SCHOOL OF ENGINEERING

organized by department/start time

Design of an Enhanced Cellular Model for the Assessment and Tracking of Nanomaterials

School of Engineering: Chemical Engineering
Poster - Independent Research

PRESENTERS Maggie Elizabeth Jewett
ADVISORS Kristen Krupa Comfort
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Due to their unique physicochemical properties nanomaterial (NM)-based technologies are growing exponentially in scope and economic importance. This surge is resulting in significant degrees of NM waste and increased rates of human exposure. This has created a vital need to fully understand the potential biological consequences of NM exposure, characterize resulting NM-biological interfaces, and determine subsequent toxicological effects. The long-term goal of this project is to design, optimize, and implement an enhanced microenvironment model (EMM) to bridge this in vitro – in vivo gap and evaluate NM characteristics, pharmacokinetic/deposition profiles, and induced biological responses under physiologically relevant conditions. To date efforts have focused on the generation of the EMM which uses a perfusion plate platform containing cellular compartments interconnected by dynamic fluid movement produced via a peristaltic pump. While the EMM system can be tailored to any target organ/tissue, this proposal is focused on the flow of NMs from lungs (A549; human alveolar epithelial) to liver (HepG2; human epithelial) to skin (HaCaT; human keratinocyte), as inhalation is a primary form of exposure and NMs have been shown to accumulate in the skin. Additionally, the human monocyte (U937) cell line will circulate through all compartments allowing for immune analysis. Once complete and optimized this EMM system will be one of the first non-microfluidic models to simultaneously incorporate physiological influences and multiple cellular compartments to improve relevance and promote in vivo-like behavior.

The Effect of Porosity on Short Beam Shear Strength of Fiberglass Composites

School of Engineering: Chemical Engineering
Poster - Independent Research

PRESENTERS Kyle Alexander Lach
ADVISORS Charles E Browning, Donald A Klosterman
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The presence of porosity is a well known and difficult-to-avoid defect in laminated composite materials. Excessive porosity can significantly reduce the mechanical properties of composite structures and is therefore a source of concern. In this study we investigated methods of preparing fiberglass/epoxy composite panels with the goal of being able to control the amount of porosity in the final panel, e.g. some panels with low porosity, some with high porosity. The panels were then tested for short beam shear strength, which is a property that is usually heavily influenced by interlaminar porosity. Our results indicated that, for the material system tested, the strength values were reduced only when the amount of porosity achieved a very high level. This implies that a low level of porosity can be tolerated with this material system.

Performance Characterization of the GS-4 Gas Induction Impeller
School of Engineering: Chemical Engineering

Poster - Independent Research

PRESENTERS Shannon Marie Hoffman
ADVISORS Kevin J Myers, Eric E. Janz (NOV Mixing Technologies)
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

High interphase contact is essential to processes involving gas-liquid reactions, and can be accomplished using gas dispersion or gas induction. In gas dispersion, gas is sparged into the vessel below the impeller, and then dispersed throughout the liquid by agitation. Gas induction is an alternative approach, which uses a hollow impeller and shaft to draw gas into the liquid phase and distribute it throughout the vessel. The GS-4 impeller is a novel gas induction impeller that is unique due to its large openings in the impeller blades and generation of an axial flow pattern. This impeller is characterized based on the power number, pressure coefficient, and modeling of the induced gas flow rate. The power number at ungassed conditions is independent of impeller size and submergence, but is higher when up-pumping than down-pumping. This parameter decreases as gas is induced, and is modeled using the relative power number as a function of the relative speed. The pressure coefficient is examined using two approaches, one using speeds below the onset of induction and the other using the critical speed. Comparison of these methods shows that the pressure coefficient is more accurately determined independently of the minimum induction speed. This information is used to relate the available pressure difference to the gas flow rate. This relationship is affected by impeller diameter, with larger impellers inducing a higher flow rate than smaller impellers for a given pressure difference. The accuracy of this model is improved by assuming that the gas flow rate is also a function of the gas-liquid contact area within the impeller.

Study of Lithium Intercalation towards the Development of an Electrochemical Kinetic Model for Lithium/Copper Phthalocyanine Cell

School of Engineering: Chemical Engineering
Poster - Graduate Research

PRESENTERS Clayton Jerrel Cashion

ADVISORS Sarwan S Sandhu
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The development of high capacity batteries is necessary to increase the viability of renewable energy sources by providing efficient storage of excess energy. Therefore, currently the lithium ion batteries, with high charge storage capacity, are being further developed. In a lithium ion battery a reversible lithiated graphite is used rather than solid lithium as an anode. Research into high charge-storage capacity cells focuses on the cathode. Experimental investigations into high charge-storage capacity cathode active materials have indicated that copper phthalocyanine is one such material. Previous work involving copper phthalocyanine or other metal phthalocyanines has indicated that solid phase mass transport has a limiting effect on the lithium intercalation process, which is key to the operation of lithium ion batteries. Some models have been developed to describe the observed cell behavior, but the system is not yet fully understood. To ensure that the model formulation will best describe observable data, a literature search into lithium intercalation was conducted. A summary of the available understanding of this process and how we can apply this knowledge to the development of a lithium-ion battery with copper phthalocyanine as cathode active material is presented.

Electrokinetic Desalinization of Kaolin Soil with Acetic Acid

School of Engineering: Chemical Engineering
Poster - Independent Research

PRESENTERS Ronald Christopher Knapp
ADVISORS Robert J Wilkens, Christopher Athmer (Terran Corporation)
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Sodium and chloride both dissolve in water and are carried into the ground by precipitation runoff. This runoff pollutes the soil, negatively impacting wildlife and vegetation. The use of electrokinetic remediation (EKR) techniques has been demonstrated to remove salt, heavy metals, and other contaminates from soil. One issue during the process is that chloride ions buildup near the anode, and are not removed. This experiment was performed to determine if using acetic acid as the cathode fluid during EKR would remove this buildup and increase the total amount of chloride removed. Three acrylic tubes were packed with kaolin clay with an initial concentration of 8000ppm NaCl. Each tube used tap water as the anode purge solution. The cathode purge solution was initially tap water; after two days, the purge solution for Tubes 2 and 3 were switched to 0.1M acetic acid and 0.5M acetic acid, respectively. The electrodes were flushed at a rate of 50.00?L/min. The tubes were hooked up to a DC power source providing 15V for 11.5 days. Ion selective electrodes, a spear-tipped pH probe, and a handheld multi-meter were used to collect data. 55.8% of the chloride ions were removed from Tube 1, 56.7% from Tube 2, and 53.1% from Tube 3. Tube 3 also had the greatest concentration of chloride ions remaining near the anode at 9220ppm. As the concentration of acetic acid increased, the amount of chloride remaining near the anode increased. The use of acetic acid did not affect the overall removal of chloride ions.

Thermal Engineering for Flexible, High-Power Electronics

School of Engineering: Chemical Engineering
Poster - Graduate Research

PRESENTERS Katherine Morris Burzynski
ADDITIONAL AUTHORS E. W. Blanton, N. R. Glavin, E. R. Heller, M. Snure, E. Heckman (WPAFB Research Laboratory); C. Muratore (University of Dayton)
ADVISORS Christopher Muratore
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Consumers and military personnel are demanding faster data speeds only available through fifth generation (5G) wireless communication technology. Furthermore, as wearable sensors and other devices become more ubiquitous, devices demonstrating enhanced flexibility and conformality are necessary. The challenge is to enable electronic devices to withstand strain and continue to operate within an acceptable tolerance to ensure reliability. A fundamental challenge for flexible electronics is thermal management. Even on rigid substrates with 100 times higher thermal conductivity than polymeric and other flexible substrates, the full potential of semiconducting materials is often thermally limited. The flexible gallium nitride (GaN) high electron mobility transistors (HEMTs) employed in this work are grown on a two-dimensional boron nitride (BN) release layer that allows the conventionally processed devices on sapphire wafers to be transferred using a polymeric stamp and placed onto a variety of rigid and flexible substrates. Characterization of the GaN device behavior on the as-grown sapphire wafers (not transferred) provide a baseline for evaluation of the thermal performance. Transferring the GaN devices to flexible substrates enables application of strain during device operation; however, device performance typically suffers due to the low thermal conductivity of most polymeric substrates, requiring more advanced schemes to remove waste heat from device operation. In situ thermal imaging of devices in operation reveals that the current passing through a non-transferred GaN transistor on a sapphire wafer reaches the target operating temperature at twice the current of the same device transferred to a flexible substrate. Packaging environment simulations and consideration of device-substrate interfacial thermal effects allow for an understanding of how the flexible GaN devices operate after they are transferred to a substrate and show the path forward for substrate design to reduce thermal limitation of high-power flexible electronics.

Effect of Stabilizing Agent Concentration on the Development of Renewable-Magnetic Nanocomposites

School of Engineering: Chemical Engineering

Oral Presentation - Graduate Research

PRESENTERS Frankie Ann Petrie
ADVISORS Erick Vasquez
LOCATION, TIME Kennedy Union 331, 10:30-10:50

Magnetic nanoparticles are attractive materials due to their ease of manipulation under the presence of a magnetic field and their inherent superparamagnetic properties. In order to produce a stable colloidal solution of magnetic nanoparticles, several encapsulation mechanisms or stabilizing agents have been proposed. In this work, iron oxide-lignin nanoparticles were synthesized using a co-precipitation method and a self-assembly mechanism in alcohol/water mixtures using Kraft lignin in twenty percent ammonium hydroxide solutions. The effects of five different ratios of iron to lignin solution were analyzed in the syntheses process, four changing the amount of lignin used, one changing the concentration of iron used. The particles were characterized by DLS, TEM, UV-Vis, FTIR, and zeta potential analyses. The hybrid nanoparticles showed an average diameter around 200 nm. TEM images of the particles displayed encapsulation of iron oxide within the lignin. The results of this research show that superparamagnetic iron oxide nanoparticles coated with lignin were successfully synthesized. The outstanding properties of lignin as a renewable material, which could be used as antioxidant, UV adsorbent, antimicrobial agent, or biomaterials conjugate, make the lignin-magnetic nanocomposite a unique substrate for a plethora of future investigations.

Electrochemical Quartz Crystal Microbalance Studies of Lignin in Aqueous Solutions

School of Engineering: Chemical Engineering
Oral Presentation - Independent Research

PRESENTERS Grace Ann Docken, John Flynn
ADVISORS Erick Vasquez
LOCATION, TIME Marianist Hall Learning Space 218, 12:30-12:50

An Electrochemical Quartz Crystal Microbalance (EQCM) uses an electric potential to induce oxidizing or reducing conditions for electrochemical synthesis and analysis. One application of EQCM applies a series of voltages to a sample and measures the corresponding current generated in the solution being analyzed. This application, known as Cyclic Voltammetry (CV), provides insight into properties such as molecular mass, impedance, and film thickness. Both EQCM and CV have been used in the characterization of polymers and various biomaterials. In this study, lignin—a naturally occurring polymer—was deposited on gold-coated substrates in a buffer solution. The corresponding lignin thin-film was characterized at various concentrations in the presence of a reducing agent, thus altering the pH of the buffer solution. The effect of ascorbic acid and polyvinylpyrrolidone (PVP) as reducing agents on the assembly of lignin to gold substrates was measured using EQCM and CV. With this study, we can determine the redox properties of lignin in various aqueous solutions of differing pH. These results provide insight into the conditions required for lignin self-assembly under a pH-controlled environment.

Characterization of Zinc-Histidine Interactions in Nvjp-1

School of Engineering: Chemical Engineering
Poster - Graduate Research

PRESENTERS Brittanie M Rooths
ADVISORS Rajiv Berry, Kristen Krupa Comfort
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The mandible of Nereis virens, a marine sandworm, is mostly organic with stiffness and hardness comparable to that of human dentin. Nvjp-1 is the primary protein in the Nereis jaw and is inherently Histidine rich. Histidine contributes to the stability of the protein structure and superior mechanical properties through metal-coordinate bonds. Crosslinking of purified recombinant Nvjp-1 creates a water stable hydrogel that is capable of expanding and contracting upon exposure to various ions. Nvjp-1 hydrogels exhibit sclerotization through metal-coordination with divalent cations. Over ninety percent of the amino acid sequence of the carboxy-terminal of Nvjp-1 is comprised of only four amino acids. In order to determine the genetic/protein motifs directly responsible for the mechanical response, a carboxy-terminal truncation mutant of Nvjp-1 was recombinately expressed and crosslinked to form hydrogels. Dynamic mechanical analysis was performed on the carboxy-terminal truncation mutant to compare its mechanical properties to that of the full-length protein. De Novo structure prediction was performed using Molecular Dynamics simulations as a technique for determining native protein structures. The role of Zn-Histidine interactions in Nvjp-1 and their effect on protein structure was also investigated.

Initial Study of Novel Flame Retardants For Epoxy Resin Systems

School of Engineering: Chemical Engineering
Poster - Graduate Research

PRESENTERS Abdulhamid Ali Bin Sulayman
ADVISORS Vladimir A Benin, Donald A Klosterman, Alexander B Morgan
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

This poster describes the initial investigation of the reaction between a novel flame retardant (FR) and epoxy resin. The novel chemical (synthesized and provided by UD Chemistry Department faculty) is a phosphorus-based flame retardant that also

incorporates primary and/or secondary amine functional groups. These groups potentially could react with epoxy resins, which would then incorporate this FR chemical directly into the polymer network through covalent bonding. This would be a way of introducing flame retardants into epoxy resins to improve flammability of composites. Initial research was conducted using Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), and Fourier Transform Infrared Spectroscopy (FTIR). The results indicate that the flame retardant is indeed reacting with the epoxy resin to form a crosslinked network. Future work will involve characterization of the cured epoxy-FR network for physical properties, mechanical properties, and flammability.

Applications of Gas Chromatography with Headspace Autosampler

School of Engineering: Chemical Engineering
Poster - Independent Research

PRESENTERS Paul Robert Maricocchi
ADVISORS Yvonne Y Sun, Erick Vasquez
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The identification and quantification of chemical compounds in a mixture aids in the analysis of a broad range of processes ranging from chemical separation processes to biological separations. In an effort to enhance interdisciplinary collaboration across Units and Departments within the University of Dayton, we seek to understand and develop Gas Chromatography (GC) and Headspace-GC (HS-GC) analytical methods for use both in the classroom and research. The overall goal of this research is to present a summary and explanation of the variables that are manipulated in a GC equipment for the development of characterization methods. Calibration curves will be used to quantify compounds from different samples. Specifically, the methods and calibrations will focus on: (1) analyzing ethanol content in aqueous and organic mixtures, which ultimately can be applied to chemical engineering unit operations such as distillation and fermentation; (2) characterizing the efficiency of liquid-liquid extraction processes, which will be characterized using HS-GC; and (3) a biological application towards characterizing SCFA (short chain fatty acids) content in Listeria metabolites present in mice feces. This is an interdisciplinary project scheduled for this coming summer with Dr. Sun of the Biology Department, along with Dr. Vasquez of the Chemical Engineering Department. Ultimately, this research will culminate in an Honors Thesis that will help to obtain various GC methods for a variety of processes.

Combinatorial Effects of Silver Nanoparticles and Hypoxia on Lung Cells

School of Engineering: Chemical Engineering
Poster - Independent Research

PRESENTERS Cameron Mark-Allan Crasto
ADVISORS Kristen Krupa Comfort
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Silver nanoparticles are used in a variety of both consumer and medical applications. They possess antimicrobial properties that can stress mammalian cells through the formation of reactive oxygen species (ROS). This experiment looked at A549 human lung alveolar cells with exposure to 10nm silver citrate nanoparticles (AgNPs) in both a normal oxygen environment and hypoxic environment. Cell viability, formation of ROS, as well as the phosphorylation of both HSP27 and NF?B. In both environments, concentrations of 5µg/ml saw significant reduction in cell viability. There was a slight loss in cell viability in the hypoxic environment. The hypoxic environment saw significant increases in ROS at concentrations as low as 0.1µg/ml. In addition, when exposed to 5µg/ml of AgNPs, it was shown to increase phosphorylation of the HSP27, but reduce the phosphorylation of NF?B proteins, which play a crucial role in the stress level of a cell. (We are going to execute another experiment this week, which would combine exposure to AgNPs and low O2 - 10% CO2 on the A549 cell line. Once we get this data, we will update the abstract and be ready for the presentation.)

Using and Implementing Continuous Stirred-Tank Reactors and Plug Flow Reactors to Study Reactions in Undergraduate Chemical Engineering

School of Engineering: Chemical Engineering
Poster - Course Project, 201810 CME 499 01

PRESENTERS Alex Robert Paschal
ADVISORS Michael J Elsass, Erick Vasquez
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Understanding the behavior of Continuous Stirred-Tank Reactors (CSTR) and Plug Flow Reactors (PFR) is vital to graduates of the University of Dayton's Chemical Engineering Program. This primarily is due to the widespread usage of these reactor types in commercial settings; therefore, students should be exposed to 'hands-on' laboratory experiences with these type of reactors prior joining the Chemical Engineering workforce. Realizing that the Unit Operations Laboratory is a capstone class, and it lacked adequate education on such reactors, experiments were developed and performed on both types of reactors to establish empirical standards of reaction kinetics and rates that can be used to guide the education of future undergraduate chemical engineering students. Overall, the CSTR and PFR reactors were used to develop theoretical and empirical understandings of the reactor systems based on calibration of reactor system mechanics; non-reactive qualitative experiments; and bimolecular-reactive experiments. Specifically, the saponification reaction between Sodium Hydroxide and Ethyl Acetate producing Sodium Acetate and Ethyl Alcohol was the primary reaction analyzed in this work. As a quantitative result, models of the studied reaction in both types of reactors were developed and compared. In addition to this common experiment, reactions for future studies to be tested by undergraduate

students using green solvents and reactants are suggested. Ultimately, this work will lay the foundation of chemical reactor analysis in the Unit Operations Laboratory at the University of Dayton.

Understanding the effects of double activated carbon, desorption temperature and time, and possible ethanol decomposition during desorption on Solar Thermal Adsorption Refrigeration (STAR) system

School of Engineering: Chemical Engineering
Poster - Graduate Research

PRESENTERS Bipin Karki
ADVISORS Jun-Ki Choi, Amy R Ciric
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The off-grid location and unreliable electricity supply to medical clinics in remote parts of India make it difficult to safely store vaccines and other medications using traditional refrigeration systems. The Engineers in Technical Humanitarian Opportunities of Service-learning (ETHOS) program at the University of Dayton, in collaboration with Solar Alternative and Associated Programmes (SAAP) of Patna India, are developing a novel refrigeration system which works on the principle of solar thermal adsorption. This refrigeration system does not require electricity for operation and uses safe, environmentally benign and locally available adsorption pair of ethanol-activated carbon. A bench-scale prototype was developed at the University of Dayton using ethanol-activated carbon as working pair which can generate evaporative temperatures between 20C and 80C. The existing horizontally oriented system can achieve targeted refrigeration temperatures (2-80C) during the adsorption cycle and ethanol can be desorbed from the activated carbon during desorption. However, the horizontal geometry inhibited the return of liquid ethanol to the evaporation chamber. A new vertical oriented bench scale system was built to addresses the limitation of the original prototype. The effects of double activated carbon on evaporative cooling, heating temperature and time during desorption, and possible decomposition of ethanol during desorption was analyzed. The evaporator temperature -12.70C achieved during the experiments indicates better adsorptive cooling with double activation technique of activated carbon. Experimental results suggested better desorption happens at elevated temperature (105 - 1150C) and most of the desorption happens in the first 2 hours of heating the activated carbon chamber. The pressure drops on ethanol side pressure gauge reading during desorption and analysis of mass spectroscopy of desorbed ethanol obtained from the chemist showed possible decomposition of ethanol preventing multiple cycle operation of the system.

Real-time camera tracking and 3D scene reconstruction based on pose graph

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Ruixu Liu
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The 3D reconstructed maps can be used in many applications such as robot navigation, augmented reality and virtual reality. 3D maps for the environment has been developed using RGB-D sensor data that provides color and depth information. RGB-D camera noise, fast camera movement, and rotation introduce drift in the reconstructed 3D maps. If the scale of the 3D model increases, the drift error is also accumulated which can affect the final 3D model performance. A good way to reduce the drift is loop closure detection which is based on visual place recognition. It is an extremely challenging problem to solve in the general sense. First, a place recognition system must have an internal representation of a map of the environment to compare to the incoming visual data. Second, the place recognition system must report a brief about whether or not the current visual information is a place already included in the map, and if so, which one. If the loop closure detects successful, we could use the loop closure pose to correct current camera pose to enhance the camera tracking accuracy and 3D model performance.

Development of the Numerical Attenuation Factor for a Spiral Antenna affected by Spurious Modes

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Joseph Vinci
ADVISORS Robert P Penno
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

This poster details the work performed in the 2017 SURE Program under Dr. Robert Penno. The objective is to improve Dr. Penno's model for the four arm, Archimedian spiral antenna in the presence of spurious modes by developing an attenuation constant. This constant is derived from the principles of a transmission line with shunt loads in the place of the arms of the antenna with spurious modes. The results are prepared to be analysed by Dr. Penno and the effectiveness of the constants on the radiation pattern of the antenna will be examined in future work.

An Efficient Leaf Recognition Based Approach for Plant Classification Using Machine Vision Strategy

School of Engineering: Electrical and Computer Engineering
Poster - Course Project, 201780 ECE 695 04

PRESENTERS Redha Ali, Russell C Hardie
ADVISORS Russell C Hardie
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The identification of plants is very important component of workflows in plant ecological research. Therefore, in this work, we are developing a novel automatic leaf recognition for plant classification. Unlike the existing techniques, our approach is efficient, fast, and simple. The proposed method is based on machine vision strategy that employs two main processing stages: 1) the Bag of Feature (BoF) approach, and 2) a decision-making model based on multiclass Support Vector Machine (SVM) classifier. The BoF is utilized for extracting the features from representative images. First, to provides excellent scale invariance break up the image into sub-regions by using speeded up robust features (SURF) detector. Then, compute the histogram of local detected features inside each sub-region. After that to create the visual words and to reduce the number of features, the K-means clustering approach is applied. The final sets of features are fed to a decision-making model based SVM classifier for automatic plant identification. Experimental results on several publicly available leaf datasets demonstrate that the effectiveness of the proposed method for plant classification compared to a set of state-of-the-art methods.

Authentication Of the Internet of Things Devices Over ZigBee Networks

School of Engineering: Electrical and Computer Engineering
Poster - Independent Research

PRESENTERS James Patrick Althoff
ADVISORS Feng Ye
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

IOT, or the Internet of Things, is the inter-networking smart devices, buildings and other embedded systems to enable them to transfer data between them. This data can be used for various uses such as power management and home automation. Current projections of the Internet of Things predicate that the use of this technology will increase dramatically within the foreseeable future. Many of these devices are currently being implemented using protocol such as Bluetooth and ZigBee. ZigBee is a wireless communication protocol based on the IEEE 802.11.4 standard. ZigBee was created for low power devices, such as those that run on batteries, with the industrial settings being among the common implementation of ZigBee enabled devices. The project focuses on improving the ZigBee protocol, specifically in the authentication section of the protocol.

Multi-Feature Fusion Approach for Object Classification on Oil/Gas Pipeline Right-of-Ways

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Ming Gong
ADVISORS Vijayan K Asari, Almabrok Essa
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Pipeline right of way (ROW) monitoring and safety pre-warning is a vital way to guarantee safe operation of the oil/gas transportation. Any construction equipment or heavy vehicle intrusion is a potential safety hazard to the pipeline infrastructure. Therefore, we propose a novel technique that can detect and classify any intrusion on oil/gas pipeline ROW. The detection part has been done based on our previous work, where we built a robust feature set to represent an object from two parts. Firstly, we divide an image into two circular regions with linearly increasing areas and pyramid levels. Then the histogram of the local feature is extracted for each sub-region and in multiple pyramid levels. After that a support vector machine with radial basis kernel is used to detect objects. For the classification part, the object can be represented by a robust fusion feature set, which is a combination of three different feature extraction techniques, histogram of oriented gradient (HOG), local binary pattern (LBP), and the color histogram of HSV (hue, saturation, value). Then a decision making model based support vector machine classifier is utilized for automatic object identification. It is observed that the proposed method provides promising results in identifying the objects that are present on the oil/gas pipeline ROW.

Aircraft Generator Design and Analysis

School of Engineering: Electrical and Computer Engineering
Poster - Honors Thesis

PRESENTERS David Gross
ADVISORS Kevin Yost (WPAFB Research Laboratory), Guru Subramanyam
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Aircraft electrical power demands have been rapidly growing due to an increased amount of electrical load onboard aircraft. This increased load has come about as electrical sources for various aircraft subsystems, such as pumps, compressors and flight controls, replace mechanical sources. The main source of electrical power on an aircraft is a generator. The power demand on an aircraft is not constant, but rather dynamic, and the nature of these power demands causes increased temperatures and complex/dynamic loads, for which many contemporary generators are not designed. Because of the need for high amounts of reliable electrical power

among future aircraft, future generators should be designed for reliability, stability, power density and long-term durability. The objective of this thesis project is to determine if generator sizing techniques (e.g. equations, assumptions, rule-of-thumb metrics) can be calculated to a reasonable accuracy for preliminary machine design optimization and analysis.

A Survey of Tundra Lake Size Changes During Around 40-year Time Interval Observed in Historical Maps and Satellite Images

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Ming Gong
ADVISORS Vijayan K Asari, Almabrok Essa, Ivan A Sudakov
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Greenhouse gas emissions from tundra lakes are a significant positive feedback to the atmosphere in a changing climate as a pronounced growth of the numbers of tundra lake patterns has been observed in the Arctic region. Detailed knowledge of changes in tundra lakes size is potentially valuable in order to understand and accurately model the sources of greenhouse gas emissions. Therefore, we are using historical maps and satellite images with time interval around 40-year to show a study of tundra lake size changes. We have developed a novel algorithm framework that is employing three main processing stages: lake detection, lake segmentation, and lake size computation. In the first stage of the framework, there are two different approaches, one is for detecting the lakes on historical maps that is a color-based segmentation technique, and another one is for detecting the lakes from satellite images which is a decision-making model based on support vector machine classifier (SVM). The second stage of the algorithm is a region growing approach that is applied for the detected lakes from both historical maps and satellite images, to segment the actual lake size. The last stage is calculation the lake size which is applied for the final segmented lakes from both historical maps and satellite images. It is based on connected component analysis strategy, which calculates the lake size in terms of number of pixels. Experiments performed on changes in lake size over time in a set of lakes that were visually matched in both the historical map and the satellite imagery demonstrate that some lakes in our study region have increased in size over time, whereas others have decreased in size over time. Lake size change during this time interval can be up to half the size of the lake as recorded in the historical map.

Optimization of Wireless Electroceutical Dressings in Wound Healing for Burn Victims

School of Engineering: Electrical and Computer Engineering
Poster - Independent Research

PRESENTERS Nilan Mani
ADVISORS Amy T Neidhard-Doll
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The purpose of the proposed interdisciplinary research is to investigate how the electrochemistry of Wireless Electroceutical Dressings (WEDs) can be optimized to fight infection and promote healing in the wounds of burn victims. One of the most common secondary complications is infection, since bacteria and microbes are able to enter the human body freely in the absence of a protective layer of skin. Infection has been determined to be the leading cause of death in approximately 61% of all reported burn victim cases. Once inside the body, bacteria readily form biofilms to shield themselves from antibiotics and increase resistance to treatment by humans. As a result, an anti-biofilm treatment method is necessary to eliminate the biofilm barrier that currently exists when treating disease. A proof of concept for the nanofabrication of an alternative, Biomimetic Wireless Electroceutical Dressing (BWED) that increases bacteria-disruptive microcurrents through optimization of electrode design (material, geometry, volume, and/or circuitry) will be discussed. This feasibility study entails monitoring the growth of various bacterial colonies cultured from common locations in the environment (e.g. cell phone, door knob, elevator buttons) in the presence of various BWED configurations. The research will attempt to show whether BWEDs work better at decreasing the growth of bacteria colonies when compared to a control group with no BWED present. This information will be used to determine the most promising electrode designs to optimize and fabricate in the future.

Study of Electrolyte/Electrodes Interface Engineering in Solid State Lithium-Ion Batteries

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Ashish Gogia
ADDITIONAL AUTHORS Priyanka Bhattacharya, Badri Shyam
ADVISORS Jitendra Kumar, Guru Subramanyam
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

There is a growing need for high energy, high power and safe lithium batteries for myriads of applications in powering microelectronic devices (such as smart cards, implantable medical devices, wearable electronics) to large power applications such as electric vehicles, aerospace and space equipments. One key requirement for such batteries is packing high energy in low form factor (i.e. thin-film form) to increase both the gravimetric and volumetric energy densities. Lithium superionic conducting solid ceramic electrolytes are the most prominent candidates amongst liquid, gel, polymer and solid ceramic electrolytes that can enable safety and optimum performance in a high energy density battery with thin-film cell components. For example, lithium aluminum germanium

phosphate (LAGP) has been proven to be a promising solid-electrolyte due to its high ionic conductivity (~ 5 mS/cm at 23 °C), high electrochemical stability window (> 5V), and single Li+ ion conduction (high transference number, no dendrite formation, no crossover of electrode materials), thus enabling high energy battery chemistries and mitigating safety and packaging issues of conventional lithium batteries. However, application of solid-electrolyte (LAGP and others) in Li batteries is being hindered by lack of understanding of thin-film fabrication techniques/parameters, mechanical stability, and poor stability between solid ceramic electrolyte and electrodes, especially with Li metal anode. Low chemical stability between solid electrolyte and Li electrodes forms resistive interface (lower conductivity) which is detrimental for high power and cell longevity. We present materials and methods for electrolyte/electrode interface engineering that have shown promise but need further investigation. One such promising stable interface material is lithium phosphorus oxynitride (LiPON), when introduced as thin-film in between LAGP and Li reduces interface resistance (increase conductivity) considerably. Details on material's thin-film fabrication techniques such as sputtering, physical vapor depositions, etc. and their resultant effects on solid-state battery performance will be presented.

On-chip memristor training with detailed op-amp circuit

School of Engineering: Electrical and Computer Engineering
Oral Presentation - Graduate Research

PRESENTERS Baminahennadige Rasitha Fernando
ADVISORS Tarek M Taha
LOCATION, TIME Kennedy Union 310, 11:00-11:20

Neural networks have gained and renewed widespread attention in recent years due to large volumes of data generation in almost all fields. This led to development of Deep Neural Networks (DNNs), which have demonstrated significantly better classification on image recognition and other datasets than previous techniques. DNN algorithms have two phases: training and inference that typically run on graphics processing units (GPUs). The training phase is much more computationally challenging, therefore it is difficult to implement it on low power systems. There is an urgent need for new systems that can provide real-time data processing with high power efficiency. Implementing learning on low power systems can open-up a broad new set of applications – particularly in making systems more smart and secure. Nanoscale analog devices called memristors can be used for this specific purpose, which can execute computations in parallel and consume small area and low power. These characteristics in the computing system allows implementation of the training of DNNs, consuming about x10000 times less energy than a GPU. In literature, fix gain op-amp circuits are suggested in memristor crossbar-based learning. Due to frequent change in the resistance values of the crossbar at weight update (will affect the op-amp gain function) causes the neural network training to fail in a circuit level implementation. A detailed op-amp circuit has been proposed to improve memristor neural training. Two and four odd parity tests at different discretized pulse width provided significant results. This detailed circuit and device analysis of the op-amp implementation may serve as a foundation for further circuit-level studies.

Human detection on omnidirectional camera imagery by multi-feature fusion based on gradients, color and local phase information

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Hussin Khalifa A Ragb
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Field of view of the traditional camera is limited such that usually more than three cameras are needed to cover the entire surveillance area. The use of multiple cameras usually require more efforts regarding camera control and set up as well as they need additional algorithms to find the relationships among the images of different cameras. In this research work, we present a multi-feature algorithm that employs only one omnidirectional camera instead of using multiple cameras to cover the entire surveillance region. Here we use the image gradients, the local phase information based on phase congruency, the phase congruency magnitude, and the color features. These features are fused together to build one descriptor named as "Fused Phase, Gradients and Color features (FPGC). The image gradients, and local phase information based on phase congruency concept are used to extract the human body shape features. Either LUV or grayscale channel features are used according to the kind of camera used. The phase congruency magnitude and orientation of each pixel in the input image is computed with respect to its neighborhood. The resultant images are divided into local regions and the histogram of oriented phase, and the histogram of oriented gradients are determined for each local region and combined. A large pool of the candidate features is randomly generated for one channel of the phase congruency magnitude and three LUV color channels. All these features are fed to a decision tree Adaboost classifier for training and classification between the classes. The proposed approach is evaluated on a challenging omnidirectional dataset and observed promising performance.

A Low Power High Throughput Architecture for Deep Network Training

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Yangjie Qi
ADVISORS Tarek M Taha

LOCATION, TIME RecPlex Main Gym, 3:00-4:15

General purpose computing systems are used for a large variety of applications. Extensive supports for flexibility in these systems limit their energy efficiencies. Neural networks, including deep networks, are widely used for signal processing and pattern recognition applications. This poster presents a digital multicore on-chip learning architecture for deep neural networks. It has memories internal to each neural core to store synaptic weights. A variety of deep learning applications can be processed in this architecture. The system level area and power benefits of the specialized architecture are compared with an NVIDIA GEFORCE GTX 980Ti GPGPU. Our experimental evaluations show that the proposed architecture can provide significant area and energy efficiencies over GPGPUs for both training and inference.

Model Predictive Control Energy Dispatch to Optimize Renewable Penetration for a Microgrid with Battery and Thermal Storage

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Ibrahim Aldaouab
ADVISORS Malcolm W Daniels
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

As intermittent renewable energy becomes a larger fraction of the overall energy mix in the US, algorithms that efficiently utilize this energy are necessary. In this work, a model predictive control (MPC) method is developed to perform real-time optimization to maximize the power delivery from a renewable supply to a building. An isolated microgrid scenario is considered, consisting of a mixed-use residential and commercial building, renewable power supply, battery storage, hot water tank thermal storage, and a backup supply. The MPC strategy utilizes predictions of the building's electrical and hot water loads, on an hourly basis, along with predictions of the output from the renewable supply. At each time step, these predictions are used to create an optimized power dispatching strategy between the microgrid elements, to maximize renewable energy use. For a fixed size microgrid, the performance of this MPC approach is compared to the performance of a simple non-predictive dispatching strategy.

Brain Machine Interface Software Application for Data Collection, Thought Analysis, and Robotic Arm Control

School of Engineering: Electrical and Computer Engineering
Poster - Capstone Project

PRESENTERS Jason Demeter, Alexander Robert Jereb, Clayton T Kern, Brad Richard Sorg, Jamie Stanton
ADVISORS Vijayan K Asari, Garrett Craig Sargent
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The overall purpose of the ongoing Brain Machine Interface (BMI) project is to develop an electroencephalography (EEG) interface and a robotics control application which will further enable people with disabilities to achieve autonomy. The project consists of developing, building, and testing an end-to-end system to translate raw EEG data into actionable information. This can be used to control a robotic arm and for other research purposes. A BMI is a system that collects the brain's electromagnetic signals by utilizing sensors, extracts meaningful signals from the data, classifies thoughts, and ultimately uses thoughts as an input to a computer system. The computer system then has the ability to control hardware and software, which for this project is a robotic arm. The team improved the robotic arm user interface, developed a graphical user interface (GUI) for thought recognition, and explored future research paths by partnering with local experts. To improve the usability of the robotic arm user interface, the team developed software that allows easier performance of useful activities, such as using a pen to play tic-tac-toe, playing piano, and picking up objects. The Insight headset by Emotiv was used by the team for data collection. The headset can stream real time EEG data and control signals, however the Emotiv software solution for data collection is closed and proprietary. To use the Vision Lab's noise reduction and muscle signal removal algorithms, the team created a GUI to train the thought classification system and collect and process the data. EEG phoneme detection is a future research path that allows for thought to speech translation. The team investigated EEG phoneme detection by implementing algorithms which can identify phoneme sounds from audio recordings. Using these working algorithms, further research will implement phoneme detection using only EEG signals with no audio.

The Application of Neurologically-Controlled Robotics to Actuated Feeding Arms

School of Engineering: Electrical and Computer Engineering
Poster - Honors Thesis

PRESENTERS Timothy Edward Dombrowski
ADVISORS Raul E Ordonez, Temesguen Messay Kebede
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The medical industry is constantly performing research and trying to combat various diseases that afflict humans. Despite advancements in technology, there still remain diseases that have no cure but seem prime candidates for neurologically controlled robots. One such category of diseases consists of various muscular dystrophic diseases. Diseases such as ALS and Parkinson's have limited options regarding treatment, but by brain controlled interfaces (BCI's), robotics can help mitigate the impact on a patient's quality of life. By utilizing a functioning mind, an electroencephalographic (EEG) helmet can be used to control various exoskeletal systems

and even prosthesis in order to compensate for a damaged motor system. Through the use of neurologically controlled robotics, a user's motor control and motor strength can be rehabilitated and maintained despite the effects of muscular dystrophic diseases. The goal of this project is to use this experiment to demonstrate the current effectiveness of brain actuated robotics and telepresence that utilize an EEG Sensor. From this assessment, recommendations and further improvements can be made to this existing technology for it to be better suited for electrical engineering and biomedical applications, while simultaneously taking the technology into a new realm of application.

Variable Stiffness Series Elastic Actuator for Collaborative Robots

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Manoj Kumar Sharma
ADVISORS Raul E Ordonez
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Robotic manipulators with joints that are capable of precisely monitoring the instantaneous torque are currently being used in collaborative robots. These robots are safe to work alongside human beings, and execute tasks that rely on force control. A spring is placed in series inside a robotic joint actuator deflects as per the torque transfer; this information is then used by the controller to control the robot as needed. Based on this key idea, a new device is invented wherein the spring stiffness can be servo-controlled. An intelligent controls scheme is developed that helps to create a safe collaborative workspace.

Convolutional Neural Network Based Multi-view Object Classification

School of Engineering: Electrical and Computer Engineering
Poster - Graduate Research

PRESENTERS Zhiyuan Xie
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

In recent years, neural networks have become more and more popular because of their outstanding performance in the object classification area. The convolutional neural network (CNN) is a deep learning, feed-forward neural network that has excellent performance in visual imagery analysis area. The idea of the connectivity pattern between neurons of the CNN came from the organization of the animal visual cortex. For human vision, different observational directions of objects can get different views. Human can easily recognize objects in different observational directions, but machines cannot achieve this easily. Therefore, multi-view object classification has been researched for many years. To solve this problem, we design an efficient CNN architecture to perform classification of the multi-view images of objects by appropriately choosing the number of layers, the sequence of layers cascading, and size of the filters. Then, we improve the classification performance by adding image enhancement techniques before CNN as a preprocessing stage. CNN extracts various significant features of the image. It is expected that an enhanced image helps to extract stronger features. The training and testing input images of the CNN are original images or enhanced images. The image enhancement is performed by nonlinear enhancement techniques such as multilevel windowed inverse sigmoid (MWIS) function based technique or a locally tuned sine nonlinearity (LTSN) technique. It is observed that the preprocessing by image enhancement provides improved performance in the cases of the smaller training set. Research work is in progress to modify the CNN architecture to see the impact of recognition performance for multi-view object classification. Advanced non-linear enhancement technologies might also be investigated to see the effectiveness in classification.

Mobile Sensor Lab

School of Engineering: Electrical and Computer Engineering
Poster - Independent Research

PRESENTERS Brandon Mckenzie Hampshire
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The Vision Lab has many projects that involves data collection from various sensors. These sensors can vary by platform and programming language. In order to centralize data collection, the Robot Operating System (ROS) is applied to the Clearpath Husky robot. The Husky is made for multi-terrain transport and can be modified to carry multiple sensors. The Robot Operating System is not an operating system but is a network centralized library. ROS provides background services and different language libraries that allow sensors and languages to communicate to a common location. In addition, the libraries can let the user to receive data from the central network thus allowing multiple cross language platform communication. An application of these components can assist in data collection for environment 3D reconstruction. Environment 3D reconstruction requires depth imagery, RGB imagery, and orientation of the camera. The Husky provides estimated orientation to ROS and ROS supports the Microsoft Kinect. With open source coding, the Husky can be coded to collect the necessary data for 3D reconstruction.

Deep Neural Network Based on FPGA

School of Engineering: Electrical and Computer Engineering

Poster - Graduate Research

PRESENTERS Shuo Zhang
ADVISORS Tarek M Taha
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

With the rapid proliferation of computing systems and the internet, the amount of data generated has been increasing exponentially. This includes data from mobile devices, where almost all information is now becoming computerized, and science experiments, where large simulations on supercomputers are increasingly becoming the norm. With this massive increase in data, a key issue is how we process and make sense of this data. This is called the "Big Data" challenge.Deep learning is a class of mathematical algorithms that is now heavily used for Big Data analytics. These algorithms are based on very large scale neural networks. One of the key challenges with deep learning is that it requires massive computing power. At present clusters of high performance graphics cards designed primarily for computing (known as GPGPUs) are used for these tasks. A key problem with clusters of GPGPUs, is that they consume large amounts of energy, thus making it difficult to scale existing massive computing systems to future Big Data volumes.The deep neural network designed by Parallel Cognitive Systems Laboratory is based on application specific integrated circuits (ASIC), which provides high performance at reasonably low power consumption. However, these are extremely expensive to fabricate. The Field Programmable Gate Array (FPGA) is a type of integrated circuit that can be reconfigured to implement a large range of arbitrary functions according to application requirements. FPGAs are much cheaper than ASIC and consume less power than CPU and GPU. The objective of this proposal is to develop deep learning network based on FPGA. I will optimize the whole design to make it more suitable for the deep learning. Several pattern recognition applications which use deep learning will be used to test and evaluate the design.

Building a high temperature 4-point probe to study GST phase transition material

School of Engineering: Electro-Optics and Photonics
Oral Presentation - Graduate Research

PRESENTERS Pengfei Guo
ADVISORS Imad Agha, Andrew M Sarangan
LOCATION, TIME Fitz Hall 580, 1:20-1:40

Phase change materials (PCM) use the reversible phase change between crystalline and amorphous phases by Joule heating via electrical or optical sources. The chalcogenide material GST is the focus of this work. This material has different optical and electrical properties in amorphous and crystalline phases, allowing it to be used in optical and electrical switching devices. Such as reconfigurable phase retarders and polarizers.We are going to build a high temperature probe to study the resistivity of the deposited GST films. The electrical properties of thin films are determined by their chemical composition, the content and type of impurities in the thin film or on its surface, crystal structure of the thin film and the types and density of structural defects. The measurement of thin film sheet resistivity via two point probe method which inadvertently introduces errors due to probe resistance, spreading resistance and contact resistance between probing tips and the samples. On the other hand, the commercial probing devices are expensive while the principle of mechanics is simple. Due to the above limitations. This high temperature probe can give us the ability to study the resistivity of GST thin film in-situ.

Directional Emission of Light in Hyperbolic Metamaterials through Spin-Orbit Interaction

School of Engineering: Electro-Optics and Photonics
Oral Presentation - Graduate Research

PRESENTERS Hongwei Chen
ADVISORS Qiwen Zhan
LOCATION, TIME Fitz Hall 580, 1:40-2:00

Metamaterials are artificial media engineered to have the unusual electromagnetic (EM) properties that are not found in nature. We demonstrate a dipole with circular polarization located in an isotropic material, right against a metamaterial with a hyperbolic dispersion relation in two dimensions, the EM waves will be guided into two different directions dependent on the polarizations of the incident illumination. It is crucial to control the photonic emission by single emitters in nanophotonic systems for quantum information processing. The presented work of spin controlled directional emission introduces a new route to steer the direction of the EM waves, which also provides a great opportunity for compact polarization-tunable unidirectional manipulation of EM waves and nano-particles. Other applications may exist in arbitrary polarization detection.

Probing Metal-Induced-Gap-State Electrons and Photon-Assisted-Tunneling Electrons at Metal-Insulator Interfaces by Harmonic Generation

School of Engineering: Electro-Optics and Photonics
Oral Presentation - Graduate Research

PRESENTERS Raihan Hussain
ADVISORS Imad Agha, Joseph W Haus
LOCATION, TIME Fitz Hall 580, 2:10-2:30

The ubiquitous presence of metal-insulator (MI) and metal-insulator-metal (MIM) interfaces in electronic and optical devices make

them technologically very important and necessitate an understanding of their fundamental properties. We experimented on Insulator/Au and Au/Insulator/Au interfaces. First, the insulator (Al2O3 or ZnO) layer was deposited on planar Au samples using atomic layer deposition (ALD) technique to form MI interface. Later, Au nanoparticles (AuNP) of diameter 10nm were immobilized on the insulator layer to prepare MIM interface. SHG and THG from both of these interfaces were used for our analysis. The goal of our experiment is twofold: a)Measuring delocalized electron density at MIGS using SHG, b) Measuring field enhancement due to PAT theory using the changes in THG as well as no-change in SHG efficiencies.

A Risk Analysis Framework for Evaluating On-Site Wastewater Treatment Systems

School of Engineering: Engineering Management, Systems, and Technology
Poster - Independent Research

PRESENTERS Alexis Latise Wingfield
ADVISORS Kellie R Schneider, Dr. Rodney Williams
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The Beaver Water District in Lowell, AR provides clean, safe drinking water to more than 300,000 residents in Northwest Arkansas. As a water utility, the Beaver Water Department is concerned with the potential of on-site systems (septic tanks) contaminating Beaver Lake – the area's primary source of drinking water. The purpose of this study is to develop a framework to assess the risk potential of on-site wastewater treatment systems in the Beaver Lake Source Water Protection Area. Through a multi-year collaboration, more than 2,400 septic tank permits across two counties have been located, digitized, and used to create a geodatabase. Information from the geodatabase including the geophysical characteristics and system design of each septic tank are considered when assessing a system's risk of contaminating Beaver Lake. Our risk framework, initial risk assessment, and potential intervention areas are presented.

Performance Evolution of GPU versus CPU in Iterative algorithms

School of Engineering: Engineering Management, Systems, and Technology
Poster - Independent Research

PRESENTERS Hassan Ali Alsaad
ADVISORS Mohammadjafar Esmaeili
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

High-performance computing is one of the most demanding technologies in today's computational world with a variety of applications such as big data analysis, and solving complex computing algorithm. Engineers have invented multiple technologies such as CPUs, GPUs, GGPUS, FPGAs, clusters and distributed high-performance computational systems for high-performance computing. This research has focused on evaluating GPU and CPU two of the main technologies that could be used in high-performance computing.The researchers have developed a methodology to evaluate the performance of GPU and compare it with CPU under different test subjects. Finally, this research illustrated the power and weaknesses of GPU over the CPU under certain circumstances.

Using Strategic Business Process Architecture Models to Create a Process Architecture Reference for the Healthcare Industry

School of Engineering: Engineering Management, Systems, and Technology
Poster - Independent Research

PRESENTERS Baxter Rechtin
ADVISORS Sandra L Furterer
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Strategic Business Process Architecture (SBPA) models identify the key elements and their relationships that can be used to document, design and improve operational processes across any process type or industry. The critical SBPA process architecture elements was previously combined with a traditional process map to develop a novel process architecture mapping tool enabling the capture of important elements needed to design streamlined processes. The goal of this research project is to apply the process architecture meta models and the process architecture mapping tool to the healthcare industry, and subsequently develop a standard healthcare process architecture reference model. The process architecture reference model can be used by healthcare organizations as a basis for process management, including to document, design and improve their processes to provide excellent patient care.

Desert Storm 1990

School of Engineering: Engineering Management, Systems, and Technology
Oral Presentation - Independent Research

PRESENTERS Hussain A M H H Alhabib, Abdulaziz Almajed, Mostafa Mohammad Almousawi, Ali S A M H M Baqer
ADVISORS Sean Albert Falkowski, Scott J Schneider
LOCATION, TIME Kennedy Union 310, 10:30-10:50

the presentation will be about desert storm (The Iraqi invasion of Kuwait) in 1990. the power point technique will be used and the full story will be presented. The war is also known under other names, such as the Persian Gulf War, First Gulf War, Gulf War I,

Kuwait War, First Iraq War or Iraq War, before the term "Iraq War" became identified instead with the 2003 Iraq War (also referred to in the US as "Operation Iraqi Freedom"). The Iraqi Army's occupation of Kuwait that began 2 August 1990 was met with international condemnation and brought immediate economic sanctions against Iraq by members of the UN Security Council. Together with the UK's prime minister Margaret Thatcher (who had fiercely resisted the invasion by Argentina of the Falkland Islands a decade earlier), George H. W. Bush deployed US forces into Saudi Arabia, and urged other countries to send their own forces to the scene. An array of nations joined the coalition, forming the largest military alliance since World War II. The great majority of the coalition's military forces were from the US, with Saudi Arabia, the United Kingdom and Egypt as leading contributors, in that order. Kuwait and Saudi Arabia paid around US$32 billion of the US$60 billion cost.Two of the presenters will explain their part of the story as they were there.

Rapid Prototyping and Development for The Internet of Things

School of Engineering: Engineering Management, Systems, and Technology
Oral Presentation - Course Project, 201810 ECT 465 01

PRESENTERS David Alexander Alfano
ADVISORS Mohammadjafar Esmaeili
LOCATION, TIME Kennedy Union 207, 1:00-1:20

Development for and around internet connected devices and sensors has exploded over the past two years, and as a result companies are rushing to bring new connected devices to market. Rapid prototyping of product concepts is a crucial part of this process, and there are a variety of free and low cost tools available to aid engineers, developers, and individuals with prototyping. This presentation will focus on the $35 Raspberry Pi single board computer and the free Node-RED graphical programming suit to demonstrate the speed and ease with which ideas for internet connected devices can be implemented, proved, and tested, both on a hardware and software level. Participants will leave this presentation with the knowledge needed to obtain data from a variety of sensors and then analyze, visualize, and store that data to the cloud.

Leadership and Diversity of Professionals Working in Healthcare

School of Engineering: Engineering Management, Systems, and Technology
Poster - Graduate Research

PRESENTERS Emily E Kloos
ADVISORS Sandra L Furterer
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

This study relates to previous research done to find out why women engineers leave engineering. It is said that women make up more than 20% of engineering school graduates and yet only 11% of practicing engineers are women, despite various efforts to address the gender gap. Through research, it has been found that many women engineers move from manufacturing and other engineering facilities to service industries such as Healthcare. The purpose of this research is to take the past research done and find out if women engineers working in Healthcare face the same issues as the women engineers in manufacturing or similar environment. 58% of the Healthcare companies are non-profit, 22% are owned by government and 20% are investor owned. There are about 3100 hospitals in Health systems in the United States. Healthcare centers in the United States will be contacted through e-mail, LinkedIn or by appointment. The research topic will be discussed with the management/HR teams at each center to see if they are interested to participate in this study. A survey has been created to distribute to the participating centers. The target respondents for this study are women with an undergraduate degree in engineering but will also use other men and women currently working in Healthcare. We are expecting over 30 Healthcare centers to participate and will compare results of those who never entered engineering field to women who had worked in an engineering field in the past. The survey results will be collected through Google Forms and the results will be compared to the findings in previous research articles.

Cluster Computing with the Raspberry PI

School of Engineering: Engineering Management, Systems, and Technology
Poster - Course Project, 201780 ECT 466 01

PRESENTERS Ali Hussain Alwahimed
ADVISORS Mohammadjafar Esmaeili
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

No abstract submitted.

Performance Evolution of GPU versus CPU in Iterative algorithms

School of Engineering: Engineering Management, Systems, and Technology
Poster - Independent Research

PRESENTERS Hassan Ali Alsaad
ADVISORS Mohammadjafar Esmaeili
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

High-performance computing is one of the most demanding technologies in today's computational world with a variety of

applications such as big data analysis, and solving complex computing algorithm. Engineers have invented multiple technologies such as CPUs, GPUs, GGPUS, FPGAs, clusters and distributed high-performance computational systems for high-performance computing. This research has focused on evaluating GPU and CPU two of the main technologies that could be used in high-performance computing.The researchers have developed a methodology to evaluate the performance of GPU and compare it with CPU under different test subjects. Finally, this research illustrated the power and weaknesses of GPU over the CPU under certain circumstances.

Waiting and Service Time Optimization During Lunch at Milton-Union Elementary School Cafeteria, Dayton, OH

School of Engineering: Engineering Management, Systems, and Technology
Poster - Capstone Project

PRESENTERS Saud Abdulaziz M Alshaikh, Emma Raye Trappe
ADVISORS Sandra L Furterer, Daniel J Zalewski
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Long waiting time by itself is a bad experience, but when you couple it with a limited available time to have lunch, that is a recipe for disaster. Milton-Union Elementary School found this out the hard way, as they were trying unsuccessfully to run their lunch process in a timely manner. Apparently, dealing with little, hesitant, uncertain kids about their meal choices, along with the constraint of time was a bit hard to intake by the teachers and lunch worker, ending up with kids being yelled at and continuous complaints by the teachers.There are high school and middle school students in the same building. They are using the same cafeteria for their lunch and they eat before the elementary school. The management stated that the only problem being encountered is with the elementary school students finishing their lunch effectively in a timely manner. There are 679 students in the elementary school distributed over 32 classes. Each class has 30 minutes for lunch followed by another 30 minutes for recess. To manage all schools lunch timing, all students at elementary school must finish their lunch within 90 minutes starting at 11:25 AM. Two lines are there to serve the students and all classes are scheduled to be released in batches with two classes per batch. Those batches are separated by 3-5 minutes as an effort to reduce the long-stacked waiting queue, which normally considered as part of that 30 minutes of lunch. Each lunch line has two servers and one cashier, except for line 2 where there is one more cashier for a limited time only (from 11:25 AM to 12:20 PM). Management believes that elementary students need at least 20 minutes to eat their lunch, otherwise they will consume less of their entrees, vegetables, and milk which means that the kids won't meet their nutritional needs. Moreover, this often leads having an unsatisfied child for the rest of the day beside the posed long-term health risks to students. Unfortunately, management tried several improvement tactics to have the waiting and service time not exceeding 10 minutes with no success. As stated by the management, that time may exceed 15-20 minutes which is usually associated with teachers being tense and nervous beside having a chaotic environment.Other problems have been disclosed by the management as well. Dining space was one of those problems as there are not enough seats for all students. There are 16 handicap accessible seats that are currently not utilized at all. Too many choices for entrees was one of the problems as well. A third one was the layout of the cafeteria lines that could be improved. The objective of this research is to maintain the average time of waiting plus service to be equal to or less than 10 minutes by April 23rd, 2018. The research will consider the future growth as well of the elementary school to its recorded capacity.

Advance cooling feedback system

School of Engineering: Engineering Management, Systems, and Technology
Poster - Course Project, 201751 ECT 408 61

PRESENTERS OMAR Mohammed Alokali
ADVISORS Mohammadjafar Esmaeili, Jim E Globig
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

it is an advanced cooling feedback control system, attached with a motor control..

Data Mining Approach for Estimating Residential Attic Thermal Resistance from Aerial Thermal Imagery, Utility Data, and Housing Data

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Salahaldin Faraj Alshatshati
ADVISORS Kevin P Hallinan
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Conventional residential building energy auditing needed to identify opportunities for energy savings is expensive and time consuming. On-site energy audits require quantification of envelope U-values, air and duct leakage, and heating and cooling system efficiencies. There is a need to advance lower cost automated approaches, which could include aerial and drive-by thermal imaging at-scale in an effort to measure the building U-value. However, the thermal imaging approaches implemented to date, all based upon thermal-physical models of the envelopes, to estimate the U-values of walls require additional measurements and analysis prohibiting low-cost, at-scale implementation. This research focuses on interpreting aerial thermal images to estimate the U-value of roofs. A thermal-physics model of a ceiling is developed to show the difficulty in using the same approach used by others for walls, as new parameter estimates and thus more measurements would be required. A data-based methodology instead is posed. This approach integrates the inferred roof temperature measurement, historical utility data, and easily accessible or potentially easily accessible

housing data. A Random Forest model is developed from a training subset of residences for which the ceiling U-values are known. This model is used to predict the roof U-values in a validation set of houses with unknown U-value. Demonstrated is an ability to estimate the attic/roof U-value with an R-squared value in the range of 0.96 using as few as 24 training houses. The implication of this research is significant, offering the possibility of auditing residences remotely at-scale via aerial and drive-by thermal imaging

Determining Recovery Response to Slips on a Slip Trainer

School of Engineering: Mechanical and Aerospace Engineering
Poster - Honors Thesis

PRESENTERS Stephen Thomas McFadden
ADVISORS Kim E Bigelow
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Common injuries in the elderly population often result from slipping or falling. A slip is a loss of balance which may lead to an injurious fall. To counter these falls, proactive balance training, which focuses on preventing slips from occurring through physical therapy and environmental modifications, has been tried with mixed results. Reactive balance training, which can increase how well an individual can recover once their balance is upset by a disruption, is a novel method to decrease injuries from falls. However, current reactive balance training is conducted in academic environments with highly expensive equipment. While this training has proved productive, a need has arisen for this reactive slip training to be helpful in clinical settings and provided at a reduced cost. This project is centered around work to design, build, and test a low-cost slip trainer to measure the recovery response of individuals in terms of a reactive step.

Analyzing the Factors of Performance: Is There a More Precise Way for Trainers to Score an Individual's Form During Exercises?

School of Engineering: Mechanical and Aerospace Engineering
Poster - Honors Thesis

PRESENTERS Amanda Nicole Delaney
ADVISORS Kim E Bigelow
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

As part of a collaborative project, our overall research aim was to gain a better understanding of factors that contribute to successfully predicting performance in a variable environment. My research concentrated on adding objectivity for evaluating the effectiveness of training exercises and assessments that are performed and normally scored based on an expert's rating. The Lock and Load exercise, which resembles the bird dog exercise but is done in a high plank position, was the focus of this study. Biomechanical marker data was recorded with an Xsens Awinda 17 sensor suit for comparison to the ratings of form assigned by the trainer. Analyzing the center of mass and maximum acceleration of the individual allowed for examination of how well the person was balanced, controlled, and in sync throughout the test. This data was then used to determine the accuracy of the form ratings given by the certified trainer involved in the project. Results suggest that other sensor-based outcomes may need to be incorporated in training exercises to provide a better picture that equates to the expert's rating. Analysis of jerk, hip rotation, and coordination plots are the next steps in determining the relationship between the expert's form rating and the true form.

Data Mining of Smart WiFi Thermostats to Develop Multiple Zonal Dynamic Energy and Comfort Models of a Residential Building

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Abdulrahman Mubarak Q Alanezi, Kefan Huang
ADVISORS Kevin P Hallinan
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Smart WiFi thermostats have gained an increasing foothold in the residential building market. The data emerging from from these thermostats is transmitted to the cloud. Companies like Nest and Emerson Climate Technologies are attempting to use this data to add value to their customers. This overarching theme establishes the foundation for this research. This research seeks to utilize WiFi data from the Emerson Climate Technologies' Helix test house to: develop a dynamic model to predict real time cooling demand and then apply this model to running 'what-if' thermostat scheduling scenarios with the ultimate goal of reducing energy use in the residence or responding to high demand events. The Helix residence, with two thermostat controlled zones for each floor, exists in a temperature/humidity controlled external environment, which can be controlled to simulate environmental conditions present in the hottest to coldest climates. A Design of Experiment approach was used to establish data needed for the model. The control variables in the experiments included: levels for the exterior environmental schedule and levels for the interior setpoint schedules for both zones. Simply, this data enabled data collection for constant or cyclical exterior environmental conditions and constant and scheduled interior setpoint conditions, not necessarily the same for each floor. From this data, a regression tree approach (Random Forest) was used to develop models to predict the room temperature as measured by each thermostat, as well as the cooling status for each zone. The models developed, when applied to validation data (e..g, data not employed in training the model) R2 values of greater than 0.95. Then, the models developed were utilized for various 'What if' scenarios. Two such scenarios were considered. The first looked at the possibility of using the model to estimate comfort in a demand response event, e.g., when the grid manager

calls for demand reduction. In this case, the heat pump providing cooling would be powered off for some time. The second scenario sought to quantify the cooling savings from use of higher thermostat setpoint during simulated non-occupied periods and for different exterior temperature schedules. The 'What if' predictions are validated with experimental data, thus demonstrating the value of the data-driven, dynamic data solely from smart WiFi thermostat information.

Understanding the Impact of Fuel Volatility and Viscosity on Gas Turbine Engine Ignition

School of Engineering: Mechanical and Aerospace Engineering
Poster - Independent Research

PRESENTERS Katherine Claire Opacich
ADVISORS Joshua S Heyne
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

In the current alternative jet fuel certification process, approximately $3-4 million and 20,000-100,000 gallons of fuel are used over a three to five year period to evaluate the behavior of new blends of fuel within engines. This extended process is not only costly but also carbon intensive. The National Jet Fuels Combustion Program's (NJFCP) mission is to streamline the certification process of alternative jet fuels, which is controlled by a fuel's operability limits for select ignition and lean blowout conditions. For ignition, the propensity of a fuel to ignite is limited by its ability to form a flammable mixture with air near a spark kernel. The fuel properties of viscosity and volatility largely govern this reaction because of their influence on the mean droplet size and vaporization rate, respectively. This research aims to achieve a thorough droplet modeling analysis and surrogate generation that imparts key information about whether viscosity or volatility is the fundamental factor in ignition performance. The proposed work will also supplement the NJFCP's goal of assessing the behavior of alternative fuels within combustors with minimal engine testing. Success of this research will assist the NJFCP in their efforts to accelerate the alternative fuel certification process, promote the de-carbonization of aviation jet fuels, and produce next generation high performance fuels.

Analyzing the Use of Pressure Sensing Shoe Insolesfor Biomechanical Research

School of Engineering: Mechanical and Aerospace Engineering
Poster - Independent Research

PRESENTERS Kevin Michael Nowacki
ADVISORS Timothy Reissman
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The foot is an especially intricate piece of the already complex human body. In biomechanical research, gait is a popular research topic, but it is hard to demonstrate¬–or even understand–how the foot articulates. Motion capture is a common way to attempt to analyze how the foot works during gait. This method has shown major improvements in understanding the human foot, but has many limitations. There can be variation on where markers are placed, which lead to varying kinematics, which leads to inconsistent results. A pressure sensing insole could assist in understanding multi-segment foot kinematics. This would allow pressure mapping of the foot throughout the gait cycle. There are limited people and studies that have looked at pressure mapping of the foot through gait using insoles. In collaboration with a company called SensingTex out of Spain, I am experimenting with their product in development to analyze if it could be useful for future biomechanical research. This research will hopefully validate the device, and show it can accurately detect how people are distributing their weight across their foot. The ability to see how and where the pressure is being dispersed throughout the foot during gait can open a lot of doors and create many opportunities for other research moving forward. This research is a pilot study to analyze how the device works, and if it is a viable option for understanding multi-segment foot kinematics. Through initial testing, it was found that the sampling rate of the sensors is not fast enough to get an adequate number of samples during a foot strike. The next steps include increasing the sampling speed of the sensors, and continue testing to compare these data.

Wearable Cardiac Monitoring

School of Engineering: Mechanical and Aerospace Engineering
Poster - Independent Research

PRESENTERS Sarah V Miller
ADVISORS Timothy Reissman
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

Arrhythmias, or irregular heartbeats, are a very common problem. In the United States alone, it is estimated that more than 850,000 people are hospitalized each year for arrhythmias. One of the most common arrhythmias is atrial fibrillation. Atrial fibrillation is a quivering heart beat that can lead to serious issues such as blood clots and strokes. There are several existing products, such as Fitbits and Apple Watches, that are working towards being able to detect and alert users of possible atrial fibrillation. This project looks into how to improve existing technology as well as how to modify it to detect other forms of arrhythmias.

Energy GPA in Student Neighborhood

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Saroj Bhattarai
ADVISORS Kevin P Hallinan
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

The University of Dayton houses almost 90% undergraduate student in on-campus residence. The university charges a fixed amount to every student for a semester, that amount covers the utility bills for that semester and no penalty charges even if they waste energy. This may lead to unnecessary use of energy like turning light on when the residence is empty and setting the thermostat set point constant every time. These behaviors can be controlled if an incentive is offered to the students that motivate them to use energy efficiently. This is possible in UD due to unique nature of university housing with separate gas and electric meter. A mathematical model is developed in R-software using the historical electrical and gas usage data from utility provider DP&L and Vectren respectively. This model helps to disaggregate the weather dependent and weather independent energy use. The actual energy use is compared with the baseline, heating and cooling energy use of the student residence. A report card is developed to provide the student with the feedback about their energy usage status and their residence's energy saving level in the student neighborhood. This energy performance report card is sent to every resident via email which contains energy grade for natural gas, electricity and overall energy grade, residence rank in student neighborhood for energy saving, winning residence, and tips for improving the energy grade in the successive months. The residents of the winning residence are awarded a t-shirt and an article of the winning residents in a flyer news as a part of this program to incentivize them. After the implementation of this program, 5 to 10% of carbon emission saving is achieved through natural gas saving and some carbon emission saving in available from electricity saving due to change in student behavior toward energy use.

Design of a Body-Powered, Variable Strength and Conformable Shape Prosthetic Hand

School of Engineering: Mechanical and Aerospace Engineering
Poster - Honors Thesis

PRESENTERS Zhipeng Jiang
ADVISORS Timothy Reissman
LOCATION, TIME RecPlex Main Gym, 9:00-10:15

People with below elbow amputations often wear a body-powered prosthesis due to its affordable cost and the fact that it can improve their ability to do daily activities. While this technology is functional, it poses difficulties when trying to work with a range of different objects. The focus of this work is to improve its versatility by engineering both variable grip strength and changeable gripper shape capabilities into the device. Through mechanism design, the new prosthesis will have user-selected force options, thereby being able to hold objects of different masses. Additionally, exploring conformable-topology gripper designs will enable the ability to be able to grab items of diverse shapes and textures.

Walker Light for Improved Mobility in Older Adults: Effects and Recommendations

School of Engineering: Mechanical and Aerospace Engineering
Porch Project - Honors Thesis

PRESENTERS Lauren Marie Rivera
ADVISORS Kim E Bigelow
LOCATION, TIME 413 Stonemill Road, 11:00-11:15

As a direct response to a need in our community, this project sought to evaluate the effectiveness of a lighting device for older adult walker users. A staff member at St. Leonard Retirement Community in Centerville approached our team about residents having issues with current walker designs. This thesis focuses specifically on the testing related to the lighting device portion of the larger SmartWalker project. This part of the study sought to compare how older adults who regularly use rolling walkers navigate in darkened environments, such as getting up at night to use the restroom, with and without the walker light device on. To complete this comparison, rolling walker users were studied as they performed a series of walking tasks. These included a walking-speed trial and an object identification trial. Each task was performed under multiple lighting conditions, ranging from daylight to almost completely dark. Speed and distance showed some changes when the lighting device was used, but these changes were not significant increase in mobility when the lighting device was used, compared to when it was not in use. There was no correlation between participant rating of confidence and mobility outcomes. The small number of participants and the great variation of lighting among the different testing locations were factors. The participants confirmed they benefit from increased light, and the majority would be willing to attach and charge the device regularly. Also, 86% of participants agreed that the lighting device was as good as, or better than, using a night light in their room at night. Although the results were not significant under the testing conditions used, in-home testing with more participants should be conducted to determine if lighting devices would aid in increased mobility.

The STEM Gender Gap: An Evaluation of the Efficacy of Women in Engineering Camps

School of Engineering: Mechanical and Aerospace Engineering
Porch Project - Honors Thesis

PRESENTERS Malle Rea Schilling
ADVISORS Margaret Frances Pinnell
LOCATION, TIME 418 Stonemill Road, 11:30-11:45

It is not uncommon to see a class full of engineering students with very few women in the room. To combat this gender gap,

colleges and universities have employed outreach programs and developed summer engagement opportunities that allow women to explore engineering before they graduate high school. To understand how these programs affect the women who participate in them, a research study was conducted to evaluate the effects week-long engineering camps had on participants through a disseminated survey and observations of activities at both a single-sex female camp and a co-ed camp. Additionally, interviews were conducted with leaders of engineering camps at universities across the nation to better understand the programming and purpose of engineering camps.

Out of Site, Out of Mind: An Assessment of State-Level Siting Policies for Wind Power Generation Facilities

School of Engineering: Mechanical and Aerospace Engineering
Oral Presentation - Honors Thesis

PRESENTERS Madalyn Ann Beban
ADVISORS Kevin P Hallinan
LOCATION, TIME Kennedy Union 312, 11:30-11:50

The growth of the on-shore wind industry in the United States over the past decade alone has been monumental, yielding an eight-fold increase in national generation capacity. Economic incentives at the federal and state level coupled with technology advances influencing turbine operation have kept wind energy as a actionable choice for domestic power generation. With increased installations comes conflict. As projects are sited, a greater number of interactions with local communities and ecosystems occur. This project intends to address the conflict between project developers and community members by analyzing state-level wind farm siting policies nationwide. exploring approaches that balance the interests of landowners, community members, industry participants, and relevant stakeholders. Meeting current installation trends with policy that mitigates negative externalities on project surroundings can be done by governing bodies seeking to address these desires.Current siting policies at the state and county levels, where energy generation facility siting authority lies, were examined to locate possible systemic changes in the permitting process. Negative externalities from project siting, specifically social and environmental impacts on project surroundings, were identified. Following this, policy alternatives were compared in order to make recommendations for the best possible approach for creating equity as wind power spreads. With the goal of identifying policy actions for a more equitable siting process, options including permit streamlining, decision deadline implementation, and residential compensation plans, are recommended moving forward.

Affecting the Wingtip Vortex by Influencing Wing Surface-Flow Direction

School of Engineering: Mechanical and Aerospace Engineering
Oral Presentation - Independent Research

PRESENTERS Nathan Robert Thomas
ADVISORS Sid Gunasekaran
LOCATION, TIME Kennedy Union 211, 12:30-12:50

The aerodynamic efficiency of a NACA 0012 AR 4 wing was affected through periodic contours aligned in the flow direction resembling a “wrinkled” texture. Streamwise and cross-stream Particle Image Velocimetry (PIV) were conducted at the University of Dayton Low Speed Wind Tunnel around Reynolds number of 135,000 on the NACA 0012 AR 4 wing with and without surface contours. Wings with 6 contour sections was designed by spline fitting two NACA 0012 airfoil profiles in the spanwise direction. Both 2D (wall-to-wall model) configuration and 3D configuration of the wings were tested to determine the effects of surface contours on the parasite and induced drag of the wing. Streamwise PIV results indicated an increase in momentum deficit in the wake of the mid-contour region due to enhanced boundary layer separation from the upper surface of the mid-contour region. The cross-stream PIV results indicated a decrease in the magnitude of azimuthal velocity, circulation and RMS quantities in the wingtip vortex with the surface contours. The reduction in the wingtip vortex properties indicates that the contours were effective in blocking the spanwise flow feeding into the wingtip vortex on the surface of the wing.

Autonomous Sumo Bot Tournament

School of Engineering: Mechanical and Aerospace Engineering
Interactive Competition - Course Project, 201810 MEE 298 02

PRESENTERS Matthew Thomas Adkins, Bander Saleh Al Yami, Abdullah A Alharbi, Mansour Kh M A H A Almutawa, Austin Lawrence Andwan, Nathan Robert Berner, Adam J Berry, Ben Daniel Berry, Garrett Nichols Bolton, Nathan Thomas Borries, Merrideth Rose Braucher, Jeff Alan Brown, Liam Cregg Budnik, Hamad N M R Bumaryoum, Jimmy Joseph Butch, Jack William Cleave, Austin Patrick Clemens, Ali Ann Danielson, Sam Powell Dasco, Jared Walter Dejonckheere, David Charles Di Staulo, John Michael Dougherty, Alexander Nicholas Duda, Caroline Joan Ellis, Leah S Henkel, Beth Kate Hoffman, Elizabeth I Horner, Kaitlyn Nicole Hoying, Pearson Lee Ihmels, Camden Lee Ives, Matthew Patrick Jensen, Jimmy Michael John, Zach Thomas Johnson, Zack James Jordan, Justin Louis Karem, Hannah Ruth Kelly, Michael Patrick Kerner, Scot Philip Kingan, Matthew Quin Klein, Michael Robert Komanetsky, John Carl Kunzmann, Ashley Marie Kush, Michael Henry Lander, Mark W Lauterbach, Kevin Robert Lawson, Kathleen G Lehman, Sydney Marie Lundell, Mary Grace Malon, Samuel Charles Marek, Kyle J McGibbeny, Eva Rose McLaughlin, Will Robert Medved, Maria Elizabeth Mescher, Michael Mongin, Jeremy Preston Neff, Amy T Neidhard-Doll, Jacob T Nguyen, Michael H Niese, Grant Henry Noll, Meredith Kathleen Nortz, Justin T O’Neill, Alex Thomas Otto, Liz P Overbeek, Ethan Park Owens, Josh M Panczyk, Nicholas Alexander Pannunzio, Connor Ryan Paxton, Anthony Dominic Petrilli, Mickey Thinh Pham, Sean Michael Prophit, Timothy Reissman,

Kyle Rudolph, Patrick Neil Ruhala, Kristen Mae Sanson, Joe Edward Schlangen, Thomas Joseph Schlitt, Zachary Robert Schumm, Katherine Grace Sexton, Daniel Jay Sisler, Luke Tomokatsu Stromberg, Adam C Suddarth, Rachael Marie Supina, Colin Robert Theis, Annie Patricia Trotta, Joseph Patrick Vicario, Liam Patrick Walsh, Joe Reed Weeks, Jack Robert Wernet, Colt Anderson Whitman, Cassie Leigh Woodward, Spencer Ashton Wyatt, David William Yackzan, Drake Thomas Yinger, Michael Jeffrey Zawlocki
ADVISORS Amy T Neidhard-Doll, Timothy Reissman
LOCATION, TIME Science Center Atrium, 2:00-5:00

The Sumo Bot IV Tournament is back at Stander and keeps getting bigger! This year we estimate 44 robots will be competing in a battle royal to see who is the top Sumo Bot. The format is the following: Two robots compete in a head-to-head match following the basic system of traditional human sumo matches. The sole purpose is a pushing match between the two robots to force the other from the Dohyo (Sumo arena). The best-of-3 matches winner moves on to the next round to face their next opponent and the process continues until our new champion is crowned. Some cool notables about the students: Many of the students are engineering sophomores and in their first class for electronics. Not only are they learning how to mechanically and electrically design their sumo robot, but they are also learning how to program their robots to be autonomous while in the Dohyo... meaning no remote controls! So while self-driving cars maybe a thing of the future, self-sumo robots are already here at Dayton! Come cheer on the students and their robots as we showcase their creations.

Influence of Reverse Shoulder Implant Positioning on Patient-Specific Muscle Forces: A Simulation Study

School of Engineering: Mechanical and Aerospace Engineering
Stander Undergraduate Fellowship Awardee
Oral Presentation - Honors Thesis

PRESENTERS Kayla Pariser
ADVISORS Allison L Kinney
LOCATION, TIME Kennedy Union 207, 2:30-2:50

Currently there is not a standardized, objective method for a surgeon to position a reverse total shoulder arthroplasty (RTSA) in a specific patient. Simulation and optimization methods have been used to analyze how surgeries affect muscle function with generic models. However, the effect of patient-specific muscle parameters on modeling realistic muscle function in the RTSA population in unknown. Calibration of patient-specific parameters via optimization is feasible, but can be time consuming. Due to the fast workplace environment, surgeons cannot afford to wait for optimizations to converge. To decrease convergence time and apply these tools clinically, muscle parameter optimizations must be provided a realistic initial guess representative of the patient's muscle function. To our knowledge, previous studies have not established guidelines for adjusting muscle parameter values from literature sources to patient-specific values, but one possible mechanism is reduction of passive force. The purpose of this study was to investigate how much deviation from the literature muscle parameter values is necessary to reduce passive force and produce more realistic muscle activations for patient-specific cases. Patient-specific shoulder models were generated for eight subjects with two different implants. The literature muscle parameter values for the three deltoid muscles were modified via manually chosen scaling factors chosen to reduce passive muscle force and find common factors across all subjects for each deltoid. Following the parameter sensitivity study it was determined that reduction of passive force produced more realistic muscle forces and activations for all subjects. Common scaling factors were found across all of the subjects for two of the deltoids. There was inconsistency among the subjects as to which deltoid required the most parameter adjustment, emphasizing the importance of patient-specific muscle parameter adjustment. Once the parameters were adjusted, the muscle activation and force contribution became more realistic for all three deltoid muscles for all subjects.

Mechanical Testing and Finite-Element Modeling of Polymer Composites and Additively ManufacturedThermoplastics

School of Engineering: Mechanical and Aerospace Engineering
Oral Presentation - Independent Research

PRESENTERS Rockford Raymond Bowman, Alex R Elsbrock
ADVISORS Robert L Lowe, Tom J Whitney
LOCATION, TIME Marianist Hall Learning Space 218, 2:30-2:50

Woven fiber-reinforced polymer composites (WFRPCs) and additively manufactured (AM)thermoplastics have received increasing interest as candidate materials for structural (load-bearing)applications. Our research consisted of two synergistic parts, one experimental and the othercomputational. The experimental portion focused on fabricating epoxy-fiberglass WFRPCs with differentfiber orientations and using tensile testing to determine their mechanical properties. Thecomputational portion builds on punch test experiments previously conducted at UDRI on additivelymanufactured polyetherimide (PEI, commercially known as "ULTEM"). We focused on developingpredictive finite-element models/simulations capable of capturing (and explaining) the noveldeformation, damage, and failure observed in these experiments. Solid models of the disk-shaped testspecimens were rendered in SolidWorks, meshed in HyperMesh, and modeled using the finite-elementsoftware LS-DYNA.

Steady-State Modeling of Condensing Units with an Economizer Loop

School of Engineering: Mechanical and Aerospace Engineering

Poster - Graduate Research

PRESENTERS Haithem Murgham
ADVISORS Dave Harry Myszka
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

This work presents an engineering model that simulates the steady-state operation of air-cooled condensing units. Packaged, air-cooled, condensing units includes a compressor, condensing coil, tubing, and fans, fastened to a base or installed within an enclosure. To increase capacity, modern condensing units are being equipped with a brazed-plate heat exchanger for an economizer loop, configured in either upstream or downstream extraction schemes.

Design of a Self-Orienting Solar Array for Small Low-Earth Orbit Satellites

School of Engineering: Mechanical and Aerospace Engineering
Poster - Honors Thesis

PRESENTERS Eric Matthew McGill
ADVISORS Andrew P Murray, Dave Harry Myszka
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

As electronics have become increasingly smaller and more capable, small satellites called cubesats are deployed in missions that would have taken much larger spacecraft 30 years ago. To power these satellites while in orbit, a novel solar array design is proposed by which these small satellites may harvest energy. With the inspiration of a sunflower that autonomously faces the sun as it passes overhead, a solar array possessing similar characteristics is desirable. The proposed design could generate more energy during the craft's time in the sunlight by continuously adjusting to face the sun. More energy gathered corresponds to an enhancement of the capability of these cubesats due to the ability to accomplish missions with greater scope than those currently in use.

Displacement Analysis and Rigid Body Guidance in Spherical Linkages Using SU(2) and Homotopy Continuation

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Saleh Almestiri
ADVISORS Andrew P Murray, Dave Harry Myszka
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

This work seeks to efficiently and systematically model and solve the equations associated with the class of design problems arising in the study of spherical kinematics. To accomplish this, the group of special unitary matrices, SU(2), is utilized. SU(2) is used to analyze and synthesize the kinematics of a variety of systems including the three-roll wrist, the spherical four-bar mechanism, and the spherical Watt I linkage. Two methods of formulating the synthesis problem are considered. Specifically, the five orientation synthesis of a spherical four-bar mechanism and the eight orientation task of the Watt I linkage are solved using both the loop closure equations and an approach derived from the dot product that recognizes physical constraints within the linkage. Finally, using SU(2) readily allows for the use of a homotopy-continuation-based solver, in this case Bertini. The use of Bertini is motivated by its capacity to calculate every solution to a design problem.

Development and Actuation of a Shape-changing Rigid-body Human Foot Prototype

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Tanner Rolfe
ADVISORS Andrew P Murray, Dave Harry Myszka
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

This project focuses on the actuation of a multi-segment rigid body foot prototype capable of matching the change in profile of a human foot during gait. Previous work has focused on the design of the prototype using methods of shape-changing kinematic synthesis. In order to actuate the prototype, a tendon-based actuation scheme was conceived and partially implemented. The current prototype includes a series of paired cables, each connected to a separate segment of the foot. Tension in the cables counteracts the force of torsional springs implemented at the joints keeping the segments positioned in a neutral configuration, allowing each segment to achieve appropriate plantar- and dorsiflexion to match gait-derived configurations. Current work focuses on implementing active elements to drive the cables, as well as refinement of joint stiffness to increase the functionality and biomechanical accuracy of the prototype.

Validating the Location and Tracking of a Human's Center of Mass Using a Statically Equivalent Serial Chain

School of Engineering: Mechanical and Aerospace Engineering
Poster - Independent Research

PRESENTERS Luke Evan Schepers

ADVISORS Andrew P Murray, David A Perkins
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

This project seeks to validate the use of a statically equivalent serial chain (SESC) in locating and tracking a human's center of mass (CoM). The statically equivalent serial chain used in this project is comprised of 13 parameters, each roughly corresponding to a portion of the human body. Given these 13 parameters, the SESC points directly at a person's CoM. Every individual has a unique set parameters to calculate their SESC. These parameters are determined by capturing poses and using the body segment length and position information, as well as the center of pressure reading, acquired from the different poses. A Wii Balance Board and Xbox Kinect were used in this study as inexpensive force plate and motion capture systems. There are other methods for calculating a person's center of mass, but these require expensive equipment and more complex computational processes. The method proposed here is a low cost, fast, and easy way to accurately predict a person's CoM. In order to determine the feasibility of the SESC model, subjects of varying body types were tested, and SESC predictions for the CoM were checked for both accuracy and repeatability. A minimum number of poses required to achieve an accurate CoM prediction was determined by figuring out where subject' parameters converged, which increases time efficiency of the process. Additionally, it was found that the number of frames required to capture a pose could be decreased from 30 to 15 frames without sacrificing accuracy. This resulted in a total testing and setup time of 30 minutes per subject, opposed to one hour previously. Thus, validating the SESC method as a fast, easy, and fairly accurate solution for predicting a human's CoM.

Experimental Validation and Reliability Testing for Center of Mass Body Tracking

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Kevin Michael Brand
ADVISORS Andrew P Murray, David A Perkins
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Determining and then tracking the center of mass is difficult for a connected system of segments, such as a human, animal, or humanoid robot. Available techniques to perform these operations are complicated, time-consuming, or expensive. The technique known as Statically Equivalent Serial Chain (SESC) modeling promises to be inexpensive, using only an Xbox Kinect and a Wii Balance Board for equipment, and quick because only a modest number of subject poses are needed. Although SESC models have previously proven to reasonably estimate the center of mass (CoM) of systems of bodies from a limited number of experiments, recent validation testing shows the capacity for significant improvement. This research aimed to improve upon current testing protocols, reduce sensor error through improved calibration, and refine the algorithm employed to produce more meaningful parameters. As the CoM is an important parameter in gait analysis, SESC methods are prominent when considering in-home rehabilitation techniques that are versatile enough to improve potentially offset CoM problems for people of differing body types and sizes. Due to this significance, the research performed continued the development of the SESC technique toward its use in individualized rehabilitation protocols.

Dynamic Analysis of Alternative Mechanical Press Linkages

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Hardik Hasmukhbhai Viradiya
ADVISORS Andrew P Murray, Dave Harry Myszka
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The goal is this project is to compare the dynamic characteristics of alternative linkages for a mechanical press. Mechanical presses are the most common machine used in the mass production of sheet metal parts. Forming sheet metal parts, such as a car door or a tin can, involves striking a flat piece of metal with a die that shapes the part and punctures holes. A conventional press uses a slider-crank linkage and flywheel to provide a high energy strike for a short time period. A motor delivers torque to a flywheel that in turn, provides the rated capacity (tonnage) during the strike. Certain operations, such as deep drawing, require a longer dwell time than is possible with the slider-crank design. Various alternative linkages are proposed that have the ability to provide long dwell times. A dynamic analysis of each linkage is essential to understand motor demands, joint loads, and efficient design options. The linkage analyses are performed using SolidWorks multi-body dynamic simulation software.

Moving towards tuning of ankle-foot orthoses: The influence of carbon and plastic AFOs for individuals with Multiple Sclerosis

School of Engineering: Mechanical and Aerospace Engineering
Poster - Independent Research

PRESENTERS Sarah Elizabeth Hollis
ADVISORS Kim E Bigelow, Kurt J Jackson
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Mobility impairments are reported as the most debilitating symptoms for individuals with Multiple Sclerosis (MS). Fatigue, a major symptom of MS, further affects mobility. Ankle-foot orthoses (AFOs) are one potential solution to alleviate some of these mobility

impairments; however, the effectiveness of AFOs for individuals with MS are currently inconclusive and have known downfalls. We took a comprehensive look at both carbon fiber and polypropylene AFOs to gain an understanding of the immediate effects of AFOs for individuals with MS. In collaboration with the University of Dayton's Doctorate of Physical Therapy Program, data was collected for 10 participants on various balance, gait, and strength/fatigue assessments. Overall, no significant differences existed between the baseline, carbon, or plastic AFO conditions for any assessment outcome ($p>0.05$); however trends did arise within the static and dynamic balance task results. Many outcome parameters varied among participants, suggesting the importance of individual responses to AFOs and patient preferences in prescribing AFOs. The majority of participants preferred the carbon AFO. All AFOs were off-the-shelf with only slight adjustments to account for fit and alleviate any pain, AFO tuning is believed to help optimize the efficiency of AFOs by adjusting the angle of the shank during midstance and the stiffness of the footplate. The next step in this work is to investigate the effects of AFO tuning in collaboration with area clinical partners. A case study is currently underway to give insight and better understanding to the effects of AFO tuning.

Spatial Morphometric Analysis Using Shape-Changing Rigid-Body Chains

School of Engineering: Mechanical and Aerospace Engineering
Poster - Graduate Research

PRESENTERS Yucheng Li
ADVISORS Andrew P Murray
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Morphometry is the quantitative comparison of shapes, primarily curves. As an alternate to classical methods of spatial morphometry, this work investigates a kinematic synthesis methodology for designing a spatial chain of rigid-bodies to match arbitrary spatial curves. The goal is to find a single set of spatial bodies that can be moved to approximately align with any given set of spatial curves. Previous rigid-body shape-change morphometry work focused on mechanisms composed of rigid planar links connected by prismatic and revolute joints to approximate planar curves. Open space curves are the current focus of the research. The primary advantage of this method is its capacity to describe the difference in space curves with a limited number of parameters.

The Development of a Deeper Understanding of Cantera for use in the Simulation of Modern Combustion Problems

School of Engineering: Mechanical and Aerospace Engineering
Poster - Independent Research

PRESENTERS Shane Thomas Kosir
ADVISORS Joshua S Heyne, Rob D Stachler
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

The emergence of computing, such as multiprocessing and raw processing speed, allows for opportunities to simulate chemical models with relative ease. An open source software module, Cantera, is increasing in popularity within the combustion community as well as among other chemistry and chemical engineering disciplines. This software module can be easily integrated into Python or MATLAB and is often used to simulate problems involving thermodynamics, transport phenomena, and/or chemical kinetics. The purpose of this research is to develop a deeper understanding of physically controlling autoignition processes. The time for a fuel to autoignite, often referred to as ignition delay, is an important measure as it describes the reactivity of a fuel under given conditions. Experiments, such as rapid compression machines and shock tubes, can measure this parameter. These experimental values can be compared to simulations performed in Cantera or CHEMKIN, another chemical kinetic software similar to Cantera, to validate chemical kinetic models of given fuel species. It is of interest to investigate ignition delay as it is a contributing factor to the overall chemical timescale relating to lean blowoff (LBO) in a typical gas turbine engine. LBO represents the lowest possible fuel/air mixture, relative to the stoichiometric ratio, before a flame is not self-sustained and becomes extinguished. A better understanding of the time scales leading to LBO could allow it to be used as a criterion for the approval of alternative (non-petroleum) jet fuels.

The GEMnasium Experience: Creating a Recycling Enterprise for Individuals in Recovery

School of Engineering: Mechanical and Aerospace Engineering
Poster - Course Project, 201810 MEE 460 H1

PRESENTERS Abby Schubert Lisjak
ADVISORS Kevin P Hallinan
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Throughout the Spring semester, Engineering Analysis students have worked in the GEMnasium to explore the creation of a recycling enterprise for individuals in recovery from addiction. This project aims to demonstrate the process taken by the class to design an enterprise that merges wellness activities with work responsibilities. It explores how the enterprise can assist with re-entry as well as the continuation of the recovery process. Wellness, job training, funding, and community input were considered throughout the design process. The recycling enterprise will be presented to Montgomery County officials with the hope to implement the designed program in the county.

Improving Cook-Stove Bricks with Organic Material

School of Engineering: Mechanical and Aerospace Engineering

Poster - Independent Research

PRESENTERS Tyler Antonio Dinardo, Brandon Montel Payne, Antonio Keith Thomas
ADVISORS Margaret Frances Pinnell
LOCATION, TIME RecPlex Main Gym, 3:00-4:15

Ceramic bricks are used all over the world to help build stoves but can prove to be inefficient because of their inability to hold heat, individuals are required to use more fuel that can create harmful fumes. In order to address this a team comprised of teachers and engineers, designed and tested an experiment that used multiple different organic materials that were added to bricks to increase insinuative properties by producing more pores in the bricks. These organic bricks were then heat treated then were tested through three-point bend, compression, and porosity tests to determine if adding organic material would create more pores to increase insinuative properties without jeopardizing the overall strength of the brick.