through the study of heat transfer principles, combined with the use of SolidWorks software and fabrication, a fixture was designed and built to increase the rate of heat reduction for various welded components. The new fixture not only decreased the time required for each part to cool, but it also allows for easier access and flow for the line operators which increased efficiency even further.

AEROSHIP-A RADIO CONTROLLED HYBRID DESIGN FOR A SUSTAINED STEADY FLIGHT

by: Thinnesh Ragupathy and Ralphael Ayala
Sponsor: None
Faculty Advisor: Tianshu Liu, Ph.D.
3:30 p.m. – 3:55 p.m.

The purpose of this project was to achieve a stable and sustainable flight of the Aeroship at low altitudes. The Aeroship is a combination of a large blimp which was configured with flight control dynamics such as wings, vertical stabilizers and ailerons. Apart from that, propulsion systems were also fitted to generate thrust to give a similar characteristic of an aircraft. The project mainly focuses on design of new wings which will be able to generate enough lift to make the blimp airborne and maintain a long sustained flight. The wind tunnel facility was used to test out the wings built for this project. Apart from that, the wings will be a control free surface to avoid control complexity and was designed to have very smooth laminar flow. The wing box was to be redesigned as it proved to play a major role to achieve a stable take off.

MECHANICAL AND AEROSPACE ENGINEERING B

Session Chair – Claudia Fajardo, Ph.D. and Ho Sung Lee, Ph.D.

Room D-212

NEED A LIFT? STANDING ASSISTANCE DEVICE DESIGN

by: Mohammed Farran, Jacob Piechota, and Samantha Richardson

Sponsor: None

Faculty Advisor: Pnina Ari-Gur, Ph.D.

9:00 a.m. – 9:25 a.m.

Many elderly and physically impaired people have trouble standing up by themselves. The device uses a pump mechanism that enables an individual who may not have the necessary balance or strength to go from a seated to standing position. The battery-powered pump allows the seat to be inflated to an angle at which the individuals center of gravity is over their feet to allow them to stand easily. Being able to accomplish this task required multiple different computer software to design and perfect the device. This device will help the elderly and physically impaired gain independence in their everyday life.

DESIGN OF A BALLOON ALTITUDE AND FLIGHT TERMINATION SYSTEM

by: Connor Cannella, Curt Kronback, and Nick Timmermann

Sponsor: None

Faculty Advisor: Kristina Lemmer, Ph.D.

9:30 a.m. – 9:55 a.m.

The WMU Biology Department has built a sampling system that is able to collect microbial samples from the atmosphere. The task of this project is to keep this sampler at 5,000 m (+/-500 m) for up to 6 hours, before safely returning it to the ground. To accomplish this mission, a ballast and bleed System, as well as an emergency cutdown and recovery procedure, was developed. An Arduino Mega 2560 microcontroller is used to operate all onboard systems in conjunction with a communication system, operated using a HAM Radio.

AUTOMATED ARMATURE AND POPPET PRESS FIXTURE
by: Joseph Hammel and Markus Houser
Sponsor: FEMA Corporation
Faculty Advisor: Damon Miller, Ph.D.
10:00 a.m. – 10:25 a.m.

In order to meet the rising demand, it was necessary to automate the existing armature and poppet press process for a particular electro-hydraulic valve production line. To accomplish this, a fixture utilizing a SCARA robot, bowl feeder, and servo driven press was designed. This fixture not only reduces the required operator labor hours for this process, but also addresses various failure modes by eliminating operator error and providing valuable feedback data for each processed assembly. By implementing this fixture, this production line will be able to meet and exceed all current and projected volumes.

DESIGN OF A THRUST STAND FOR ELECTRIC PROPULSION DEVICES
by: Sarah Sokolski and Hannah Watts
Sponsor: Western Aerospace Launch Initiative
Faculty Advisor: Kristina Lemmer, Ph.D.
10:30 a.m. – 10:55 a.m.

Electric propulsion (EP) thrusters are commonly used, complex systems for in-space propulsion in which the actual performance can vary from theoretical calculations. The most commonly used EP devices generate low thrust requiring specific sensors capable of characterizing actual performance. Thrust stands are the industry standard devices used to measure the actual thrust generated by EP systems. A thrust stand was designed for use in the Aerospace laboratory for Plasma Experiments (ALPE) capable of measuring thrust in the milli-newton range. This design allows for the characterization of a pulsed plasma thruster to be flown by Western Aerospace Launch Initiative (WALI) CubeSat.

ALTITUDE CONTROL TEST FIXTURE
by: Anthony Krieger, Evan Milburn, and Matthew Staal
Sponsor: Western Aerospace Launch Initiative (WALI)
Faculty Advisor: Jennifer Hudson, Ph.D.
11:00 a.m. – 11:25 a.m.

Western Aerospace Launch Initiative at Western Michigan University requested a testing environment to validate their CubeSat's detumbling control system. This will be accomplished using a previously constructed Helmholtz cage in conjunction with a spherical air bearing, mimicking the frictionless environment of space. The goal of this project is to construct a modular test fixture for the attitude control system accommodating several sizes of satellites.

THE DESIGN OF A UAV TO FLY IN THE MARTIAN ATMOSPHERE
by: Maxwell Allen, Stephen DeCarlo, Joseph DiGivanno, and Nathan Partee
Sponsor: None
Faculty Advisor: Kapseong Ro, Ph.D.
11:30 a.m. – 11:55 a.m.

The exploration of Mars is a major interest for the space community. The rover is slow and isolated to certain areas of Mars where the satellites orbiting the planet cannot get the same image quality as equipment of the surface. More surface area of Mar's surface can be covered with greater accuracy using a UAV equipped with LiDAR. Mars has an atmosphere with a density of around 1% of Earths, thus creating unfavorable conditions to produce lift. Using MATLAB, CAD, and other computational modeling methods a prototype of a UAV was designed. This UAV can be used in conjunction with other methods to help map, explore and accomplish missions to support the NASA's Mars Habitat project.

MODULAR WATER MODELING FOR MANUFACTURING
by: Tyler Drobnik, Jordan Stoy, and Steven Taylor
Sponsor: Dan Irvine and Brandon Torres, Pfizer
Faculty Advisor: Decker Hains, Ph.D.
1:00 p.m. – 1:25 p.m.

In the pharmaceutical manufacturing industry, regulation of utility water systems is of the utmost importance. A modular and interactive model of Qualified Utilities systems in the industry was created using Microsoft Visio with Visual Basic for Applications working in the background. System element information is used to calculate available flows and is checked against required output flow rates. This model will allow for immediate calculations of how changes in the water flows will affect the existing systems and generate recommendations to improve system reliability.

TITAN INVESTIGATOR: TOURING A NEW WORLD
by: Madyson Claflin, Marissa Doyen, and Rupal Patel
Sponsor: None
Faculty Advisor: Jennifer Hudson, Ph.D.
1:30 p.m. – 1:55 p.m.

Titan, Saturn's largest moon, harbors unique Earth-like environments enriched with organic elements and subsurface oceans. Further investigation of this icy world is necessary to gain insight into its complex chemistry and potential habitability. A conceptual spacecraft design and the orbital trajectory to Titan have been developed using orbital analysis and simulation applications. The trajectory design was optimized to decrease duration, fuel consumption, and cost based on scientific objectives derived from a NASA-ESA proposal. The analysis models created can contribute to the design of future deep space exploration missions.

THERMAL ADAPTATION OF A VACUUM CHAMBER
by: Ryan Geiger, Nicholas Nuzzo, and Jacob Russell
Sponsor: Edward VanNoord, Heraeus Noblelight America LLC
Faculty Advisor: Jennifer Hudson, Ph.D.
2:00 p.m. – 2:25 p.m.

Thermal Vacuum chambers are used for various testing and manufacturing methods. An already existing vacuum chamber was modified with temperature control elements to produce specific conditions for a subject under vacuum. The scaffolding for heating element provided a reflective surface to magnify the temperature effects through conduction and reflection. SolidWorks, a computer aided design package, and LabVIEW, a control system programming tool, was used to build the model and its control system that would operate within the already existing vacuum chamber. The thermal vacuum chamber provides a cheaper testing solution for WALI, the university's small satellite team.

HANDS FREE WHITE CANE
by: Mitchell Herweyer, Jacob Peterson, and Riley Zenas
Sponsor: None
Faculty Advisor: Pnina Ari-Gur, Ph.D.
2:30 p.m. – 2:55 p.m.

The traditional white cane has helped the visually impaired navigate for almost a century, but the information it provides to the user is limited. A design for a hands-free white cane has been developed to provide the user with more detailed information about their surroundings. The designed vest created by a previous group at WMU was modified and enhanced by switching to powering the sensors using thermoelectric energy harvesting, adding rain protection to the electronics, providing better signals and fixing all present bugs. The new unit functions by sensing an obstruction in the user's path and providing them with a detailed alert by sounding music.

DESIGN OF A SOLAR DRONE
by: Farhan Iqbal and Jeremy Shaw
Sponsor: None
Faculty Advisor: Kapseong Ro, Ph.D.
3:00 p.m. – 3:25 p.m.

Main goal of this project is to design an electric drone prototype powered entirely by solar energy. This project consists of reviewing the past and current development in the field of solar energy. Firstly, a detailed study is done on the properties and requirements followed by calculations and implementation. The wild fires in California and Australia highlight a very specific need for near non-stop surveillance which cannot be achieved by one aircraft along. With the solar drone design, it shows how efficient solar energy is for such operations and other application.

MECHANICAL AND AEROSPACE ENGINEERING C

Session Chair – Dan Kujawski, Ph.D. and Muralidhar Ghantasala, Ph.D.

Room D-206

DUAL RATE ELECTRO-HYDRAULIC RELIEF VALVE

by: Russell Goodrich, Nathan Parker, and Andrew Rollend

Sponsor: Jerry Boza, FEMA Corporation

Faculty Advisor: Javier Montefort-Sanchez, Ph.D.

9:00 a.m. – 9:25 a.m.

Electro-hydraulic relief valves are commonly used to control pressure in hydraulic systems. Existing relief valve designs possess highly variable flow rates with input pressures below poppet cracking pressure, resulting in reduced flow controllability. To improve flow controllability, a valve was designed with dual-rate flow characteristics. Multiple design options were compared with the assistance of SolidWorks and ANSYS. A final design was prototyped and tested to validate the results obtained through simulation.

AERODYNAMIC EFFICIENCY OF THE LANDING GEAR IN THE VELOCITY XL WITH FIXED LANDING GEAR

by: Ivan Arvelo, Hamlet Hernandez, and Jamil Stefan

Sponsor: Andrew Millin

Faculty Advisor: Peter Gustafson, Ph.D.

9:30 a.m. – 9:55 a.m.

The drag produced by the fixed landing gear of the velocity XL reduces the speed of the airplane. The struts and the wheel pants of the main landing gear, measured to develop CAD models and analyzed for their aerodynamic efficiency with a Computational Fluid Dynamic software ANSYS Fluent, to develop the most practical alternative designs. The models will reduce the drag of the airplane, allowing higher speed, and providing new alternatives for airplanes with fixed landing gears.

ALL-IN-ONE APPENDECTOMY DEVICE
by: Jorden Kegeler and Graham Peterson
Sponsor: Michael Leinwand, MD
Faculty Advisor: Peter Gustafson, Ph.D.
10:00 a.m. – 10:25 a.m.
CLOSED SESSION TO PUBLIC

Appendectomies are an extremely common and necessary surgical procedure. A specialized trocar combining the ligation, cutting and removal of the inflamed appendix was developed by evaluating current appendectomy procedures. Initial prototyping, 3-D modeling and 3-D printing was employed to create a final prototype. The final prototype was designed using the best features from the previous prototype iterations. The specialized trocar is easy to use, consistent and reduces operating time with the intents to reduce surgery cost and recovery time for the patient.

BLUFF BODY AERODYNAMICS AND DRAG REDUCTION MECHANISMS
by: Jacob Ganzak, Noor Halima Jahan, and Orlando Romero
Sponsor: Sudesh Woodiga, Ph.D., Ford Motor Company
Faculty Advisors: Tianshu Liu, Ph.D. and David Moussa
10:30 a.m. – 10:55 a.m.

As the automotive industry continues to develop mechanisms to reduce C02 emissions, wind tunnel testing demonstrates reliable drag measurement capabilities to improve vehicle geometry. An Ahmed body model was provided to study the effects of bluff body aerodynamics of conventional ground vehicles to generate drag reduction mechanisms. Flow visualization techniques using optical flow measurements allows the comparison of baseline and morphed rear end geometry. Through wind tunnel testing, the model was stabilized in the wind tunnel test section to validate a reliable system for future vehicle aerodynamic research.

ELECTRIC POWERBANK FOR HYBRID ENGERY SYSTEMS
by: Majed Ababtain, Louis Chee, Aaron Herbert, and Jared Wendland
Sponsor: None
Faculty Advisor: Peter Gustafson, Ph.D.
11:00 a.m. – 11:25 a.m.

Electric power is a vital for any community to grow. This need is amplified in the case of medical facilities where electricity maintains lifesaving functions. The project was to design an electrical powerbank system to work as a backup for small healthcare facilities operating with unreliable grid power. The device stores the electrical energy from a solar system and the current grid. A prototype was built to show the capabilities of the design. The system combines major components of a solar system into a single cost-effective unit. Cost, serviceability, and life was evaluated to design a product that meets the needs of these medical facilities.

AUTOMATED HYDRAULIC DEAERATOR
by: Adam Blematl, Kyle Leamer, and Travis Shoffner
Sponsor: Chris Dykstra, Parker Hannifin HSD
Faculty Advisor: Javier Montefort, Ph.D.
11:30 a.m. – 11:55 a.m.

Matching aircraft conditions such as air content in the hydraulic fluid is required for product development and validation. Deaeration is the process of removing free and dissolved air from fluid. The current system in place for deaeration is highly inefficient and requires a technician to remain inside a test cell while the hydraulic stand is pressurized. Using the existing system as a reference, an automated deaerator with a dissolved air measuring device was designed that increases safety, efficiency, and reduces labor cost.

DESIGN, CONSTRUCTION, AND EVALUATION OF AN ULTRASONIC WELDER
by: Sawyer Caley, Paul Clawson, and Joseph Turner
Sponsor: Chris Bergman, Summit Polymers, Inc.
Faculty Advisor: Rick Meyer, Ph.D., P.E.
1:00 p.m. – 1:25 p.m.

Hydraulically operated ultrasonic welding machines are commonly used for fusing plastic components together; however, these machines can suffer from intermittent failures due to daily environmental variations. A new ultrasonic welding apparatus was designed to operate hydraulically, pneumatically, or electrically in order to seek a more consistent and superior form of welding. The new welding apparatus was quantitatively and qualitatively evaluated using an industry standard welding scale to determine which method of operation yields the best results.

PONTOON CLEANER
by: Spencer Dobbin, Samuel Sibula, Austin Webster, and Andrew Wojdyla
Sponsor: None
Faculty Advisor: Peter Gustafson, Ph.D.
1:30 p.m. – 1:55 p.m.

Pontoons that sit in the water while docked, slowly grow algae and collect dirt and grime. This can cause poor aesthetics as well as a slower and less efficient pontoon boat. A pontoon cleaning device was designed using Inventor. Research was done on what would clean an aluminum pontoon the best, and what other solutions there are at this point. Analysis was done on the model to calculate the forces acting on the pontoon and pontoon cleaner. The completed design if fully built will be an efficient way to clean your pontoons as opposed to other current solutions.

UTLIZING EXISTING STRUCTURES IN THE IMPLEMENTATION OF WIND TURBINES
by: Robert Mayfield, Chris Messecar, and Josh Smiley
Sponsor: None
Faculty Advisor: Yufeng Hu, Ph.D.
2:00 p.m. – 2:25 p.m.

The energy industry is moving towards sustainable sources of energy production. One prominent source of clean energy is the wind turbine. The aim of this project was to study how wind flows in the urban environment using CFD modeling techniques. The data found from the model was validated and used to recommend optimal locations of wind turbine use in urban areas. Installation of the turbine was researched and designed. Financial benefits and costs have been examined to define fiscal feasibility. This study has provided further information needed to integrate sustainable energy production into the existing environment.

3D PRINTING ROBOTIC ARM ON LINEAR RAILS
by: Nick Goberville and Trenton Steele
Sponsor: None
Faculty Advisor: Zachary Asher, Ph.D.
2:30 p.m. – 2:55 p.m.

Typical 3D printers are bound by the printing bed volume relative to the printer frame volume. A 3D printing robotic arm set upon sliding linear rails was designed and built. The arm was 3D printed with a traditional 3D printer designed using Autodesk Inventor. This product reduces printer size while increasing bed area and reduces cost with use of 3D printed parts.

INTERGRATED AND AUTOMATED PUNCH SKIN BIOPSY DEVICE
by: Francis Otieno, Michael Owens, and Markus Suwignyo
Sponsor: Harib Ezaldein, M.D., Miesha Merati, M.D., and Herb Skingineering, M.D.
Faculty Advisor: Parviz Merati, Ph.D., P.E.
CLOSED SESSION TO PUBLIC
3:00 p.m. – 3:25 p.m.

Demand for skin biopsies is fast increasing at a pace dermatologist cannot keep up with. This presents a need to incorporate other healthcare professionals such as primary care providers, nurse & physician assistants, and all specialist consultants that encounter skin conditions that potentially require a punch skin biopsy. An integrated and automated punch skin biopsy device was designed and developed based off a preset template of specifications. The design concept and testing would help in standardization of the process and reduce the procedure time. This would improve outcomes for patients such as early detection of potentially terminal illnesses like cancer, faster healing time, and better aesthetic appeal as relates to the wound.

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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;
- Transform: cultivate an inclusive learning environment, contributing to diversity in the engineering workforce; and
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