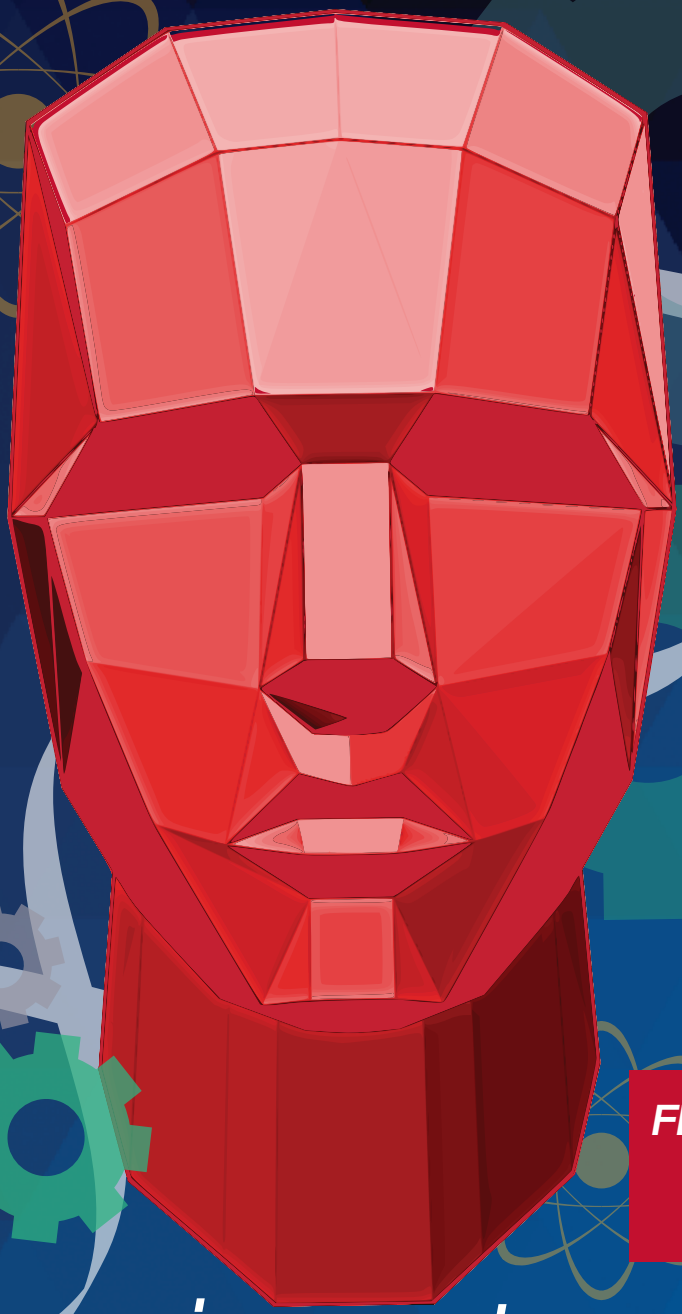
SVSU SAGINAW VALLEY STATE UNIVERSITY



FRIDAY, APRIL 26, 2019
PIONEER HALL,
8:30 A.M -4:30 P.M

We *experiment.*

SVSU SCIENCE & ENGINEERING SYMPOSIUM

SVSU Science and Engineering Symposium

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SVSU Science and Engineering Symposium

Program

8:00 a.m.	**Registration**	Pioneer First Floor
9:00 a.m.	**Opening Remarks** Dr. Andrew Chubb Dean, College of SE&T	Science East 204
9:05 a.m.	**Keynote Lecture** Mary Draves Vice President and Chief Sustainability Officer The Dow Chemical Company	Science East 204
10:00-noon	**Poster Session**	Pioneer First Floor
	Biology Posters Chemistry Posters Computer Information Systems Poster Mathematical Sciences Poster Physics Poster Mechanical Engineering Research Posters Electrical Engineering Senior Design Posters Mechanical Engineering Senior Design Posters	
11:00-11:15	**Morning Oral Session**	
	Mathematical Sciences	Pioneer-231
12:00 p.m.	**Lunch**	Pioneer First Floor
1:00-4:00	**Afternoon Oral Session**	
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	B. Electrical Engineering	Pioneer-240
	C. Mechanical Engineering – I	Pioneer-245
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Keynote Lecture

Sustainability and Dow: Collaborating for Change

Speaker: Mary Draves
Vice President and Chief Sustainability Officer
The Dow Chemical Company

As chief sustainability officer and vice president of Environment, Health and Safety (EH&S) for Dow, Mary Draves is passionate about using science, innovation and collaboration to drive transformative and sustainable change. She leads corporate EH&S governance and Dow's ambitious 2025 Sustainability Goals. Priority areas include solutions for a circular economy, climate change, sustainable chemistry and incorporating nature into business decisions.

Draves previously led Dow's groundbreaking Valuing Nature Goal, which represents the first-ever commitment by a corporation to formerly factor nature into its business decisions. Under her leadership, Dow has enjoyed a highly productive collaboration with The Nature Conservancy (TNC). Together with TNC, she and her team have helped pioneer tools and create a cultural shift that are enabling Dow sites to make a compelling business case for adopting nature-based project solutions. Dow's aim is to identify $1 billion worth of value to Dow from projects that enhance nature by 2025. Since launching the goal in 2015, the Company has realized about $275 million of value in nature-based decisions.

Draves joined Dow in 1989 and has held several manufacturing and EH&S leadership roles. During her three decades at Dow, Draves has built a reputation for being an effective and collaborative leader who helps inspire commitment in her teams and attain results. She holds a Bachelor of Science degree in biology and Master of Science in technological processes from Saginaw Valley State University. She resides in Midland, Michigan, with her family.

To sum-up, Draves has three professional passions: sustainability, leading people and building effective collaborations. When it comes to personal passions, she is focused on her family, community service and supporting women in STEM careers.

Biology Posters

B01. Are Plastic Microbeads an Environmental Threat to Aquatic Microbial Communities?

Amanda Weiss (Advisor: Dr. Sylvia Fromherz)

Plastic microbeads (defined as 0.1μm to 5mm diameter spheres) are present in many manufactured products throughout the world, such as cosmetics, toothpaste, hand soap, and other common household products. Growing concerns about potential negative impacts of microbeads on aquatic and marine environments led to a 2018 ban on the inclusion of microbeads in manufactured products in the USA. However, throughout the world microbeads are still being released in large quantities into the environment where they continually accumulate. Since the microbial ecosystem forms the foundation of every aquatic and marine ecosystem, further research is needed to better understand the impacts of microbeads on these environments. The goal of this research is to provide insight of unknown impacts microbeads have on microbial communities, by using the single-celled microorganism, *Tetrahymena thermophila*. *Tetrahymena* uses the process of phagocytosis, to engulf natural food sources like *Saccharomyces cerevisiae* or yeast and other non-nutritive particles like microbeads. We have developed a visual assay to monitor bead uptake as a measurement of phagocytosis and have determined the rate of phagocytosis by *Tetrahymena* using blue-colored microbeads and red stained yeast. We are currently using this assay to determine if plastic microbeads place a "load" on *Tetrahymena* by interfering with their uptake of nutritive yeast.

B02. Effects of Vitamin B_6 Toxicity on Coordination and Balance at the Cellular Level

Cole Pero and Julie Learst (Advisor: Dr. Sylvia Fromherz)

Vitamin B_6 (pyridoxine) overdose in humans can cause permanent neuropathies resulting in loss of coordination. This is of clinical concern because Vitamin B_6 is readily available over the counter, in energy drinks, or as a prescription. The molecular basis by which Vitamin B_6 has its toxic effect is currently unknown. Elucidation of this mechanism would help in development of treatments and consumption safety guidelines. In animal models, including embryonic chickens (Sharp and Fedorovich, 2015; Sharp and Bekoff, 2015) and adult rats (Helgren et al., 1997), Vitamin B_6 has been shown to cause selective loss of proprioceptive neurons, the sensory neurons responsible for coordination. Normally, proprioceptive neurons require a factor (neurotrophin-3, NT-3) produced by associated muscle fibers for neuron survival, and indirect evidence has suggested that the NT-3 pathway may be disrupted by Vitamin B_6 treatment. Specifically, it has been found that excess NT-3 rescues Vitamin B_6-induced toxicity in rats (Helgren et al., 1997). Therefore, we suspected that Vitamin B_6 might have its toxic effects by decreasing the levels of NT-3. To test this hypothesis, we set out to quantify levels of NT-3 in Vitamin B_6-treated and control mid-stage chicken embryos using an ELISA assay. After multiple trials, our data suggests that there is no reproducible, statistically-significant change in NT-3 levels after Vitamin B_6-treatment when compared to controls. Our data suggests that Vitamin B_6-induced proprioceptive neuron death is likely occurring independent of NT-3.

B03. Exploring Terpene Synthase Diversity in the Ferns
Anh (Wendy) Pham (Advisor: Dr. Dennis W. Gray)

Terpenes are a large class of secondary metabolites produced by a group of enzymes called terpene synthases. Early studies on the evolution of terpene synthase genes in seed plants suggested they evolved from a single ancestral gene. However, recent work has shown that Selaginella (a basal land plant) contains TPS genes from three distinct lineages (Bacteria, Fungi and Seed plants) suggesting that the evolutionary history of TPS genes in plants is more complex than initially thought. This project seeks to improve our understanding of the evolution of the terpene synthase biosynthetic pathway in plants by identifying the isoprene synthase gene in an early diverging group of land plants (Ferns). To identify the isoprene synthase gene in the ferns we have taken a two pronged approach by attempting to extract, purify and sequence the protein, and by constructing and screening a cDNA library. Early attempts at protein extraction and purification were successful at extracting an enzyme with isoprene synthase activity from the fern *Onoclea sensibilis*; however we discovered that our ability to extract protein declined as the season progressed, probably due to changes in secondary chemistry. Attempts to construct a cDNA library encountered a hurdle as well, and we were unable to extract intact RNA from these fern leaves. In summer 2019 we plan to use the knowledge gained in Summer 2018 to refine our analytical technique as we pursue identification of the isoprene synthase gene in ferns.

B04. In Search of the Isoprene Synthase Gene in *Abies alba*
Asmita Ra (Advisor: Dr. Dennis W. Gray)

Isoprene is a five carbon compound produced and emitted by many plants in vast quantities. These emissions contribute to the production of tropospheric ozone pollution, may serve to protect emitting plants from high temperature thermal damage, and are interesting from a biotechnological perspective because isoprene is a basic feedstock used in the synthesis

of synthetic rubber. Historically most of the isoprene used in rubber synthesis has been derived from petroleum; however there is considerable interest in developing biological systems for isoprene production based on engineering bacteria to express isoprene synthase genes. The goal of this study was to identify the gene encoding the isoprene synthase in a group of Firs (*Abies sp.*) native to the Mediterranean region of Europe, in hopes of discovering an enzyme with biochemical properties that are more favorable for isoprene production in bacterial systems. To identify the isoprene synthase gene, we used a homology based cloning approach, and identified partial sequences for three novel monoterpene synthase like genes, of which two possessed features that were consistent with isoprene synthase function. Using gene specific primers designed to these partial sequences, we performed 3' RACE and 5' RACE to obtain the full length sequence of one of these genes. While this gene does not appear to encode an isoprene synthase, we are preparing to clone and express this gene to confirm its product profile.

B05. 5' RACE Amplification of a Candidate Isoprene Synthase Gene in *Abies sp.*
Kelsey Lewis (Advisor: Dr. Dennis W. Gray)

Isoprene is a five carbon compound produced and emitted by many plants in vast quantities. These emissions contribute to the production of tropospheric ozone pollution, may serve to protect emitting plants from high temperature thermal damage, and are interesting from a biotechnological perspective because isoprene is a basic feedstock used in the synthesis of synthetic rubber. Historically most of the isoprene used in rubber synthesis has been derived from petroleum; however there is considerable interest in developing biological systems for isoprene production based on engineering bacteria to express isoprene synthase genes. The goal of this study was to identify the gene encoding the isoprene synthase in a group of Firs (*Abies sp.*) native to the Mediterranean region of Europe, in hopes of discovering an enzyme with biochemical properties that are more favorable for isoprene production in bacterial systems. Under a prior UGRP project, three partial sequences of potential isoprene synthases were identified. In this project we focused on one sequence that had strong similarity with the MBO synthase found in pines. Using gene specific primers designed to this "MBO-like" gene we performed 3' RACE and 5' RACE to obtain the full length sequence of this gene, and are preparing to clone and express this gene to confirm its product profile.

B06. Growth of Native and Invasive Genotypes of Phragmites australis under contrasting nutrient regimes
Molly Leslie (Advisor: Dr. Dennis W. Gray)

Phragmites australis is one of the most important invasive species in the Great Lakes Bay Region. The introduced European genotype of *Phragmites* grows quickly to form dense monocultural stands, crowds out native vegetation, reduces biodiversity and aesthetic appeal of invaded habitats, and has largely replaced native genotypes within their historical range. Efforts to control *Phragmites* rely heavily on herbicides which may impact non-target species and lead to contamination of drinking water sources. This study explores the potential for ecological controls to replace chemical controls by examining growth responses of native and invasive forms of *Phragmites australis* to differing levels of nutrient inputs in a greenhouse experiment. Both native and invasive *Phragmites* showed enhanced growth at higher nutrient input levels, with native genotypes showing slightly greater responses than the invasive genotype. As the season progressed native genotypes stopped growing by Day 254, while invasive *Phragmites* continued to grow until day 276 in the low and medium nutrient addition treatment and until day 309 in the high nutrient treatment under benign greenhouse growth conditions. This extended growing season exhibited by the invasive *Phragmites* under high nutrient conditions suggest that in a future world characterized by warmer temperatures, the invasive *Phragmites* genotype will have an advantage over native *Phragmites* through its ability to take advantage of a longer growing season.

B07. Investigating the metabolic and physiological effects of varying fat and carbohydrate content in diets

DruAnne Brogren*, Anna Burley, Megan Holihan, Sydney Graves, Kara Popps, and Taylor Fritz (Advisor: Dr. Jay Scott)

Metabolic syndrome is characterized by fat accumulation, metabolic changes, inflammation and an increase in blood pressure and blood cholesterol. These characteristics are associated with obesity and lead to an increased risk of diabetes, stroke and cardiovascular diseases, all of which are leading causes of death in the United States. Western diets (high fat, moderate carbohydrate) are linked to metabolic syndrome; however, the physiological effects of ketogenic diets (high fat, low carbohydrate) is not fully understood. To investigate the metabolic and physiological effects fat and carbohydrate ratios in the diet, mice were placed on normal (low fat, moderate carbohydrates), Western, and ketogenic diets for 8 weeks. All diets consisted of equal amounts of protein. The changes in physiology were analyzed using: anatomical changes, histology, blood chemistry measurements, and gene expression. Furthermore, 84 genes associated with metabolic syndrome and Nonalcoholic Fatty Liver Disease were analyzed in liver tissue. An increase in lipid uptake in the liver (steatosis) occurred with both Western and ketogenic diet, with a greater amount observed in ketogenic diet mice. Hepatic gene expression suggested that the ketogenic diet induced a higher expression of anti-inflammatory genes and had an increased expression of genes associated with fat metabolism and cell survival. Thus, the data suggest that a ketogenic diet induces metabolic changes to use fat for energy, limit inflammation, and increase health of liver cells, which may provide protection against metabolic syndrome and its associated disease states.

B08. Do environmental contaminants influence diet-related changes in physiology?

Anna Burley*, DruAnne Brogren, Megan Holihan, Sydney Graves, Kara Popps, and Taylor Fritz (Advisor: Dr. Jay Scott)

Diets high in fat have been associated with fat accumulation and changes in hepatic metabolism that lead to an increased risk of developing metabolic syndrome, diabetes, and cardiovascular disease. Fat-soluble environmental contaminants tend to accumulate in animal fat, which suggests that we may be exposing ourselves to contaminants when ingesting foods high in fat. It is known that, independently, some contaminants that stimulate the aryl hydrocarbon receptor (AhR) induce similar effects in the liver as high fat diets. Thus, environmental contaminants may exacerbate the physiological effects of a diet high in fats. To test this, mice were put on a high fat and low carbohydrates and were exposed to a lipid soluble, AhR agonist (2,3,7,8-tetrachlorodibenzo-P-dioxin) for 4 weeks. Liver, stool, and cardiovascular tissue was extracted for the analysis of 84 genes associated with fatty liver disease and hepatoxicity, alterations in the gut microbiome, and histological changes. It is to be expected that dioxin exposure to these varying diets will further increase factors that contribute to metabolic syndrome and liver disease

B09. Changes in the gut microbiome induced by Western and ketogenic diets

Kara Popps*, DruAnne Brogren, Megan Holihan, Sydney Graves, and Taylor Fritz
(Advisor: Dr. Jay Scott)

The gut microbiome is an essential component to a healthy metabolic center in the body. Varying species within the gut have long reaches in maintaining metabolic homeostasis and have been shown to drastically alter the speed of micronutrient absorption and contribute to metabolic syndrome and obesity. Populations of microbiota are established early in life, and are composed mainly of the two families, Firmicutes and Bacteroidetes, with Firmicutes generally being obesity promoting populations. Despite early establishment of gut populations, long term exposure to restrictive diets can alter the gut microbiome. As restrictive fad diets increase in popularity, there is the added risk that microbiome alterations affect downstream pathways. To explore how restrictive diets change population density of major bacteria phyla, mice were placed on three diets with varying macronutrient ratios: Normal (low fat/high carbohydrate), Western (high fat/high carbohydrate), and Ketogenic (high fat/low carbohydrate) diets. After eight weeks of diet exposure, fecal pellets were collected from the large intestine and bacterial DNA was isolated to identify bacterial colonies. Changes in the gut microbiota will be correlated to physiological changes, including fat accumulation, and changes in hepatic expression of genes associated with fat metabolism and inflammatory responses.

* denotes the presenter

Chemistry Research Posters

C01. Studies Toward the Synthesis of Dual-Action Antibiotic Using Click Chemistry

Nele Heinemeier (Advisor: Dr. Stephanie Brouet)

Click chemistry is a high yielding methodology that has a promising application by clicking cefotaxime to an alkyne with hopes of creating a triazole product. Cefotaxime is a third generation cephalosporin that has the ability to combat a broad spectrum of Gram positive and Gram-negative bacteria, making it favorable for treating bacterial infections. In order to perform the click, the C3 acetyl group on the cefotaxime must be substituted with an azide. After the substitution reaction, the cefotaxime can be clicked with the alkyne in the presence of copper sulfate pentahydrate and sodium ascorbate. The results were monitored using nuclear magnetic resonance (NMR).

C02. Exploring the Coordination Mode and Redox Properties of d8-Metal Hydroxamate Complexe

Alice Erman and Dustin Pumford (Advisor: Dr. Adam Warhausen)

In the field of chemistry, the interactions between biologically available materials and nitric oxide (NO) are thoroughly studied and researched. Although, much more can be learned from molecules that have the ability to generate nitric oxide within a biological system. The goal of this project is to study the interactions between molecules that donate nitric oxide and iron-containing synthetic models of the heme unit. Hydroxamic acids are used as NO contributing compounds. Additionally, benzoyl hydrazine complexes are substituted as synthetic porphyrins. The focus of this research is understanding the redox behavior of the interactions between these compounds through the use of electrochemical and spectroelectrochemical techniques.

It is important to understand the interactions between organic nitric oxide donating molecules and heme-containing biomolecules due to their abundance in biological structures. This project could potentially provide insight to unknown side effects of hydroxamic acid containing medications.

C03. Electrochemical Investigation of Ruthenium Complexes Utilizing Cyclic Voltammerty

Vincent Flores and Jonathan Lillo (Advisor: Dr. Adam Warhausen)

The complexes benzylidene-bis(tricyclohexylphosphine)-dichlororuthenium, and [1,3-bis-(2,4,6-trimethylphenyl)-2- imidazolidinylidene]dichloro(phenylmethylene)(tricyclohexylphosphine) ruthenium are well-known and extensively studied complexes. They are known for the wide range of reactions that they can be involved in. An area of interest that lacks in current literature is the redox properties of these complexes and their analogues. Our focus is to expand the knowledge of these complexes, more specifically, with respect to their first oxidation potential. Our group set out to investigate the electrochemical and spectroelectrochemical properties of these complexes as well as their analogues. The redox properties of these complexes have been examined utilizing cyclic voltammetry (CV) techniques using various solvents, temperatures, and electrolytes. The extensive CV experimentation includes the utilization of screen printed platinum, platinum disk, and glassy carbon disk electrodes.

C04. Synthesis and Electrochemistry of Rhodium Catalyst Analogues
Hayley Lillo (Advisor: Dr. Adam Warhausen)

A commonly studied example of an organometallic catalyst is Wilkinson's catalyst, formally named tris(triphenylphosphine) rhodium(I) chloride. It was discovered by Sir Geoffrey Wilkinson in 1964, from whom the catalyst gains its name, and he won a Nobel Prize for his work in 1973. The complex is known to catalyze the hydrogenation of unsaturated alkenes and alkynes; this mechanism is well-known. The electrochemistry of this compound and its analogues, however, is not given much attention in the literature. The goal of this project is to synthesize analogues of Wilkinson's catalyst, characterize their structure by infrared (IR) spectroscopy, nuclear magnetic resonance (NMR), and thin-layer chromatography (TLC), and observe their electrochemical properties by cyclic voltammetry (CV). The cyclic voltammograms will be analyzed to determine the oxidation peaks of the analogues.

C05. Urban and Rural Phosphorus Contributions of the Pinnebog River Watershed to Saginaw Bay
Paul Braman*, Emmalee Griswold, Aleece Rambow, and Alexander Yankely
(Advisors: Dr. David Karpovich and Mr. Lee Koski)
* denotes the presenter

The total loading of phosphorus into the Saginaw Bay was 757 tons/year in 2009 according to the J-THIA NPS model. This is 72% over the goal value of 440 tons/year set forth by the Great Lakes Water Quality Agreement of 1978. In the Saginaw Bay Watershed, the Pigeon-Wiscoggin sub-watershed contributes 18.7% of the annual "NPS total Phosphorus" loading. The Pinnebog River serves as the main outgoing channel for drainage from Bad Axe, Michigan, within this sub watershed.

The Pinnebog River is predominantly filled with rural run off, but Bad Axe serves as one of its few urban basins. We monitored four storm drains in Bad Axe and several sites on Bad Axe Creek to determine both urban and rural contributions to phosphorus loading. This was done over a two-year period on a 1.5 mile stretch of the Bad Axe Drain, which ultimately flows into the Pinnebog River. The concentration of pollutants was measured along with volumetric flow to determine pollutant loading at each site. The results will ultimately be used for watershed land use planning in order to reduce phosphorus loading to the Pinnebog River and Saginaw Bay.

C06. Analysis of the Enzymatic Activity of Extracted Salivary α- Amylase

Jeff Miller and Amanda Thielen (Advisor: Dr. Tami Sivy)

Amylase is an enzyme that catalyzes the hydrolysis of starch and glycogen into simple sugars such as glucose and maltose. It can be found in the pancreas and salivary glands of humans and other mammals. The purpose of this experiment is to observe the activity of **α**-amylase in human saliva. If all methods of this experiment are followed correctly, then the reaction rate of **α**-amylase found in human saliva samples will be determined. This particular enzyme was qualitatively analyzed by performing a microplate-based starch-iodine assay to ensure starch was broken down to yield glucose as a byproduct. Quantitative analysis was performed using a Bradford assay to determine the concentration of **α**-amylase present in the extracted samples. The activity of the two saliva samples were measured at 580 nm using photometric analysis at room temperature. The data was then set against a standard curve and normalized to approximately 50ug/mL. The results will indicate the activity of **α**-amylase present in the human saliva samples.

C07. Analysis of the Inhibition of Bacterial Dihydrofolate Reductase by varying concentrations of Trimethoprim

Anna Burley and Lauren Weidner (Advisor: Dr. Tami Sivy)

Folic acid is a necessary vitamin in living organisms, such as *E. coli*, that is synthesized through the bacterial folate pathway. Patients infected with *E.coli* can target this pathway with Trimethoprim, which replaces dihydrofolic acid, the substrate for dihydrofolate reductase in the bacterial folate pathway. We are attempting to analyze the effect of changes in concentration of the antibiotic Trimethoprim on the dihydrofolate reductase enzyme activity in *E. Coli* cells. If the concentration of Trimethoprim in the cells is increased, it is likely that the activity of dihydrofolate reductase will decrease. The *E. coli* cells were first grown on LB plates and inoculated into LB broth containing 1 mL of Trimethoprim of varying concentrations. After the incubation period, the cells were lysed and the enzyme was extracted. Enzymatic activity was then monitored after the addition of dihydrofolic acid substrate and NADPH cofactor using a spectrophotometer.

C08. Determination of a Binding Assay between Miraculin and Cow Tongue
Nicholas Graves and Nicholas Grocholski (Advisor: Dr. Tami Sivy)

Miraculin is a protein found in the Miracle Berry, *Synsepalum dulcificum*, which is native to West Africa. This glycoprotein binds to sweet taste receptors TAS1R2:TAS1R3 so that anything sour that enters the mouth tastes sweet. This phenomenon is due to the miraculin absorbing protons from the acidic sour substances and channeling them through the sweet taste receptor. Which causes the substance to taste sweet as it passes over the tongue. Miraculin may go through a conformational change due to the uptake of protons. To monitor those changes, a cow tongue will be treated with miraculin and then exposed to a sour solution. A separate taste modifier, lactisole, will be used to displace miraculin and thus be indicitive of the protein. UV-Vis spectrophotometry will be used to determine if any conformational changes occurred on the protein. Additionally, to demonstrate miraculin efficacy, volunteers will ingest a sour substance, place miraculin on their tongue, and then taste the sour substance again. To quantify the degree to which the miraculin changes taste the volunteers will rate the intensity of taste before and after miraculin application.

C09. Immobilization of a- Galactosidase
Bayley Pfau and Jakob Schneider (Advisor: Dr. Tami Sivy)

Enzymes play an important role in the catalysis of chemical and biomedical reactions. Soluble enzymes are not economical because they can only be used for a single operation. Traditional methods of enzyme recovery are expensive or cause denaturation of the enzyme. Because of this, the immobilization of enzymes has been a major study in the field of biotechnology. Enzyme immobilization is defined as an enzyme being physically confined or localized in a defined region of space with retention of its catalytic activity, which can be used repeatedly and continuously. a-Galactosidase was chosen enzyme for this study because it is widely distributed in microorganisms, plants, and animals and can catalyze the hydrolysis of simple galactosides and polysaccharides. We predict that a- Galactosidase can be isolated from *Aspergillus flavus* and be used to demonstrate enzyme immobilization, which can be practically used by the food industry.

Computer Information Systems Poster

Design and Development of a Software System for Assessment Frameworks
CIS 424 Senior Capstone Class (Advisor: Dr. Scott James)

This year's CIS capstone class was tasked with building a software system that would allow for the custom creation of assessment templates, administration tools, automated scoring systems and custom report generation of completed assessments. Various assessment question types and categories can be constructed using the software with the same system allowing assessors to carry out the actual assessments. Completed assessments are then scored and customized reporting based on the assessment results are generated and can be viewed as either Docx or PDF files. The system was built from scratch using a combination of custom developed software in Visual Basic .NET and Microsoft Word for reporting.

Mathematical Sciences Poster

Modern Portfolio Theory: Momentum using Negative Earnings Drift
Sarah Grossmeyer*, Angelica Johnson*, and Connor Doyle
(Advisor: Prof. Curtis Grosse)
* denotes the presenters

Within modern portfolio theory, momentum-based investment strategies relative to pure market strategies have superior risk-adjusted returns based on U.S. stock market history. For example, companies that report earnings below analyst expectations see their stock prices exhibit negative pricing behavior called negative earnings drift. Investors incorporate this negative news with delay, leading to further downward pricing pressure over a 10-day window. Predicting such downward movement in these stock's prices is profitable based on statistical analysis when creating a "short" position (predicting downward price movement) in such stocks and a "long" position (predicting upward price movement) in the overall market. This was analyzed by comparing the stock's typical behavior with its behavior over the 10 days following an earnings report that fell below analyst expectations. Standard statistical measures were used to evaluate success and in aggregate, on a quarterly basis, the existence of negative earnings drift was confirmed.

Physics Poster

Computer Generated Binary Fraunhofer Hologram
Teresa Jeffrey (Advisor: Dr. Marian Shih)

We report using Matlab to generate, by computer, a Binary Fraunhofer Hologram. Most holograms are made from actual, physical objects. Instead of a physical object, we devise a mathematical representationofan object and compute its hologram. We print out the hologram as a large black and white drawing using a laser printer, and photographically reduce it. The resulting computer generated hologram optically reconstructs an image just like an ordinary hologram. The numerical reconstruction of the hologram is computationally verified in Matlab.

Mechanical Engineering Research Posters

ME01. Cooling and Heating Load Calculations in a Multi-Storied Educational Building

Saadman Bin Abdullah, Jessica S. Apel, and Bishrut Pokhrel
(Advisor: Dr. Aneesha Gogineni)

This paper details numerous calculations to determine whether the renovated building's HVAC system was up to code by total amount of heat gain and air flow (measured in Cubic Feet per Minute (CFM)) within the building. Cooling Load Temperature Difference (CLTD) method of load calculation and measurements were obtained from the engineering block as a part of a research. Research was conducted from the site in two different seasons, Fall of 2018 and Winter of 2019. Cooling load calculation from fall and heating load calculation in winter season provided a dynamic approach to varying load and climate that affected the energy consumption. Parameters like outside and room temperature, geographic position of building, occupancy etc., were significant for calculation of CLTD loads. Medium used for the heat transfer calculations were walls, glasses, partitions, floor, ceiling and overall any machinery equipment's that generated heat or provided change in room air flow pressure. Calculated data was then validated with the real operating data of the HVAC system for cross-reference purposes to ensure that HVAC system was meeting the required demand of the load during each season. Separate measurements were taken to obtain real operating data from the building's HVAC system after conducting load calculations. The theoretical and measured data were compared in Fall and Winter season which shows that the total heat gain and airflow within the building meets the building code standards for small class sizes. The cooling and heating loads, air flow rates in the building needs modifications for full class sizes.

ME02. Engineering Approach to Determine Indoor Air Quality at Different Schools

Zackary Maszatics (Advisor: Dr. Aneesha Gogineni)

Indoor Air Quality can be a major concern in workforce, schoolwork, and daily life. A major concern for Indoor Air Quality (IAQ) has arisen in the areas surrounding Saginaw Michigan. The research conducted involves testing for accelerated values of carbon dioxide, Toxic Volatile Organic compounds (TVOC), air flow, air exchange rates, and temperature. The IAQ testing is conducted inside classrooms at different schools using mechanical and electrical equipment. These acquired data is used to determine if the air is an adequate level of lean outdoor air inside the work setting. The IAQ is compared to the ASHRAE 62.1 building standard. The electrical equipment used in the testing process is designed by undergraduate students as part of their capstone project. Deviation in the test results and observed concerns will be shared with building management. The other objective of this research is to introduce STEM learning into all levels of schooling through this process. The testing methods used in this process utilize mechanical and electrical equipment. The activities assigned to students demonstrates how to use mechanical and electrical testing devices, analyze the difference in the equipment and teach ASHRAE standards. Overall, this research is conducted to analyze the indoor air quality in different schools and try to influence several students to choose STEM as their career path.

Electrical Engineering Senior Design Posters

E01. Automated Fault Injection Test System (AFITS)

Jeremy Bierlein and Nicholas Srebinski (Advisor: Dr. Rajani Muraleedharan)
Client: John Rombach, Nexteer Automotive

Nexteer's goal is to develop safe electric power steering systems for various original equipment manufacturers. To ensure safe products are delivered, Nexteer conducts electrical fault injection tests of connections to the circuit card assembly. Currently these electrical faults are manually induced and monitored. The weaknesses of the current testing system are caused by human variation which can lead to incorrect connections and timing errors. To improve the current system, a software-controlled module consisting of a switching circuit and a user interface will be designed to run repeatable tests. The proposed module will ensure that specific timing requirements within each test case are met and the electrical fault injections are accurately induced. The proposed system promises to improve Nexteer's testing functionalities by reducing the possibility of human error and increase the reliability and flexibility of the existing test system.

E02. Testing the Torsional Stiffness of an Intermediate Steering Shaft

Roseanne Albin, Abdulaziz Alhumoudi, Korbin Kovac, and Andrew Vivian
(Advisor: Dr. Rajani Muraleedharan)
Client: Steve Burk, Nexteer Automotive

An Intermediate Steering Shaft Energy Absorbing joint test-stand that can evaluate the torsional stiffness at the tube and intermediate shaft sub-assembly to detect part failures is critical for Nexteer Automotive industry. In this project, a unique and reliable electro-mechanical design prototype that requires control panel, torque sensors, motors, and other components to conform to specified constraints of the customer such as size and safety measures will be developed. Furthermore, a lab manual will be created so the prototype can be reproducible for larger scale manufacturing. The designed test stand will help Nexteer reduce scrap in plants, test torsional stiffness in Intermediate Steering Shafts, and monitor the integrity of the plastic injections in the energy absorbing joints. The Intermediate Steering Shaft torsional stiffness test stand promises to be a more reliable and efficient method of manufacturing Intermediate Steering Shafts for automotive industries.

E03. Electric Distribution Automation Loop

Rhishav Mahaju, Aaron G. Squanda, and Nina F. Day (Advisor: Dr. Rajani Muraleedharan)
Clients: Joshua Birchmeier and Katrina Casarez, Consumers Energy

Electric Distribution Automation Loop strives to improve customer reliability by minimizing the impact of power outages for Consumers Energy, a utility company which provides energy to 6.7 million residents of Michigan. The project focuses on planning and designing an automated system that transfers load between circuits when an outage occurs. The automation loop will be implemented in a location with the most benefit for a designated area. During a fault, the Electric Distribution Automation Loop operates to minimize labor cost and response time by switching portions of an impaired circuit to an alternate source, in order to decrease the outage duration for the customer.

E04. Single Location Multi-Device Enumeration System

Amina Shrestha, Habeeb Alqalaf, and Nick Israel (Advisor: Dr. Rajani Muraleedharan)

The intent of this senior design project is to research the latest Bluetooth (BT) and Bluetooth Low Energy (BLE) standards, how these standards are applied and the potential marketable applications that a well-designed sensor could benefit. Functions such as asset tracking, wayfinding and beaconing are broad in concept but are currently being researched and implemented, leaving room for continuous improvement. The proposed project will broaden the research background on the latest Bluetooth technology and seek to improve existing market applications; such as retail marketing, household asset monitoring, equipment inventory in fields of medicine and construction, to name few. The project includes researching new standards in BT and BLE protocols, while looking for solutions to existing shortcomings in terms of size, range and lack of interoperability with existing consumer electronics. A flexible PCB prototype that can provide basic asset tracking will be built, tested and validated. Lastly, combining short (BT/BLE) and long-distance (4G/LTE) communication technologies, a demonstrative intermediate management system will be constructed for a complete last-mile asset management solution. After implementation, validation testing will verify operability of the sensor and system as a whole, in relation to anticipated results. We are seeking a budget of $2243.41, which has been itemized.

E05. Rear Steer Mechanism for Cardinal Racing Team

Mohammad Albannawi and Nicholas Armstrong (Advisor: Dr. Rajani Muraleedharan)

Many advancements have been made in the vehicle industry throughout the years. Steering, however, has stayed [mostly] with a front wheel steer implementation. In addition to front steering, rear-steering systems provide greater stability and maneuverability. The proposed rear steer system utilizes hall position sensors, Arduino microcontrollers, linear actuators, and a digital control system. In the design, the tie rods of the provided rear assembly from the Cardinal race team have been replaced with linear actuators. The angle of the steering wheel is obtained using a sine and cosine wave from the two hall sensors and a programmed look up table to provide an arctangent calculation. The battery powered motor drive stage receives the angle and articulates the rear wheels up to six degrees in the opposite direction in response by servo control. Through the proposed implementation, minimal modification is required to obtain greater maneuverability and stability for existing small vehicles.

E06. Sensor-Controlled Prosthetic Arm

Alex Brzeczkiewicz, Tyler Sledz, and Brandon Schnieder
(Advisor: Dr. Rajani Muraleedharan)
Client: Romo Family
Collaborators: Dr. Tracy Zhang, Michigan State University
Janel Caverly, Bangor Township Schools

Prosthetics have been aiding disabled individuals for hundreds of years. The advances in technology over the last century have drastically changed the way prosthetics are made. The proposed, affordable and light-weight, sensor-controlled prosthetic arm design will feature a closed loop control system, using (a) sensors to detect user inputs such as muscle movements, (b) feedback sensors from motors to achieve movement of the extremities. At the end of the project, the designed prototype will be gifted to a child who is in need of a prosthetic arm. The project outcome promises to further the advancements made in the field of prosthetic design using engineering concepts. In addition, the experiential learning, in robotics and sensor technology, associated with the project will result in an increase in knowledge and refinement of skills required to succeed as an engineer.

Mechanical Engineering Senior Design Posters

M01. Magliner Hand Truck Redesign Project

Brandon Gigliotti, Connor Jacoby, Zachariah Morris, Dylan Ricky, and Nathan Vigneaux
(Advisor: Dr. Thomas Mahank)

Magline has built a legacy of innovation, quality, and value that customers trust. For over 70 years, Magline has manufactured premium, durable, and reliable material handling equipment tailored to larger commercial companies. The orignal Glyde hand truck works but has several drawbacks. The original friction pulley design limits a smooth descent to only a specific load range, whereas a braking system will allow smooth descents for varying loads. Another drawback to the original Glyde system is that several components are custom-made and expensive, which drives up the overall price.

A new track and latch system were designed, and braking architecture was integrated into the original Glyde hand truck so as to safely and efficiently traverse stairs. Refinement steps were implemented based on engineering practices to develop several concepts. Analyses were conducted on the hand truck consisting of load calculations derived from free-body diagrams. Finite element analysis was implemented to ensure the integrity of the designs. By dividing the project into two main sub-assemblies, the track and brake assembly, and the latching assembly, the best concepts of each were determined and ultimately will be combined as a final prototype.

M02. Storch Magnetics SuperMag Magnet Loader

Jacob Bowden, Haley Delestowicz, Zack Maszatics, Anthony Sainz, and Adam Tebbe
(Advisor: Dr. Brooks Byam)

Storch Magnetics is a Michigan based magnet company which produces a product called the SuperMag. The SuperMag is a front or tow behind magnetic device designed to remove ferrous debris from road shoulders, construction sites and other locations. Currently, the magnet installation process is done by hand, individually installing the magnetic bricks, creating a slow production rate and safety hazard to operators. The goal of the project is to create a device to aid in the installation of the magnets to increase production and safety of employees. This device must meet a set of requirements agreed upon by the design group and Storch Magnetics. The requirements include the size of the device, safety, device features, performance and budget.

M03. TEAMTECH Multi-Utility Release Buckle (MURB)

Jacob Avery, John Wojewoda, Jeremy Porzondek, Chase Wealther, and Braeden Perzanowski
(Advisor: Dr. Brooks Byam)

TEAMTECH Motorsports has been operating for nearly four decades to help motorsport amateurs and professionals alike make the best possible choice regarding safety equipment for their sport at minimal cost. Due to TEAMTECH's unique innovations in safety products a NASA engineer reached out to have TEAMTECH design and manufacture the multi-utility release buckle (MURB). The task is to optimize a preconceived prototype that facilitates the simultaneous disengagement of both the harness buckle and the three supplied utilities. In previous designs the utilities were all separate requiring multiple actions to release the buckle and all three utilities. The problem is defined by a set of measurable objectives. The objectives define the function, size, cost, features, safety and performance of the MURB. Economic impacts are the expected profits for TEAMTECH upon design and production of the product. The social impact of the MURB greatly enhances egress and survivability of life-threatening situations to the astronauts. Project defining and planning, concept generation and refining as well as concept selection will be covered.

M04. TEAMTECH New Generation Walking Crutch

Jessica Apel, Kyle Bruce, Connar Suing, and Shaun Yap
(Advisor: Dr. Brooks Byam)

TEAMTECH’s objective is to design a system that will bypass any leg loading from the foot to the acetabulofemoral joint. The New Generation Walking Crutch will be a hands-free medical aid to reduce the compressive load on the knee and acetabulofemoral joints, to quicken the recovery process, and to assist in everyday use after surgery. The Saginaw Valley State University mechanical engineering design team has partnered with TEAMTECH’s founder Mr. Curt Tucker to develop a New Generation Walking Crutch (NGWC). The impact of the NGWC design will be to mitigate the transition from surgery to full recovery after a leg, hip, knee, and bone impairment. The design team selected at modified version of a TEAMTECH safety harness as a waist belt for the NGWC. The full design will include the waist belt, hip hinge, knee hinge, foot plate insert with an ankle hinge, and aluminum tubing to connect them. The team will forward in developing refinements thorough analysis and experimentation.

M05. Duperon Corporation Saginaw Bay Deep Water Oxygenator
Christine Bannan, Collin Gaudinier, Marty Kabacinski, Tyler Schramski, and Steven Siemen
(Advisor: Dr. John Herman)

The problem outlined by Duperon Corporation is defined as the need to remove muck from the Saginaw Bay. The proposed solution is through means of oxygenating the water in order to aid in natural decomposition of the muck. The purpose of this project is to design a system that will minimize the muck by increasing the dissolved oxygen levels in the affected water. Increasing the dissolved oxygen levels will in theory, allow aerobic bacteria to reproduce and grow in order to be able to fully decompose the organic material.

M06. General Motors Gen V Cam Shaft Polisher and Reworking Machine
Blake Rivard, Taylor Neid, Henry Pfundt, Jake Mikulak, and Joseph DeGuise
(Advisor: Dr. Brooks Byam)

The General Motors Bay City Powertrain facility will be adding our offline polishing machine to their camshaft manufacturing line. If the final check of the camshaft, after the wash, is not within tolerance the part is rejected and scrapped. Until now, there was no way to process only the ‘sprocket diameter' of the camshaft which was contributing to the heightened scrap rate. The camshaft polishing machine will give General Motors the ability to reduce scrap from the current 4% scrap rate to the plant goal of a 1.8% rate. This will save them $50.00 per scrap part for an annual savings of $30,200.00.

M07. TEAMTECH Wheelchair Docking System
Leah Bosma, Jon Girvan, Garrett Hingston, Drew Jenkins, and Zach Putnam
(Advisor: Dr. Annamalai Pandian)

The Wheelchair Docking System project aims to provide paraplegic people the ability to safely travel in motor vehicles in an independent manor. If someone is not able to be independent based on their handicap, the system aims to reduce the time and work needed by an assistant to lock the occupant of the wheelchair to the docking base.

Morning Oral Presentation

Mathematical Sciences Oral Presentation — Pioneer-231

(11:00-11:15 a.m.)

Application of Euler Lagrange equation

Reecha Upadhyay (Advisor: Dr. Arundhati Bagchi Misra)

The researchers work on an application of Euler-Lagrange equation on dynamic optimization problems and mainly replicate The Career Decisions of Young Men and The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment published by Keane and Wolpin in 1997 and 2001 respectively. In the papers, Keane and Wolpin modeled the career decisions following the Bellman principle of optimization and they used the backward recursion method to find the numerical solution, The problem does not have a functional form for the solution. The researchers plan to do so by applying Euler-Lagrange equation using MATLAB. The Bellman Principle of Optimality by Ioanid Rosu links Euler-Lagrange principle to the Bellman principle and the researcher's work is informed by Rosu's paper. Rosu developed the Bellamn-Euler equation and the researchers plan to use the same to solve the problem. The forward difference method is used to obtain a numerical solution to this equation. The discreet functions of the Keane-Wolpin paper has been appropriately translated to use in the Bellman-Euler equation of Rosu and is used to obtain the results in the original paper.

Afternoon Oral Presentations

Oral Session A: Biology

Room: Pioneer-242

Presentations are 15 minutes each, starting at 1:00 p.m.

B01. DNA fingerprinting of Walleye (Sander vitreum) from Saginaw Bay: genetic effects of stocking
Aiden Van Loo (Advisor: Dr. David Stanton)

There is a large population of walleye in Saginaw Bay that is both economically and ecologically important. The population is heavily managed and was stocked extensively up until 2006. In order to properly manage this population and to determine the genetic effects of stocking, genetic information is required. We obtained fin clips from walleye captured in Saginaw Bay by trolling. With the help of the Department of Natural Resources (DNR), we also obtained samples from several spawning populations on Saginaw Bay and from the Muskegon River, which was the source of fingerlings used for stocking. In total, nearly 500 fin clips were obtained. DNA was extracted, using a DNeasy kit. PCR amplification and capillary electrophoresis were performed in order to determine genotypes for ten fingerprint loci. This data provides genetic markers that allow for the assessment of genetic diversity and population substructure, as well as the determination of important spawning sites, determination of spawning site fidelity and the genetic effects of stocking. This information will aid management decisions regarding future stocking programs. In the future, we also hope to assess how the population is changing over time, since stocking was ceased.

B02. GMO OMG: Detecting transgenes from genetically modified organisms in local crops and foods
Zachary Bolen (Advisor: Dr. David Stanton)

In this research project samples of local crops such as corn, soy, and sugar beets were analyzed. Samples of many processed foods such as tortilla chips and soy milk were also analyzed for evidence of transgenes present in genetically modified organisms. DNA extractions were performed using a DNeasy kit, followed by polymerase chain reaction (PCR) to amplify the target sequence. Appropriate positive and negative controls were used in order to insure the fidelity of amplification and to prevent contamination. PCR products were analyzed by agarose gel electrophoresis and DNA sequencing, in order to confirm their identity. Using these results, it was determined if the 35S promoter, common to commercially used transgenes, was present. It is important to detect the presence of transgenes in food products and crops because the horizontal transfer of these genes to other organisms could have unknown ecological impacts. It is also important that people have the right to know what they consume and the degree to which it has been modified.

Oral Session B: Electrical Engineering Senior Design **Room: Pioneer-240**

Presentations are 30 minutes each, starting at 1:00 p.m. (see Pages 15-17 for abstracts)

E01. Automated Fault Injection Test System (AFITS)
Jeremy Bierlein and Nicholas Srebinski (Advisor: Dr. Rajani Muraleedharan)
Client: John Rombach, Nexteer Automotive

E02. Testing the Torsional Stiffness of an Intermediate Steering Shaft
Roseanne Albin, Abdulaziz Alhumoudi, Korbin Kovac, and Andrew Vivian
(Advisor: Dr. Rajani Muraleedharan)
Client: Steve Burk, Nexteer Automotive

E03. Electric Distribution Automation Loop
Rhishav Mahaju, Aaron G. Squanda, and Nina F. Day (Advisor: Dr. Rajani Muraleedharan)
Clients: Joshua Birchmeier and Katrina Casarez, Consumers Energy

E04. Single Location Multi-Device Enumeration System
Amina Shrestha, Habeeb Alqalaf, and Nick Israel (Advisor: Dr. Rajani Muraleedharan)

E05. Rear Steer Mechanism for Cardinal Racing Team
Mohammad Albannawi and Nicholas Armstrong (Advisor: Dr. Rajani Muraleedharan)

E06. Sensor-Controlled Prosthetic Arm
Alex Brzeczkiewicz, Tyler Sledz, and Brandon Schnieder
(Advisor: Dr. Rajani Muraleedharan)
Client: Romo Family
Collaborators: Dr. Tracy Zhang, Michigan State University
Janel Caverly, Bangor Township Schools

Oral Session C: Mechanical Engineering Senior Design I **Room: Pioneer-245**

Presentations are 30 minutes each, starting at 1:00 p.m. (see Pages 18-19 for abstracts)

M01. Magliner Hand Truck Redesign Project
Brandon Gigliotti, Connor Jacoby, Zachariah Morris, Dylan Ricky, and Nathan Vigneaux
(Advisor: Dr. Thomas Mahank)

M02. Storch Magnetics SuperMag Magnet Loader
Jacob Bowden, Haley Delestowicz, Zack Maszatics, Anthony Sainz, and Adam Tebbe
(Advisor: Dr. Brooks Byam)

M03. TEAMTECH Multi-Utility Release Buckle (MURB)
Jacob Avery, John Wojewoda, Jeremy Porzondek, Chase Wealther, and Braeden Perzanowski
(Advisor: Dr. Brooks Byam)

M04. TEAMTECH New Generation Walking Crutch
Jessica Apel, Kyle Bruce, Connar Suing, and Shaun Yap
(Advisor: Dr. Brooks Byam)

Oral Session D: Mechanical Engineering Senior Design II **Room: Pioneer-247**

Presentations are 30 minutes each, starting at 1:00 p.m. (see Page 20 for abstracts)

M05. Duperon Corporation Saginaw Bay Deep Water Oxygenator
Christine Bannan, Collin Gaudinier, Marty Kabacinski, Tyler Schramski, and Steven Siemen
(Advisor: Dr. John Herman)

M06. General Motors Gen V Cam Shaft Polisher and Reworking Machine
Blake Rivard, Taylor Neid, Henry Pfundt, Jake Mikulak, and Joseph DeGuise
(Advisor: Dr. Brooks Byam)

M07. TEAMTECH Wheelchair Docking System
Leah Bosma, Jon Girvan, Garrett Hingston, Drew Jenkins, and Zach Putnam
(Advisor: Dr. Annamalai Pandian)