SCHOOL OF ENGINEERING

“Optimization of the hydro thermal liquefaction process for increased yields, and for both energy and cost efficient production of a cleaner bio-crude suitable for refineries”

School of Engineering: Bioenergy And Carbon Mitigation | *Poster - Graduate Research*

STUDENTS Anirban Mandal | ADVISORS K A Moshan S P Kahandawala, Sukhjinder S Sidhu

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Increased use and limited reserves of fossil fuels have increased interest in renewable fuels. Algae biomass has been identified as a viable renewable fuel feedstock for biofuel (green diesel / jet fuel) generation. Hydrothermal liquefaction (HTL) is a promising energy efficient technology for converting wet-algae biomass into energy dense “bio-crude” suitable for use in refineries and recycling nutrients for growing algae. The composition of the bio-crude affects the quality and the process economics involved in converting the bio-crude to commercial fuel. Both the process operating conditions and the algal HTL feedstock composition affect the bio-crude composition. Thus, the proposed effort will focus on determining the ideal HTL conditions with various algal biomass compositions.

How to Lead Your Team to a Successful Capstone Project: A Student’s Guide

School of Engineering: Center for Competitive Change | *Poster - Course Project, IET 323H H1*

STUDENTS Kelsey E Diachun | ADVISORS Paul A Piechota

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

The purpose of this project is to analyze and develop a “student” guidebook to manage a senior design or capstone project. The outcome of the project will be a booklet which can be handed to the students chosen as project managers for their capstone project. This booklet will contain a step-by-step guide on leading projects. The guide will include best practices, software tools and how to use them, as well as describing exactly what steps should be taken in order to achieve a successful conclusion to the project. The booklet will also describe some personality traits which are seen in successful project managers both on real world projects and in past student capstone projects. To complete this project, recent graduates will be interviewed, as a means of learning what they felt were the strengths and weaknesses of their capstone projects. These interviews will also investigate what tools the graduates have used for project management and which ones they feel are the easiest to use while having the highest success rate. These analyses will then be used to determine which tool is best for student projects. Throughout the process, research will be done to develop a list of key personality traits shared by project managers in varying disciplines. Research will also be done to collect a listing of techniques that are used in helping to teach students the field of project management and explain which are the most successful and why they work. The final booklets will be available as handouts on the day of the presentation.

Tower of London Poppy Removal & Distribution Preparation Process

School of Engineering: Center for Competitive Change | *Poster - Independent Research*

STUDENTS Emily E Cooperrider | ADVISORS Paul A Piechota

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

More than 880,000 ceramic poppies were created and planted in the moat and surrounding areas of the Tower of London to signify each death in England and Colonies during World War I. This document is a step-by-step guide for carrying out Process Improvement initiative, and tracking the information a Process Improvement Team (PIT) develops. The poppy removal and distribution preparation project needed a plan to remove the 888,246 ceramic poppies planted around the Tower of London, materials for the removal and packaging, calculations for weights and numbers, and job descriptions for over 8,000 volunteers. The poppy installation is to be removed from the Tower Moat by 27 November 2014 in order to allow their worldwide distribution to buyers. The following plan will outline a method of removing the ceramic poppies and the resources necessary to effectively remove the poppies before the mentioned date. It is necessary to reduce the amount of time it takes to remove, clean, and prepare the ceramic poppies for distribution. The planting of the poppies took longer than expected, and because the customers expect the poppies by a certain date, the total process must be more efficient, raise quality, and reduce risk of breakage.

Transformational Learning-Improving Estimating

School of Engineering: Center for Competitive Change | *Poster - Independent Research*

STUDENTS Lacey E Engle, Laura E Stroyne | ADVISORS Paul A Piechota

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

Two students from the University of Dayton, one Chemical Engineering and one Industrial Engineering Technology major, were selected as charter students to partake in an 8 week internship abroad in London, England. The students would be working at Tryzens Group, an ecommerce solutions company. In this internship, the students were to use the classroom knowledge gained

from their Lean Six Sigma course, and apply it to an unfamiliar process. This internship/project was the last step in receiving a Lean Six Sigma Green Belt Certification. Tryzens Group is an international company delivering ecommerce solutions. Their systems drive business performance and multichannel retail experience for leading companies world-wide. A sharp increase in popularity of the company drove Tryzens to expand rapidly. They now have offices in the United Kingdom, India, and Bulgaria. Since growing, Tryzens has struggled with providing accurate requirement estimations. This project was focused on improving Tryzens' estimation process.

Transformational Learning-Improving Estimating

School of Engineering: Center for Competitive Change | *Oral Presentation - Independent Research*

STUDENTS Lacey E Engle, Laura E Stroyne | ADVISORS Paul A Piechota

LOCATION, TIME Kennedy Union 312, 4:00 PM–4:20 PM

Two students from the University of Dayton, one Chemical Engineering and one Industrial Engineering Technology major, were selected as charter students to partake in an 8 week internship abroad in London, England. The students would be working at Tryzens Group, an ecommerce solutions company. In this internship, the students were to use the classroom knowledge gained from their Lean Six Sigma course, and apply it to an unfamiliar process. This internship/project was the last step in receiving a Lean Six Sigma Green Belt Certification. Tryzens Group is an international company delivering ecommerce solutions. Their systems drive business performance and multichannel retail experience for leading companies world-wide. A sharp increase in popularity of the company drove Tryzens to expand rapidly. They now have offices in the United Kingdom, India, and Bulgaria. Since growing, Tryzens has struggled with providing accurate requirement estimations. This project was focused on improving Tryzens' estimation process.

Atomically Thin Electronics for Molecular Sensing

School of Engineering: Chemical and Materials Engineering | *Poster - Graduate Research*

STUDENTS Phillip T Hagerty | ADVISORS Christopher Muratore

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Atomically Thin Electronics for Molecular Sensing P.T. Hagerty (UD/AFRL), R.T. Stevenson(UD/AFRL), J.M. Dagher (UD/AFRL), M.E. McConney (AFRL) , N.R.Glavin (AFRL),M. H. Check (AFRL), R.J. Berry (AFRL), V. N. Varshney (UTC/AFRL), S. V. Shenogin (UDRI/AFRL), M.A. Haque (Penn State), J.E. Bultman (UDRI/AFRL), R.R. Naik (AFRL), S. S. Kim (UES/AFRL), A.A. Voevodin (AFRL), C. Muratore (UD/AFRL)A new class of ultra-thin (<2 nm) layered atomic structures, referred to as two-dimensional (2D) materials, are revolutionizing performance and tailorability of electro-optical devices fabricated entirely from molecularly thin components with a combination of remarkable mechanical and electronic properties. In a departure from traditional exfoliation or high temperature chemical vapor deposition approaches for 2D materials synthesis, plasma-based physical vapor deposition techniques are being used to fabricate uniform films over large areas at temperatures low enough for application to polymer substrates enabling a wider range of device material selection. Tailorable electronic, mechanical, and chemical properties have been investigated by adjusting grain boundary size (5-500 nm) and vacancy concentrations (S:Mo ratios from 1.1-2.0 in MoS2). Unique simulation approaches captured realistic experimental time and length scales which guided the refinement of growth processes and the multi-stimulus (strain, electrical potential, and heat) post-growth tailoring of defect densities for devices. Correlation of simulation to experiment is conducted via integration of 2D materials into nanofabricated testbeds facilitating in situ techniques for real-time atomic-scale visualization during application of stimulus and electrical characterization. This effort leads to controlled bottom-up assembly of 2D devices on flexible substrates to experimentally couple the remarkable intrinsic mechanical and electronic properties of ultrathin materials, which are particularly appealing for molecular sensing. For 2D materials, with their extreme surface-to-volume ratio demonstrate detection mechanisms based on charge transport where adsorbed molecules act as dopants for inducing a measureable electrical response in the active device material. Two dimensional semiconducting materials show strong promise for increased sensitivity and selectivity over graphene counterparts in sensing applications due to their large intrinsic bandgap. Thermodynamics of vapor and liquid phase molecular adsorption on flexible devices will be investigated computationally and experimentally, with an emphasis on sweat analysis in relation to human health and performance.

Characterization of Iron Phthalocyanine as the Cathode Active Material for Lithium-Ion Batteries

School of Engineering: Chemical and Materials Engineering | *Poster - Graduate Research*

STUDENTS Mohammed M Albader | ADVISORS Sarwan S Sandhu

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

This project presents the characterization of iron phthalocyanine (FePc) as the cathode active material to be used in higher specific lithium storage and energy density lithium-ion cells/batteries. Theoretical work suggested the control of the active material

particle size for its optimum utilization during the discharge of lithium-ion cells. Also, the experimental work reported the lithium storage in FePc is equivalent to 2050 mAh/g FePc that was encouraging to characterize FePc as a potential cathode material. In experimental work, two types of cells were tested: 1) high temperature polyethylene oxide electrolyte-based lithium/FePc cells and 2) room temperature organic liquid electrolyte-based lithium/FePc cells. Estimating the theoretical lithium storage capacity of the cathode active material, and the experimental results from the ongoing research/development work on the lithium/iron phthalocyanine cells are included in this project.

Enhanced Physiological Microenvironment for Improved Evaluation of Nanoparticle Behavior

School of Engineering: Chemical and Materials Engineering | *Poster - Graduate Research*

STUDENTS Emily K Breitner | ADVISORS Kristen K Comfort, Saber Hussain

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Due to their distinctive physicochemical properties, nanoparticles (NPs) have proven to be extremely advantageous for product and application development, but are capable of inducing detrimental outcomes in biological systems. Standard in vitro methodologies are currently the primary means for evaluating NP safety, as vast quantities of particles exist that require appraisal. Here, we developed an enhanced in vitro model that retains the advantages of cell culture, but introduces the key physiological variables of accurate biological fluid and dynamic flow. As NP behavior and subsequent bioresponses are highly dependent upon their surroundings, this developed microenvironment provides a more relevant system to evaluate responses following NP exposure. In this study, the microenvironment comprised of the A549 lung cell model, artificial alveolar fluid, and dynamic flow at realistic rates; to mimic a NP inhalation exposure. We identified significant modulations to silver and gold NP characteristics and the nano-cellular interface as a function of particle surface chemistry, fluid composition, and flow condition. More importantly, several of these modifications were dependent on multiple variables, indicating that these responses were previously unidentifiable in a standard cellular environment. Taken together, this study demonstrates that to fully elucidate the behavior and evaluate the safety of NPs, these evaluations need to be carried out in a more complex and physiologically relevant cellular exposure model.

Influence of Environment and Physiological Fluid on Nanoparticle Behavior and Bioresponses

School of Engineering: Chemical and Materials Engineering | *Poster - Independent Research*

STUDENTS Deidre Simone Cathey, Jasmine N Whitaker | ADVISORS Charles E Browning, Maceo E Cofield, Kristen K Comfort

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Nanotoxicology determines to what extent nanoparticles pose a threat to the environment and human beings, and this is the overall purpose of this research. The goal is to characterize nanofluid behavior and examine the influence of different nanofluids on the cellular behavior, specifically the viability, of the HaCaT cell line. The nanoparticles that will be used are copper oxide and titanium dioxide. Traditional media and artificial interstitial fluid are the physiological fluids being studied. The first phase of the project involves analyzing cell growth in different nanofluids, and the second phase analyzes cell death by finding the LDH enzyme production. MTS assays are performed in each phase to determine the cell proliferation and LDH enzyme production of the HaCaT cells. This research will help determine the toxicity of these nanoparticles dispersed in different environments.

Modification of the Nano-Bio Interface through Targeted Protein Corona Formation

School of Engineering: Chemical and Materials Engineering | *Poster - Graduate Research*

STUDENTS Emily K Breitner, Alexandra O Luby | ADVISORS Kristen K Comfort

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Gold nanoparticles (AuNPs) are being increasingly utilized in biological and medical applications, such as drug delivery, bio-imaging, and cancer therapeutics. However, the efficacy of these procedures are highly dependent upon the interaction of AuNPs with the surrounding biological environment; referred to as the nano-bio interface. In recent years, it has been established that the makeup of the nano-bio interface is driven through the formation and structure of the protein corona-NP complex. While many view the protein corona as an obstacle to overcome, we sought to utilize these protein-NP interactions to improve AuNP-cellular interactions. Prior to cellular exposure, 10 nm AuNPs were incubated in epidermal growth factor (EGF), to generate a protein corona solely comprised of EGF. EGF was specifically selected owing to the fact that it is a predominant surface receptor of multiple cell lines, including the human keratinocyte HaCaT. Modification to the AuNP-protein complex was verified through NP characterization techniques and SDS-PAGE analysis. Following a 24 hour exposure, EGF-AuNPs demonstrated a significant increase in deposition efficiency over untreated AuNPs. This analysis was taken one step further and repeated under physiologically accurate rates of dynamic flow. As expected, the overall deposition of NPs was reduced due to fluid movement,

however, the EGF-AuNPs still associated with HaCaT cells to a higher degree. Furthermore, to verify these findings, the nano -bio-interface was visualized through fluorescence microscopy for all experimental conditions. This study demonstrated that pretreatment of AuNPs with target proteins can improve cellular deposition and alter the nano-bio interface, providing a potential means for improving select nano-based applications.

Development of biosensing systems using molybdenum disulfide-peptide sensing interface

School of Engineering: Chemical and Materials Engineering | *Oral Presentation - Graduate Research*

STUDENTS Jessica M Dagher | ADVISORS Christopher Muratore

LOCATION, TIME LTC Meeting Space, 1:20 PM–1:40 PM

It is anticipated that semiconducting films of ultra-thin layered materials, such as molybdenum disulfide (MoS2) and other transition metal dichalcogenides (TMDs), will achieve higher sensitivity than other ultra-thin film molecular sensor materials such as graphene, while conserving benefits of mechanical flexibility and chemical stability in diverse environments. Therefore, this study aims at development of biosensing systems with thin films (1-10 nm) of MoS2 and a biorecognition element as the active sensing interface. The high surface-to-volume ratio of these films increases the rate of charge transport properties even in the presence of low concentrations of adsorbed molecules, enhancing the detection limits. A critical step toward novel TMD molecular sensors is identification of the structure and chemistry of peptide-TMD interfaces. In this study, phage display techniques were employed to identify peptides, obtained from a commercial combinatorial, M13KE phage display library, which selectively bind to a target of inorganic MoS2 in the forms of micro scale fine powder, a natural bulk crystal, and ultra-thin films (<1.5–5 nm) with different crystalline domain sizes. An in-laboratory immunofluorescence assay was then employed as a screening tool to confirm the interaction of identified peptide sequences with MoS2. The structural, elemental, and chemical surface properties of the MoS2 materials as well as the interaction with the phage-expressed peptide and the peptide alone were characterized via Raman and Infrared spectroscopy, X-ray diffraction analysis, and X-ray photoelectron spectroscopy. To further understand peptide-MoS2 surface binding mechanisms, molecular dynamics simulations will be conducted using a newly established atomic force field, which accurately predicts the surface energy of MoS2 films with variable defect concentrations. Integration of binding peptides into the model in conjunction with experimental results will aid in developing a fundamental understanding of biomolecule interactions with MoS2 and other TMD materials.

Simulation of Mechanical Properties: Strain Rate Dependence of Epoxies

School of Engineering: Chemical and Materials Engineering | *Oral Presentation - Graduate Research*

STUDENTS Allison M Ecker | ADVISORS Rajiv Berry

LOCATION, TIME LTC Meeting Space, 2:00 PM–2:20 PM

In recent years, many have sought to understand the modes of fracture in epoxy systems to further improve their applications in aerospace technology as adhesives and composites. The fracture patterns of epoxies and other thermosets differ from those of their thermoplastic counterparts due to the inherent differences in how the materials are formed. Thermoplastic materials exposed to tension exhibit hydrogen bond cleavage as polymer chains slide past one another, whereas thermoset materials fracture under tension due to broken covalent bonds. Thermosets are valued particularly for their toughness and their properties as part of polymer matrix composites (PMCs). Epoxies in particular have been studied extensively both experimentally and computationally, and this project looks to combine the two strategies to understand how epoxies fracture when exposed to differing strain conditions. Simulations completed thus far have studied diglycidyl ether of bisphenol A (DGEBA) with 4,4'-diaminodiphenylmethane (MDA) and 3,3' – diaminodiphenylsulfone (DDS). The DGEBA monomers have varying molecular weights, accomplished by varying the chain length of the prepolymers. Stress-strain relationships for each individual system were examined for strain rates varying from 106 s-1 to 1011 s-1. The young's modulus and strength at yield were calculated which enabled analysis of the effects of molecular weight (chain length) and strain rate on epoxy fracture. Experimental results will be used to validate the computational method. The first goal will be to develop a process to construct highly cross-linked epoxy systems using DGEBA resins of varying molecular weight with both 4,4'DDS and 3,3' DDS. Differential scanning calorimetry and near- infrared will be used to provide the degree of cure for each epoxy system created. Different degrees of cure are obtained through varying stoichiometry, cure process, and molecular weight.

Civil Engineering Senior Capstone Design Presentation

School of Engineering: Civil and Environmental Engineering and Engineering Mechanics | *Oral Presentation - Capstone Project*

STUDENTS Abdullah B Al-Rodan, John A Bayer, Tyler Scott Bergfeld, Benjamin A Borton, Kevin M Colburn, Sarah M Fyda, Alexander S Gaskins, Ametra P Harris, Aaron T. Haynesworth, Laura L Helbling, Nathan D Holthaus, Alyssa N Jenkins, Brad M Johnston, Timothy D Kovach, Colleen E Kresse, Yesenia E Linares, Stephen M Mcmillan, Kent M Moneysmith, Evan J Nicholas, Petr M Prchlik, Joseph E Riley, David S Robinson, Ivan Armando Rodriguez Del Rio, Carl J Ruf, Amy K Schultz, Joseph L

Sicurezza, Michael Smith, Vincent E Spahr, Kyle A. Spoelker, Brooke A Sroczynski, Joseph B Thomas, Tyler D Waldron, Bradley J West | ADVISORS Donald V Chase

LOCATION, TIME Kennedy Union Boll Theatre, 8:30 AM–12:00 PM

The Civil Engineering Senior Capstone Design is the culmination of the major design experience that is required for all ABET accredited programs. In this course, students were exposed to elements of practical design and integrated many of the skills learned in previous courses into a single capstone design. This year, the capstone design involved the designing of a Health and Sciences building for Sinclair Community College. Design aspects included Project Management, Structural, Geotechnical, Site/Civil, Transportation, and Environmental.

Prediction of Thermal Stress During Resistive Heating of Carbon Fiber and Glass Fiber Composites Reinforced with Carbon Nanotubes

School of Engineering: Civil and Environmental Engineering and Engineering Mechanics | *Poster - Graduate Research*

STUDENTS Manjhunath M Ayyampudur, Vignesh Kumar Gnanasekar | ADVISORS Thomas J Whitney

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Nanocomposites are polymeric materials which can conduct electrical current or heat. Like all materials, however, stress exceeding its threshold limits results in catastrophic failure of the material. Resistive heating is widely used in heating materials for various applications. In these applications, the formation of thermal stress potentially plays a very important role in failure mechanism of materials. Thermal stress are basically caused due the mismatch of coefficient of thermal expansion within the material. Hence, studying in detail about thermal stress formation in nanocomposite will help in preventing failures to a great extent. The objective of this work is to develop a Finite Element Model (FEM) which will be able to predict thermal stress in carbon fiber and glass fiber composites with carbon nanotube interlayers. This model will be validated by the ASTM method of hole drilling which is generally used to measure the residual stress in materials. Hole drilling method is an ASTM standard method used to measure the residual stress in a material. In this case, it will be used to measure thermally-induced stresses. The hole-drilling method works on the principle of redistribution of the stress when a hole is drilled in the material and is measured by strain gauge rosettes installed on the surface of material. With further calculation using the result of hole drilling method, thermal stress is obtained which is reasonably accurate. These results are then compared with FEM model and is verified. This verified FEM model can then be used to predict the thermal stress arising in nanocomposites preventing failures from happening when heated under resistive heating.

Determination of Ineffective Flow Areas in Bridge Modelling using HEC-RAS by locating Ineffective Flow Stations

School of Engineering: Civil and Environmental Engineering and Engineering Mechanics | *Oral Presentation - Graduate Research*

STUDENTS Venkatasubbarao Bayareddy | ADVISORS Donald V Chase

LOCATION, TIME Marianist Hall Learning Space 218, 1:40 PM–2:00 PM

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) is a computer program widely used by hydrologists and water resources engineers across the globe. The primary use of the simulation model is to delineate floodplains, but it may also be used to size bridges and culverts. HEC-RAS has an option for defining Ineffective flow stations at bridges and culverts. An Ineffective flow area is a portion of a river or stream's cross section where there is no water flowing downstream due to the presence of a bridge or a similar structure, i.e. no conveyance. Current practice is for modelers and engineers to provide an estimate of the location of ineffective flow stations. The objective of this research is to develop a methodology that can precisely identify the Ineffective flow stations at bridges and culverts based on the geometry of the bridge or culvert opening. A small-scale model has been constructed in the Hydraulics laboratory at University of Dayton to better understand the behavior of the flow of water through bridge abutments. To achieve our objective of accurately locating Ineffective flow stations, a computer program will be developed to work alongside the HEC-RAS. This program will contain an algorithm for calculating the location of ineffective flow stations at bridge abutments that will result in compensating or equal areas above and below the water line. The algorithm uses an iterative approach to converge into the solution. The Hydrologic Engineering Center's River Analysis System (HEC-RAS) is a computer program widely used by hydrologists and water resources engineers across the globe. The primary use of the simulation model is to delineate floodplains, but it may also be used to size bridges and culverts. HEC-RAS has an option for defining Ineffective flow stations at bridges and culverts. An Ineffective flow area is a portion of a river or stream's cross section where there is no water flowing downstream due to the presence of a bridge or a similar structure. Current practice is for modelers and engineers to provide an estimate of the location of ineffective flow stations. The objective of this research is to develop a methodology that can precisely identify the Ineffective flow stations at bridges and culverts based on the geometry of the bridge or culvert opening. To achieve our objective of accurately locating Ineffective flow stations, a computer program will be developed to work alongside the HEC-RAS. This program will contain an algorithm for

calculating the location of ineffective flow stations at bridge abutments that will result in compensating or equal areas above and below the water line. The algorithm uses an iterative approach to converge into the solution. Firstly, miscalculating the ineffective flow areas can lead to serious problems such as error in actual water surface elevation. Error in water surface level can cause misjudgment of floodplain area during a flood event and this could be catastrophic. By the proposed methodology, hydrologists and engineers will be able to locate these Ineffective flow stations in very less time with minimal error if not zero error. Our goal is to provide this tool freely available to all the hydrologists across the world.

ETHOS - Appropriate Solar Technology for Bihar, India

School of Engineering: Electrical and Computer Engineering | *Poster - Course Project, EGR 330 P3*

STUDENTS Mariana Lopes, Brooke C Place | ADVISORS Candida Crasto, Malcolm W Daniels

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

An investigation of the potential for appropriate solar technology in Bihar, India, including solar thermal refrigeration systems. The feasibility of solar PV cells within a micro grid system was studied for applications to existing refrigerators. This is pre-work for an upcoming ETHOS immersion in Bihar, India.

ETHOS – Appropriate Solar Technology for Bihar, India

School of Engineering: Electrical and Computer Engineering | *Poster - Course Project, EGR 330 P1*

STUDENTS Mariana Lopes, Brooke C Place | ADVISORS Malcolm W Daniels

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

An investigation of the potential for appropriate solar technology in Bihar, India, including solar thermal refrigeration systems. The feasibility of solar PV cells within a micro grid system was studied for applications to existing refrigerators.

ETHOS - Development and Optimization of a Micro Scale Wind Turbine

School of Engineering: Electrical and Computer Engineering | *Poster - Course Project, EGR 330 P3*

STUDENTS Michael Ralph Ising, Ryan S Schuessler | ADVISORS Candida Crasto, Malcolm W Daniels

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

A review of the fluid dynamics used to model and optimize the wind turbine blade design to maximize power output utilizing typical weather data. This is pre-work for an upcoming ETHOS immersion in Auroville, India.

ETHOS - Small Scale Wind Turbines for Rural India

School of Engineering: Electrical and Computer Engineering | *Poster - Course Project, EGR 330 P3*

STUDENTS George C Kemper | ADVISORS Candida Crasto, Malcolm W Daniels

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

An investigation into the application of small scale wind turbines to electrify rural India. This is pre-work for an upcoming ETHOS immersion in Auroville, India.

ETHOS - Virgin Coconut Oil Extraction

School of Engineering: Electrical and Computer Engineering | *Poster - Course Project, EGR 330 P3*

STUDENTS Philip M Morris | ADVISORS Candida Crasto, Malcolm W Daniels

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

An investigation of the optimization of virgin coconut oil production in a cottage industry. This will also examine the potential by-products of the process and how they could be utilized in the specific region. This is pre-work for an upcoming ETHOS immersion in Dominica, West Indies.

A novel Computer Aided Detection of identifying Lung Nodules on Chest Radiographs

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

STUDENTS Barath Narayanan | ADVISORS Russell C Hardie, Temesgen M Kebede

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Lung cancer is the leading cause of cancerous death in the United States. It usually exhibits its presence with the formation of pulmonary nodules. Nodules are round or oval-shaped growth present in the lung. Chest radiographs are used by radiologists to

detect and treat such nodules but they are quite difficult to detect with human eye and are sometimes misinterpreted with lesions present. Thus, automated analysis of such data is very essential and would be of valuable help in lung cancer screening. A new computer aided detection (CAD) system in chest radiography is proposed in this paper. The algorithmic steps include (i) local contrast enhancement; (ii) automated anatomical segmentation; (iii) detection of nodule candidates; (iv) feature extraction; (v) candidate classification. In this research, we present facets of the proposed algorithm using a publically available dataset and we explore into new set of features and classifiers. The publically available database was created by the Standard Digital Image Database Project Team of the Scientific Committee of the Japanese Society of Radiological Technology (JRST). The JRST dataset comprises of 154 chest radiographs containing one radiologist confirmed nodule each. In this term paper, we compute a rich set of 117 features for each potential candidate. Local contrast enhancement is achieved using a Gaussian low pass filter. Anatomical segmentation is performed using an active shape model. Potential candidate nodules can then be determined by using an adaptive distance- based threshold algorithm limited to delineated lung fields. Later, a set of features are computed for each potential candidate. Based on those tailored features, a classifier/neural network system can be used to identify the candidates as either true positives or false positives. This CAD system would aid in providing a second opinion to radiologists. Algorithm will be trained using River rain Database and would be tested later in JRST database.

A Self Organizing Maps Approach to Segmenting Tumors in Computed Tomography (CAT) and Magnetic Resonance Imaging (MRI) Scans

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

STUDENTS Fatema A Albalooshi, Yakov Diskin, Sidike Paheding (Co-Author: Sara Smith, University of Cincinnati College of Medicine) | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Studies and explorations of human visual perception have been the main source of inspiration for computer vision algorithms. Understanding how the human brain represents basic attributes of objects helps in developing computer vision algorithms for automatic object interpretation and understanding. Human visual perception is based on the neural coding of fundamental features, such as object boundaries, color, orientation, shape, etc. Thus, finding the contours and boundaries of objects provides the first step for object recognition and interpretation. Form here, the idea of this research inspired to introduce an automatic boundary detection technique based on active contours that is designed to detect the contours of abnormalities in X-ray and MRI imagery. Our research is aimed to aid healthcare professionals to sort and analyze large amount of imagery more effectively. Our segmentation algorithm incorporates prior information within segmentation framework to enhance the performance of object region and boundary extraction of defected tissue regions in medical imagery. We exploit Self Organizing Map (SOM) unsupervised neural network to train our prior information. One reason to prefer SOMs to other neural network models is the specific ability of SOMs to learn the intensity information via their topology preservation property. In addition, SOMs have several characteristics that make them pretty much similar to the way the human brain works. A dual self-organizing map approach is being used to learn the object of interest and the background independently in order to guide the active contour to extract the target region. The segmentation process is achieved by the construction of a level set cost function, in which, the dynamic variables are the Best Matching Units (BMU)s coming from the SOM maps. We evaluate our algorithm by comparing our detection results to the results of the manually segmented by health professionals.

Adaptation of Fast Converging Optimal Techniques to Path Planning of Hyper-Redundant Manipulators

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

STUDENTS Hariharan Ananthanarayanan | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

A multi-pass distributed localized search technique to solve the problem of path planning of hyper-redundant manipulators for the shortest path in real-time in the presence of obstacles is proposed. The problem is approached from a control perspective as a shortest path Optimal control problem, where the configuration space is searched for path points that optimize a cost function. This method addresses the ‘’Curse of Dimensionality” of exhaustive search techniques via the multi-pass distributed local search and local minima of Greedy approach via a backtracking technique. Further, theoretical proof shows that the proposed technique converges to an optimal (if only one exists) or a suboptimal (if many exist) solution. The algorithm is implemented on a 9-DOF manipulator arm for various paths.

Adaptive Particle Swarm Optimization Applied to Aircraft Control

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

STUDENTS Ouboti Djaneye-Boundjou | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

For the longitudinal dynamics of a fixed wing aircraft with rigid frame, a Proportional-Integral (PI) controller for controlling the forward velocity of the aircraft and a gain-scheduled Proportional-Integral-Differential (PID) like controller, with the forward velocity used as the scheduling variable, for controlling the flight path angle of the aircraft are designed. For a set of working PI gains, previously found through an experienced-based design, derivation and tuning of PID gains for a select number of forward velocities is computationally achieved through the use of a stable Adaptive Particle Swarm Optimization algorithm. Several performance measures, normalized so as to suppress differences in scale, are aggregated into the designed cost function.

Automatic Building Change Detection by 2D and 3D Representation for Wide Area Surveillance

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

STUDENTS Fatema A Albalooshi, Yakov Diskin, ALmabrok Essa Essa, Sidike Paheding | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

We present an automated image processing tool for building change detection by analyzing aerial imagery. The proposed scheme can be categorized into three phases: 2D change detection, 3D change detection, and 2D and 3D fusion. In the first phase of the algorithm, an adaptive perception based object detection model is developed for robust classification of buildings from aerial images. The method will be able to address the issues of varying illumination, varying shapes, sizes, orientation and occlusion of the building in interest. To detect regions that contain buildings in a scene, we defined a histogram of illumination invariant features (i.e., monogenic phase) to represent region segments that belonged to buildings as one class and other regions as another class. A support vector machine with radial basis kernel is trained using segments from both classes. Then we implement a modified level set prior-based segmentation approach, which integrates neural networks with level set active contour models for boundary extraction of buildings in cluttered environment. By extracting boundary, we can estimate actual size of the building in current or previous time period, so that the changes can be found in terms of area of the building. In the second phase, a 3D reconstruction algorithm, named Dense Point-cloud Representation (DPR), is utilized to flag volumetric changes in a building. By obtaining accurate dense representations of the scene using DPR, we are able to detect building changes irrespective of lighting, seasonal and view point changes. In the last phase of the proposed scheme, we suggest to combine 2D and 3D change detection algorithms as a full-fledged system for building change characterization

Automatic Intrusion Detection on Pipeline Right-of-Way via Aerial Imagery

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

STUDENTS ALmabrok Essa Essa, Sidike Paheding | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Object detection in aerial imagery has received a great deal of attention in recent years and become one of the most popular research areas in the field of surveillance systems. Issues in aerial imagery, such as low resolution, the presence of noise, complex appearances of objects and more importantly viewpoints variations of objects have made the process of intrusion detection on oil pipeline Right-of-Way (RoW) more challenge. Thus, a detection system must be able to extract prominent features from an object which has to be distinct and stable under different conditions during the image acquisition process. In this work, we present a novel scheme that automatically detects intrusions such as construction vehicles and equipment on pipeline RoW from aerial imagery. In the first part of the framework, a region-of-interest detector is employed to extract potential regions that may contain objects and to reduce the search region from imagery that are not considered to be a region-of-interest. Next, we develop a rotation-invariant gradient histogram based descriptor for a robust object representation. Since it is built in grayscale space, it is independent of the color changes. In terms of tackling motion blur and noise introduced by sensors or atmospheric effects, a noise reducing kernel is used to compute the gradient of the region, and then histogram of orientated gradient is computed for each key region obtained from the first step of the algorithm. The final descriptor is built by concatenating the magnitude of fast Fourier transform of orientation histograms over all key regions. In the last phase of the framework, a support vector machine with radial basis kernel is used as the classifier to detect objects in an image.

Automatic Perception and Target Detection in LiDAR Data

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

STUDENTS Nina M Varney | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

LiDAR is a remote sensing technology which uses a set of 3D geo-referenced points in order to describe a scene. Aerial LiDAR is often collected using UAVs or airplanes which can passively collect data over a short period of time, often over several miles. This can result in millions of points used to describe a scene. LiDAR data is often used for surveillance and military applications and because of the large amount of data and varying resolutions it can be difficult for analysts to recognize and identify mission critical targets within the scene. The goal of this project is to develop a technique for the automatic segmen-

tation and classification of distinct objects within the scene to aid analysts in scene understanding. We focus our method on five distinct classes that we wish to identify; ground, vegetation, buildings, vehicles and fences or barriers. The first step is to use a RANSAC-based ground estimation in order to estimate the digital terrain model (DTM) of the scene. Next, 3D octree segmentation is performed in order to distinguish between individual objects within the data. A novel volume component analysis (VCA) method is used to extract distinct geometric signatures from each individual object and these features are used as the input to several support vector machines (SVM) in cascade of classifiers configuration. The cascade of classifiers separates the objects into the four remaining classes. Our method was tested on an aerial urban LiDAR scene from Vancouver, Canada with a resolution of 15.6 pts/m^2 and was found to have an overall accuracy of 93.6%.

Blind full reference image quality assessment of Poisson image denoising

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

STUDENTS Chen Zhang | ADVISORS Keigo Hirakawa

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

—FR-QA (Full Reference Image Quality Assessment) is an appropriate measure for comparing denoised image to the ideal noise-free image.--CR-QA (Corrupted Reference Image Quality Assessment) enables Blind FR-QA with the help of a noisy-version of the reference image (Cheng & Hirakawa 2012).— We propose a computational technique predicting SSIM (structural similarity index) and VSNR □a wavelet-based visual signal-to-noise Ratio□ score for Poisson denoised image.--CR-QA optimal denoising outperforms Training-optimal and CR-MSE optimal denoising methods.

Brain Machine Interface for a Robotic Arm

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

STUDENTS Matthew Thomas Cusumano, Mark J Edmonds, Wenjie Lu, Daniel P Prince, Andrew J Sutter

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

The purpose of this project is to expand the capabilities of an existing interface of controlling a static robotic arm with brainwaves. Brainwaves are collected with an Emotiv EPOC headset. The Emotiv headset utilizes electroencephalography (EEG) to collect the brain signals. This project makes use of the Emotiv software suites to classify the thoughts of a subject as a specific action. The software then sends a keystroke to the robotic interface to control the robotic arm. The team is to identify actions for mapping, implement these chosen actions, and evaluate the system's performance. The actions chosen and their implementation would also test the limits of the interface, and provide groundwork for future research. This semester, we are actively working on creating our own, independent signal processing system for analysis on subjects' thought patterns.

Classification of Vehicles using Monocular 3D Reconstruction

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

STUDENTS Yakov Diskin, Nina M Varney | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

State of the art 3D reconstruction techniques utilize frames from a video sequence to render a 3D model of the scene. Our 3D reconstruction technique utilizes Speeded-Up Robust Features along with optical flow points to create a dense point cloud. Each point within the model has been tracked from frame to frame and triangulated into its (X,Y,Z) model position. We present an application for these structure from motion models that exploits our previous work in 3D object classification. In our experiments, we reconstruct a parking lot scene that contains several vehicles. The first step of our object classification algorithm is to segment each of the vehicles. Then, for each separate point cluster, our algorithm utilizes the volumetric and shape properties of the 3D object to label it with a vehicle type. The novelty of this classification approach allows us to tackle the noise challenges commonly associated with monocular 3D reconstructed models.

Cybersecurity Software Research for Specialized Hardware Adaptation

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

STUDENTS Brandon M Hampshire, Francisco Luis Palenzuela | ADVISORS Tarek M Taha

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Security of electronic devices and information is important in the defense industry, where protecting information is synonymous with protecting human lives. Cybersecurity software is used to protect the devices used and the information gathered in this field, but at the cost of additional device power and resources, harming the usability of the device in many cases. The purpose of this research is to adapt a popular Network Intrusion Prevention System to partially run on specialized hardware processor. This processor will run concurrently with the device that is protected. With the parts of the program that are the most time and power intensive running on a different, more specialized, processor, the device itself will be more energy efficient and be

protected more efficiently and faster. This research will determine the most suitable and effective parts of the system to adapt for the new hardware and begin the preparatory work to port the program.

Design and MIMO control of A Hyper-Redundant Robotic Arm

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

STUDENTS Xingsheng Xu | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

An application robotic platform has been constructed based on the kinematic model of a 9-DOF hyper-redundant manipulator. The efficacy of our kinematic algorithm affects the accuracy and stability of both motion control and path tracking. An objective of this work is to achieve multi-input multi output (MIMO) control, where the inputs are the torques at each joint, and they are used to control joint dynamic variables such as position, orientation, velocity and acceleration in a hyper-redundant robotic system. This control approach can highly improve the robotic performance considering both its kinematics and dynamics while executing motion control or tracking a path. The result of tracking different paths and the error analysis both in joint space and work space show that the MIMO control algorithm works functionally and satisfies all the requirements of experimental design.

Determining Volume Changes from Overhead Video Surveillance

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

STUDENTS Yakov Diskin | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Cost effective persistent wide area surveillance is a challenging real-world problem that research has not sufficiently tackled yet. At present, surveillance corporations spend millions on human analysts to monitor live or recorded video feeds. Depending on the application, the analysts may be looking for unauthorized activities, suspicious behavior, or a more specific sequence of events. Human performance is costly and is often affected by ambiguous definitions of anomalies as well as natural factors such as fatigue. We present a fully automatic 3D change detection technique designed to support persistent overhead surveillance in changing environmental conditions. The novelty of the work lies in our approach of creating an intensity invariant system tasked with detecting changes in a changing environment. Although previous techniques have proven to work in some cases, these techniques fail when the intensity of the scene significantly changes between the capture of the datasets. Our techniques leverages our 3D reconstruction capabilities to overcome the intensity variation challenges. We present several proof of concept experiments conducted in a laboratory setting, in which we study the effects of model noise and scene illumination on the proposed volumetric changed detection algorithm.

Directional Ringlet Intensity Feature Transform for Pedestrian Tracking

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

STUDENTS Theus H Aspiras, Evan W Krieger, Sidike Paheding | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

The tracking of pedestrians in wide area motion imagery (WAMI) is a challenge due to the extremely small pixel size of the pedestrian in the scene. The size of a pedestrian depends on the database but is typically 4 to 8 pixels squared. In addition, a pedestrian occupies a rectangular area while the tracker searches using square areas for efficient processing. This means that the background around the pedestrian is included as the search object. For current intensity-based histogram feature tracking methods, background intensity variations can cause misidentification of the target. These background variations occur as the ground the target walks over or next to changes in material or lighting. These challenges necessitate a stronger feature descriptor to be constructed. We propose a new feature tracking method, Directional Ringlet Intensity Feature Transform (DRIFT), which uses a combination the edge information of the object with the intensity to create a feature histogram. This is accomplished using a Gaussian ringlet masking strategy that utilizes rotational invariance of the Gaussian ringlet and directional edge information of the Kirsch kernel. The proposed method allows for more accurate and robust tracking of extremely small targets, such as pedestrians. A quantitative evaluation is performed by comparing tracking results of the proposed method with other intensity-based histogram feature tracking methods. The WAMI sequences that are used for evaluation are of pedestrians captured in the Columbus Large Image Format (CLIF) database.

Extremum Seeking Control Observer Design for Multiple-Input Multiple-Output Linear Time-Invariant Systems

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

STUDENTS Abdulhakim A Daluom | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

In this proposal a control strategy, we try to address the problem of output (performance) function for an observer of Multiple-Input Multiple-Output (MIMO) linear time-invariant system by applying the Extremum Seeking Control (ESC) approach. By this control approach, we drive the performance function to its maximum or minimum value. The construction of a seeking algorithm is used to drive the system states to the desired set-points that maximize or minimize the value of an objective (performance) function. Also, Lyapunov's stability theorem and the perturbation theory including the averaging method is used in the design of the extremum seeking controller structure to check the stability of the system.

Image Restoration Under Low Illumination

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

STUDENTS Wu Cheng | ADVISORS Keigo Hirakawa

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Image taken under low illumination suffers severe distortion as the photon counts received by the camera sensor is too low. By investigating the statistic properties of photon count, we can inverse such distortion and restore the scene even in the dark night.

Intention Based Upper-limb Exoskeleton

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

STUDENTS Manoj-Kumar Sharma | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Exoskeletons, a wearable robot that intelligently augments the physical power of a human being. These robots are used in military and similar applications, but the challenge remains that how to make the human-machine interaction safe and sound. The idea behind the 'intention based approach' is that an array of compliant force sensors will continuously monitor the movement of the limb and then map the filtered data to drive the respective actuator which in turn helps in doing the same 'movement' with augmented power and better stability. Additionally a 9 DoF IMU, continuously map the end effector's spatial position as an additional feedback utilizing the Inertial Reference Unit's (IRU) algorithm.

Nonlinear MIMO Adaptive Control for Longitudinal Aerodynamics Forces and Moments of Hypersonic Aircraft Vehicle Model

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

STUDENTS Turki Mohammed Alsuwian | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Aircraft vehicle has complex nonlinear functions which affected in design the control issues. In this paper, introduce and design accurate control of longitudinal dynamic and pitch moment. Longitudinal dynamics equations have complex parameters and this paper maintains control methods as using feedback linearization method. This method is separating longitudinal dynamics equations which causes directly to the flight path angle and aircraft speed with certain approximations of drag, lift and moment functions. Therefore, MIMO adaptive control approach is used instead of feedback linearization with first approximations of drag, lift and moments functions to achieve reasonable results of aircraft dynamics control. MIMO adaptive control technique is presented combined direct and indirect adaptive control methods because the uncertainties variables of longitudinal equations. This paper displays control design for thrust and elevator deflection as inputs of aircraft dynamic with flight path angle and aircraft speed as outputs of the system. The simulations results of feedback linearization and MIMO adaptive control is illustrated in this paper and achieved the tracking of aircraft speed and flight path angles to desired aircraft speed and desired flight path angle.

Power Efficient Circuits for Intrusion Detection using Memristor Crossbars

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

STUDENTS Venkataramesh Bontupalli | ADVISORS Tarek M Taha

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Intrusion Detection System (IDS) is an intelligent specialized system designed to interpret the intrusion attempts in incoming network traffic. IDS aims at minimizing the risk of accessing the unauthorized data and potential vulnerabilities of critical systems by the examining the every packet entering into the system. Deep Packet inspection and Pattern matching are computationally intensive processes and most power hungry functionalities in network intrusion detection systems. In particular, every incoming packet is well screened by string matching with previously known malicious signatures/contents essentially known as attacks or intrusions. In particular, nearly 70 % of the execution time and power is utilized against matching the malicious contents against all the incoming packets. Indeed, the heart of every IDS is the detection process itself hence our key focus and efforts are towards developing a memristor crossbar based low power intrusion detection system that would reduce the execu-

tion time and power consumption due to its high density grid and massive parallelism. We propose a brute force string matching algorithm implementation on a low power memristor based cross bar array giving rise to detection accuracy of 100% and 0% false positive consuming 0.013mW/signature. As it turns out, memristor cross bar designed, trigger only if there is an exact match between the stored and incoming pattern extending its applications towards text processing, speech processing, computational biology, etc. besides intrusion detection.

Robust Textural Features for Real Time Face Recognition

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

STUDENTS Andrew D Braun, Chen Cui | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Automatic face recognition in real life environment is challenged by various issues such as object motion, lighting conditions, poses and expressions. The Enhanced Local Binary Pattern (ELBP) is able to represent textural features of a face image in different lighting conditions. Instead of comparing the intensity of every neighborhood pixel with the center pixel's intensity value directly as in LBP, ELBP description compares the total positive distance and the total absolute distance between the neighborhood pixels and the center pixel. In this paper, we propose a system based on a refined Enhanced Local Binary Pattern (ELBP) feature set and a Support Vector Machine (SVM) classifier to perform face recognition in a real life environment. The counting strategy from ELBP is replaced by converting the samplings to a binary image after obtaining the 8-bit code from a thresholded neighborhood information. The proposed system is currently trained with several people's face images obtained from video sequences captured by a surveillance. One test set contains the disjoint images of the trained people's faces to test the accuracy and the second test set contains the images of non-trained people's faces to test the percentage of the false positives. The recognition rate among 300 images of 10 trained faces is around 85%, and the false positive rate with 5000 images of 30 non -trained faces is around 8%. Research work is progressing for the recognition of partial occluded faces as well. An appropriate weighting strategy will be applied to the different parts of the face area to achieve a promising result.

Rotation, Scaling and Illumination Invariant Pattern Recognition Using Joint Transform Correlation for Object Detection and Tracking

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

STUDENTS Sidike Paheding | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Challenges in pattern recognition mainly includes object rotation, scaling, and illumination variations. Joint Transform Correlation (JTC) based filtering techniques yield promising outputs in optical pattern recognition and they have been widely used for real-time pattern recognition applications such as object detection and tracking. However, objects in complex background brings difficulty to JTC based algorithms since the performance of the JTC is sensitive to object distortions such as changes due to rotation, scaling, and illumination. One of the solutions is to add or modify filters during JTC process. Synthetic discriminant function (SDF) can be integrated with fringe-adjusted filter to alleviate the problems of scale and rotation variations of the target. Fringe-adjusted JTC with monogenic signal representation can achieve illumination invariant pattern recognition. In the case of multiple target detection, the input-scene subtraction algorithm can be employed in JTC to efficiently detect multiple targets simultaneously with high correlation peak intensity with low false detection rate. While these techniques resolve specific problems of JTC, a full-fledged approach to equip the JTC with features that are robust to object rotation, scaling, and illumination variations is yet to be done. Therefore, our goal in this research is to reduce the sensitivity of the JTC to object distortions in the input image so that it can improve the detection efficiency in terms of sharper correlation peak intensity, narrow correlation width and higher pattern discriminability. In the proposed scheme, a local phase feature set is extracted prior to the JTC process, while the SDF is integrated with JTC during the correlation process. We evaluate our algorithm for face recognition and car tracking. Experimental results show that the proposed method yields better performance compared to alternate JTC based methods.

Thermally Switchable Antennas using Vanadium Oxide Thin Film Material Integrated with Microstrip Patch Antennas

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

STUDENTS Kuan-Chang Pan | ADVISORS Guru Subramanyam

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

The main objective for this research is to develop a thermally switchable reconfigurable antenna. The thermally switchable antenna is dependent on vanadium dioxide thin film's properties. Vanadium dioxide is an insulator at room temperature and becomes a conductor when heated to above 68C. The reconfigurable antenna is also achieved by using vanadium dioxide thin films. In this research, two different dimensions of microstrip patch antennas are used. The resonant frequency of the bigger

antenna is 6.2 GHz (made with vanadium oxide in the periphery), and the resonant frequency of the smaller antenna is 6.8 GHz(made with normal metal). The overall size of the microstrip patch of the bigger antenna is 6.4mm×7.75 mm, and the smaller antenna is 6.2mm×7.05 mm. When heated, the antenna becomes larger as the vanadium oxide becomes full conductive, and thereby shifts the resonance frequency from 6.2 GHz to 6.8 GHz.

Three-Dimensional Point Cloud Representation of Surveillance Scenes in Real-Time

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

STUDENTS Kevin C Krucki | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

There are many surveillance applications which use video to review a scene. These applications include crime review, object recognition, and traffic control amongst others. Using several different computer vision algorithms 3D point clouds of moving objects can be gathered and placed into pre-gathered point clouds to makeup a whole scene in real-time. This will lead to better understanding of a scene for those watching and provide for real-time 3D surveillance. First, camera calibration will be completed. In turn, depth maps can be created, allowing us to map out each point in the scene to a real world coordinate. At this point in time, motion detection will be performed and only moving pixels will be translated to real world coordinates. Then interpolation will be completed on the moving points to create a full 3D model of the moving parts of a scene. The moving parts are then placed into point clouds that were gathered using Lidar to create an entire 3D model. This will give those using the 3D points a larger sense of awareness in the scene and aid in surveillance applications.

Blind Motion Deblurring and Denoising

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

STUDENTS Yi Zhang | ADVISORS Keigo Hirakawa

LOCATION, TIME Kennedy Union 311, 2:20 PM–2:40 PM

Low light photography suffers from blur and noise. We propose a novel method to recover a dense estimate of spatially varying blur kernel as well as a denoised and deblurred image from a single noisy and motion blurred image. Proposed method takes advantage of the sparse representation of double discrete wavelet transform (DDWT) and the Bayesian statistics that makes the noise handling explicit. We reduce the computational complexity by exploiting Expectation-Maximization (EM) algorithm and separating the estimation of blur direction and length.

Aiding Bio-optics with Tapered Fibers Coated with Gold

School of Engineering: Electro-Optics Graduate Program | *Poster - Independent Research*

STUDENTS Noelle G Jacobs, Cheyney M Myers | ADVISORS Karolyn M Hansen, Joseph W Haus

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Organosilane molecules will be absorbed onto the silica surface of the tapered fibers. The gold nano-particle solution will be placed with the silica fibers to bond the nanoparticles to the surface. The amino groups will capture the gold nanoparticles on the surface. The silica will then be placed in a container for reduction of a chloroauric acid and potassium carbonate mixture using sodium borohydride in order to grow the nanoparticles. The gold coating of silica optical fibers will be used for iosensing applications.

Characterization and Application of Bubbles during Thermal Blooming in a Thermal Medium

School of Engineering: Electro-Optics Graduate Program | *Poster - Graduate Research*

STUDENTS Ujitha A Abeywickrema | ADVISORS Partha P Banerjee

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

When a highly absorbing thermal medium is heated with a focused laser pump beam, diffraction ring patterns can be observed due to self-phase modulation. When the laser power increases, the usual self-phase modulation diffraction patterns change due to bubble formation inside the thermal lens created by the focused beam. This phenomenon is called thermal blooming and can be considered as the next step to self-phase modulation. A stable bubble is formed using a focused laser beam, and the bubble is characterized using holograms made with a probe beam. A 532 nm Argon-Ion laser is used as the pump and a 633 nm low power He-Ne laser is used as the probe. The thermal medium comprises a mixture of a red dye and isopropyl alcohol. To minimize the optical effects arising from convection, the focused pump is introduced vertically into the liquid sample.

The recorded in-line holograms are numerically reconstructed to determine the size and 3d shape of the bubbles. Bubble sizes are monitored as a function of the pump intensity. Once formed, the bubbles can be steered by mechanically deflecting the pump beam or any other laser beam. Finally, Ag nanoparticles are fabricated, examined, and introduced into the thermal medium. The presence of nanoparticle agglomeration around the thermally generated bubbles is tested using a focused probe beam at 405 nm corresponding to the absorption peak of the Ag nanoparticles due to plasmonic resonance. This technique should prove useful in drug delivery systems using nanoparticles agglomerated around microbubbles.

Design of Flow cells for Tapered Fiber Biosensors

School of Engineering: Electro-Optics Graduate Program | *Poster - Independent Research*

STUDENTS Aaron A Coleman, Andrew Joseph Rigaud | ADVISORS Joseph W Haus

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Optical fibers can be tapered in order to change their light coupling or light propagation properties. A tapered fiber can be produced by gently stretching an optical fiber while it is being heated by a produced heat source (i.e. an open flame). After being tapered, the fibers can be coated with biological receptors that can detect certain molecules. When in an activating environment, the coating leads to a different light propagation pattern. This project focuses on one part of the large project, the design of the flow cells. In order to test the tapered fibers functionality, the fibers must be suspended in the flow cell, where different fluids can flow past the fiber to test its reaction to different environments. Through three dimensional modeling software, flow cell designs can be generated. Then, 3D printers can be used in order to create the flow cells.

Nano-scale patterns of molybdenum on glass substrate for use in super-resolution imaging with metamaterials.

School of Engineering: Electro-Optics Graduate Program | *Poster - Graduate Research*

STUDENTS Han Li | ADVISORS Partha P Banerjee, Andrew M Sarangan

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Photolithography is widely used to transfer a geometric pattern from a mask to a photoresist film, but the minimum feature sizes are limited by diffraction through the mask. Focused ion beam and electron beam lithography can be used when higher resolution is desired, but the write times are long and costly. Deep ultraviolet interference lithography, which is a maskless technique, can be used as an alternative to produce high resolution patterns with feature sizes as small as 100 nm. Since double negative metamaterial superlenses can be used for super-resolving and imaging sub-wavelength objects, there is a need for fabricating such objects to characterize the performance of these metamaterials. In this paper, simulations using standard finite element methods are first used to verify super-resolution and near-field imaging at 405 nm for such objects using a metamaterial superlens previously fabricated from silver and silicon carbide nanoparticles. Thereafter, results of fabrication and characterization of sub-wavelength objects using molybdenum of typical thickness 50 nm initially sputtered on a glass substrate is presented. A deep ultraviolet laser source at 266 nm is used. An anti-reflection layer followed by a high resolution negative tone photoresist is coated on the top of the molybdenum film. The cross-linked photoresist created after the development and bake processes is used as a mask for etching. Fabrication of the sub-wavelength object is completed using reactive ion etching in fluorinated plasma. Both 1D and 2D patterns are fabricated. The quality of the sub-wavelength objects during fabrication is checked using scanning electron microscopy, and the 1D object is characterized using TE and TM polarized illumination.

Nonlinear Effects of Quantum Tunneling in Nanometer Sized Metal-Insulator-Metal Structures

School of Engineering: Electro-Optics Graduate Program | *Oral Presentation - Graduate Research*

STUDENTS Mallik Mohd Raihan Hussain | ADVISORS Joseph W Haus

LOCATION, TIME Kennedy Union 211, 2:00 PM–2:20 PM

In this project we will theoretically study the quantum origin of nonlinear, electromagnetic scattered waves in preparation for designing future experiments. The scattered wave appears after an incident wave impinges on a nanostructured surface, which is made from metal and dielectric constituents. The sample geometry will be designed so that there is a nanometer-sized gap between two metals that is filled with an insulator (dielectric) material. Our simulations will incorporate electron tunneling characteristics derived from the recently proposed quantum conductivity theory (QCT). QCT efficiently describes quantum tunneling effects in the electromagnetic scattering calculations by producing a set of nonlinear conductivities that are incorporated into the tiny insulator gaps between two metals. The initial results will be compared to those available in the literature to validate our simulations. For this research, we will extend the application of QCT by studying a nanometer-size wire cylinder as one of the metal structures that will lie over a metal surface that is coated with a thin dielectric film. The electromagnetic scattering properties of the metal-insulator-metal (MIM) nanostructures that we are interested in this research are: (i) second- and third- harmonic generation (ii) the quantum origin of quenching the local field enhancement, and (iii) the directionality of the electromag-

netic scattering. Following the procedures of QCT, the nonlinear quantum conductivity coefficients of the dielectric medium will be calculated for the nanocylinder-surface geometry previously described. The validated simulation results will be extended to design experiments that will be used to test further predictions of QCT.

Smartphone Based Optical Wavefront Sensors using Distorted Micro-gratings

School of Engineering: Electro-Optics Graduate Program | *Oral Presentation - Graduate Research*

STUDENTS Zhenyu Yang | ADVISORS Qiwen Zhan

LOCATION, TIME LTC Meeting Space, 2:40 PM–3:00 PM

There is a recent rapidly increasing interest in portable devices that integrate optical sensing techniques with smartphones. The communication abilities of smartphones can be utilized for sharing data to processing servers or cloud experts, making the device more useful in many field-sensing applications. The goal of this work is to demonstrate a compact smartphone based wavefront-sensing with many potential biomedical applications. In many bio-related sensing applications, tissues and other targets are transparent and can be hard to analyze with just intensity images. Wavefront sensing has the ability of capturing phase information, and significantly improves the contrast without marking the sample, which is extremely useful in applications such as living cell studies and medical diagnosis. To adapt the technique onto the smartphone based sensing platform, distorted micro-gratings are designed and placed in front of the smartphone camera. These micro-gratings were designed to separate ±1 diffraction order images onto the camera CMOS sensor. Thereafter, raw images taken in one shot can be used as a group of input data for the algorithm of solving the wavefront.

Following robot

School of Engineering: Engineering Technology | *Oral Presentation - Independent Research*

STUDENTS Donghua Lu | ADVISORS Mohammadjafar Esmaeili

LOCATION, TIME Kennedy Union 211, 1:00 PM–1:20 PM

Following RobotThe Following Robot is a kind of autonomous mobile robot that can spot the location of users and move towards them. It can be used in many scenarios in manufacturing to provide convenience, such as carrying heavy equipment, rescue robot. I decided to use Arduino to develop such a robot. Based on my research, the robot will be equipped with RFID sensors assisted with the GPS model for localization. I can also use and modify the GPS model on a cellphone to control the robot. So, my project will include implementation of sensors on Arduino board.

Comparison of Small-scale Parallelization Calculations between GPU and CPU

School of Engineering: Engineering TechnologyvOral Presentation - Course Project, 201480 ECT 466 01

STUDENTS Zhiheng Ding | ADVISORS Mohammadjafar Esmaeili

LOCATION, TIME Kennedy Union 211, 1:20 PM–1:40 PM

There is a tendency to utilize the hybrid processor (CPU & GPU) for high performance computing (HPC) in the professional field for the mass computing requirement. However in the general public or small-scale computing field, there are few studies illustrate the potential of hybrid processor. CPU has been used in the main stream and smaller scale computation for a long period of time. In order to support the necessity of the hybrid processor for the computing demands of the future, this research seeks to investigate the application of GPU and CPU in small- scale computation scenarios. Programming languages of C++ and CUDA are used to invoke CPU and GPU in the project. Small-scale of arrays are applied in parallelization calculations separately by only GPU or CPU. Execution time of all the calculation time has been analyzed in order to obtain the performance and potential of using GPU and CPU.According to the outcomes of this research:1. In the small-scale parallelization calculation, CPU has a faster execution time than GPU. But with the increment of array size or parallelization, GPU tend to have a speed up, and CPU tend to have a speed down.2. If the processors are assigned to execute repeating process, CPU tend to have a stable performance, and GPU perform randomly.3. If the processors are assigned to execute repeating process, CPU tend to have a constant performance, and GPU have a significant speed up after initiation.To sum up, CPU and GPU have their own advantages and disadvantages. Requirements of user experience and technology are increasing, conjunction of CPU and GPU has a promising potential in the application of general public.

An End of Life Study of the Post Consumer Carpet Industry

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Kyle Jeffery Agne, Hesham N Alfahad, Matthew M Orth, Heather M Smith | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

The goal of this research is to conduct a market analysis on the disposal of carpet and determine which carpet disposal method is best for the environment. The research will be studying the various recycling techniques that are currently being used. Along with these goals, research will also study various reverse logistic methods for carpet and which is the best for the environment.

After conducting the market analysis it was determined that the amount of carpet being sent somewhere other than a landfill has been increasing since 2002 and will increase linearly up to the 2024. Meanwhile, there has been a gradual decrease of the amount of millions of pounds being discarded each year. This trend will also continue through the year 2024. Along with a market analysis, a study of the economics of the recycling process of carpet, logistics of recycling, and environmental effects of carpet recycling were conducted. There is an intricate connection economically and logistically between recyclers, wholesalers, collectors, and consumers who all depend on one another to make recycling successful. To better understand the logistics of carpet recycling, all the key players from manufacturing to collection and recycling were accounted for in a flow chart to easily represent all the critical steps along the carpet recycling process. When a piece of carpet reaches the end of its life the consumer has three different options of disposing the carpet. Carpet can be recycled, sent to a landfill, or incinerated. This study will determine which of these three is the best option

Closed Loop Container Glass Recycling in the State of Ohio

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Jonathon P Caito, David D Carlos, Josh Obertino Norwood | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

Glass recycling is one of the fastest growing recycled materials in the country; however, there is a lot that comes into play in order to determine the efficiency of glass recycling. The state of Ohio is in a unique situation due to the fact that it is in close proximity to a large amount of glass production facilities, both in state and nearby out of state. This allows glass recycling facilities to achieve a high rate of production, as well as keep a relatively high efficiency rate due to low transportation cost. That being said, there is still much that Ohio can improve upon in order to both increase its efficiency and become closer to having a “closed loop” on glass usage. Currently the glass received for recycling outweighs the current demand for glass in Ohio; due to quality issues and differences in product demands, a large portion of the the processed recycled glass is shipped out of state, while raw materials are shipped in to glass manufactures. While this is not the only thing responsible for a huge loss in efficiency, it is also responsible for the unnecessary environmental impact of the excessive use of raw materials. This research will examine possible solutions in order to increase the efficiency and quality of the glass recycling process. Such acts as separate glass curbside recycling and color separation have shown to hold a significant impact on the percentage of the glass material retained form the recycling process, as well as the overall quality.

Comparison of the Life Cycle Energy Consumption in the Use Phase of Wireless Devices

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, RCL 572 01*

STUDENTS Nicole S. Erlich, Mariana Lopes, Ahmad Maarafi, Daniel C Smith | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

Smartphone and wireless device market has more than doubled in the United States since 2010. However, only few research have done regarding how much energy is consumed by the smartphone and the wireless device. This research aims at comparing the energy consumption and environmental emissions generated from the most energy-intensive processes in the life cycle of various smartphones and wireless devices with different consumption scenarios. The major processes looked at were the energy consumption for charging smartphones, data usage over 4G, 3G, and WiFi networks, as well as wireless storage in “the cloud”. Data transmission was found to be the greatest source of energy consumption in smartphones, however, new developed networks have dramatically improved the efficiency of data transmission. In order to compare the energy consumption of the wireless devices with the traditional methodology, energy consumption of desktop computers are compared. Moreover, energy required for networking and storage of data for traditional desktops and wireless devices are compared. Desktop computers typically utilize traditional networks and storage application whereas wireless devices typically utilize cloud networking and storage applications. It was observed that traditional desktops require more energy than modern wireless devices. The lower operation costs of smartphones more than make up for their higher data transmission energy compared to a WiFi connected desktop. When comparing traditional networking to cloud networking it was observed that the energy, server utilization, and many other benefits of cloud networking outweighed the benefits of traditional networking.

Copper Recycling: The Need of Increasing Copper Recycling in the United States

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Farouq M Al Omari, Thamer A Alasseri, Ibraheem M Alawadhi, Kevin P Hegman, Robert P Noll

ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

Global consumer electronic markets have been growing exponentially in recent years. Copper is one of the most important

non-ferrous materials contained in all electronic products and the portion of copper contents keep increasing for the new products on the market. Therefore, ensuring the resource availability along with the environmental impacts and economic aspects of copper becomes more important. The goal of this study is to analyze the environmental impacts and economic feasibility of the current copper recycling practice in the United States. Life cycle environmental impact analysis is performed for the copper production and recycling processes stages to evaluate the overall environmental impacts of both operations. The analysis was narrowed down to study sulfur dioxide emissions as a major influence over environment. Results shows that increasing copper recycling rates will lead to significant benefit in terms of reducing sulfur dioxide emissions which directly related to the acidification impacts. A cost-benefit analysis was performed to evaluate the difference in systematic costs between producing copper from scratch versus options for processing and recycling. Results showed that copper recycling could be more efficient and increasing copper recycling could bring more cost saving benefits to stakeholders involved in copper recycling business. The final conclusion of this study is that increasing copper recycling and reusing in the US is strongly encouraged due to the great benefits for environment along with it substantial cost savings. Stakeholders associated with the copper recycling are encouraged to make significant advancements in their recycling processes and recycling infrastructure design to gain all of the environmental and cost saving benefits.

Fleecing the Textile Industry: Economic and Environmental Perspectives of Polyester (PET) Recycling

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Moath K Aljohar, Stephen E Osseiran, Timothy J. Skillen, Prashanth Subburam | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM-10:15 AM

Approximately 64 billion pounds of textiles are produced annually in the world with 54.4 billion pounds of that going to landfill. Roughly 24.5 billion pounds of textile waste, or 45% of this amount, is composed of polyester clothing and textile waste. Of all of this polyester waste around 15% or 3.67 billion pounds of polyester is recycled every year. These materials are recycled in one of two ways; mechanical recycling (which shreds fibers and goes to create lower quality goods such as rags) and chemical recycling, where the material is broken down and restructured to create a material with characteristics almost exactly like a virgin material. In this study an economic cost-benefit analysis as well as environmental impact analysis will be performed. The economic cost-benefit analysis will provide details on what is more economically practical to produce; recycled polyester or a virgin product. The environmental analysis will focus on the impact creating virgin polyester has on the environment from a primarily energy based standpoint. This data will be compared to the same analysis on recycling polyester.The comparison will decide what product is more environmentally ethical and imperative to produce. These two assessments will then be combined to decide the practicality of using only recycled polyester to make products. The results of this study indicate that the economic cost impact of using recycled materials over virgin materials to be only slightly better. The environmental impact of recycling is inherently better than producing virgin products, but still requires large amounts of energy to transport from pickup location to recycling and re-spinning facilities. Future work on this subject should include a more concrete formula for transportation and production costs, something that does not currently exist on a macro scale.

Glass Recovery is Half the Battle

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Abdullah Almandeel, Anas M Alwatban, Shanthan Reddy Kakulavaram, Daniel J. Kelley | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

In an energy conscious society, all methods of saving or conserving energy become important. One such way is through recycling. The energy saved by recycling a single glass bottle could be used to light a 100-watt light bulb for four hours, power a computer for half an hour, or a television for 20 minutes. Ohio sends approximately 90% of consumed glass containers to the landfill. There is tremendous room for improvement for glass recycling. This research focuses on how to increase the glass recovery from consumer to recycling facilities by addressing the social, economical, political, and logistical aspects associated with glass recovery. Social factors that influence likelihood to recycle are investigated through a literature review. The container deposit law that a small number of states employ will be quantified through statistics and compared to Ohio's statistics. The logistics of recycling availability for Ohioans will be assessed and displayed. The economics of incentive programs and the impacts of an increase in glass recovery will be quantified through a cost savings analysis. An integrated plan of these four aspects will be provided. The results will show what the estimated potential percentage participation increase could be by implementing this proposed plan. The paper will conclude with the impacts of various levels of participation and how much energy savings will increase.

MY GREEN PC: The Government Program to Kick-Off Green Technology

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Hussain Aziz, Matt D Hurtubise, Amanda Leah Post | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

The use of personal computers throughout industry and society has dramatically increased in the last 20 years. In 2010 alone, the number of PCs sold in the U.S. reached nearly 40 million devices. However, according to a study conducted by Columbia University, only 40% of laptops and PC's in the U.S. were recycled in 2010. The environmental concerns for disposing PC's are rising due to the amount of toxic wastes and slow-degrading plastics that are being put in landfills. There are many disposal methods currently used for e-waste but the U.S. has not implemented a plan to improve PC recycling or encourage computer users to resell their old computers. Economically and environmentally, the recycling of a PC is more efficient than disposing of it due to the many recyclable materials within the components of a computer. The objective of this study is prove that a federally funded strategy can be implemented in the U.S. which will encourage consumers to turn in their used PCs for a rebated price to increase the number of recycled computers throughout the country. The method for analyzing the data on PC recycling is calculated by summing the cost of recyclable materials that can be sold from the computer parts. In addition, wholesale companies will receive benefits for collaborating with the US government to improve the recycling program which is big step toward the program's success. The calculations made in the study prove that a federally funded program is possible with the consumers receiving an 8% rebate on returned computers which will allow the government to hopefully reach a recycling rate of nearly 80% of recycled computers in the United States.

Optimization of Photovoltaics Recycling Network: Case Study of California

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

STUDENTS Qi Guo | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

In the United States, there is no systematic movement to set up a photovoltaics (PV) recycling infrastructure as of now. Like any other end-of-life planning, it is vital to develop and institute economically feasible and environmentally viable recycling infrastructure for the emerging PV industry in parallel with the rapid commercialization of these new technologies. PV recycling planning includes various challenging issues in temporal, spatial, and technical dimension. Various stakeholders will be involved in the recycling network and the issue of management covers diverse aspects such as the collection, distribution, inventory, and reclaiming of materials. Within such a complex recycling network, a systematic approach has to be adopted to adequately capture the dynamic interactions between stakeholders. The main objective of this study is to develop a rigorous mathematical framework, with which to analyze the economic feasibility of PV recycling systems in the United States. California is selected as the geographical location of this study because of the prevalence of PV installation as well as the strict environmental regulation in the region. There are four main steps of research performed: 1) Information about the location of all the PV installation sites in the state of California along with the location of stakeholders involved in the proposed recycling framework are gathered, 2) Geographic Information Systems (GIS) tool boxes are utilize to locate the feasible location of PV recycling centers for various scenarios, 3) total system costs and environmental emissions generated from diverse PV recycling scenarios are compared, 4) economic and environmental trade-off analysis are performed to assist optimized decision making processes. The outcome of this research will facilitate systems analyses for planning of state and national recycling programs for various kinds of PV modules. The general framework developed by the proposed research will allow an efficient decision making on the conservation of natural resources and the mitigation of environmental emission.

Pathway Toward the End-of-life Options for Medical Devices and Equipment

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 472 01*

STUDENTS Tyler J Bagdasarian, Aleksandar Grocic, Julia C Hauser, Jose C Panameno | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM-10:15 AM

At the end of life, medical equipment can follow three major paths. The first being destruction, medical equipment which cannot be sterilized and is contaminated, then are incinerated; an example of this would be surgical waste that is soaked in bodily fluids and cannot possible be re-used. Some equipment contains toxic elements such as mercury and are dealt with according to the proper regulations and standards. The second path is recycling option. For example, in the case of MRI machines and many medical devices, more than 90% by weight can be recycled for material content. The final major path medical devices take is refurbishment. Medical devices on this path are generally collected by the manufacturers, fixed, updated, supplied with a new warranty and resold to the secondary market at a large percent of the original sticker price.This research examines the current practices of incineration, landfill, reuse, and refurbishment for medical devices and how the the industry can best reduce the environmental impact of these practices, reduce costs for hospitals and consumers, and improve the humanitarian efforts which are already underway. In addition, this research will discuss the philanthropy efforts surrounding reusable medical equipment and government involvement and incentives to recycling, reuse, and donate medical devices. A trend of refurbishment rather than buying new could be emerging from hospitals due to the Affordable Care Act which often case exempts refurbishers from a new medical device tax that was implemented under the law.

Retrofitting Retiring Coal Fired Power Plants to Burn Rubber Tire Scraps

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, RCL 572 01*

STUDENTS Abijitth Guruprasad, Naga Bhavya Kancheti, Abhinandan Ravikumar | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 9:00 AM–10:15 AM

New legislation passed by United States Environmental Protection Agency in 2011 requires fossil-fuel fired electric generation units to limit the amount of toxic emissions releases by combustion. Two most important measures, known as Cross-State Air Pollution Rule and the Mercury and Air Toxic Standards, will effect roughly 1,100 coal-fired electric generation units. These facilities are forced to decide between investing in scrubbing technology to reduce their emission rates and retiring. The number of facilities retiring is unknown but many predictions expect severe electric generation capacity reductions in regions that rely heavily on coal-fired generation. The amount of planned electric capacity additions at this juncture do appear to be enough to replace the minimum projections of coal-fired capacity lost while also sustaining the steadily yearly growth of electric capacity that has occurred every year to meet increasing electricity consumption in the United States. In this study, the emergence of cleaner burning tire-derived fuels was examined as an alternative fuel source to help combat this loss in electric capacity. Tires produce almost the same energy as petroleum and approximately produces 25% more energy than coal. The pollutants emitted from the combustion of coal versus the combustion of scrap tires, and their environmental impacts are assessed. An actual power plant retiring in 2015 in central Ohio near both tire collection and tire shredding facilities was considered as a case study to test the feasibility of tire-derived electricity generation to replace the coal-fired capacity. In addition, the electricity generated from different grades of coal compared to rubber tires are examined.

A Mechanical Regenerative Brake and Launch Assist using an Open Differential and Elastic Energy Storage

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

STUDENTS Vijay Krishna | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Regenerative brake and launch assist (RBLA) systems are used to capture kinetic energy while a vehicle decelerates and subsequently use that stored energy to assist propulsion. Commercially available hybrid vehicles use generators, batteries, and motors to electrically implement RBLA systems. Substantial increases in vehicle efficiency have been widely cited. This project presents the development of a mechanical RBLA that stores energy in an elastic medium. An open differential is coupled with a variable transmission to store and release energy to an axle that principally rotates in a single direction. The concept applies regenerative braking technology to conventional automobiles equipped with only an internal combustion engine where the electrical systems of hybrid vehicles are not available. Governing performance equations are formulated and design parameters are selected based on an optimization of the vehicle operation over a simulated urban driving cycle. The functionality of this elastically-based regenerative brake device has been demonstrated on a physical prototype.

Assessing Shape Repeatability in Variable Geometry, Polymer Extrusion Dies

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

STUDENTS Alex M Watt | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Polymer extrusion is a manufacturing process of forcing a melted plastic through a die to create a continuous part with a constant cross-section dictated by the die's geometry. The typical process uses a fixed die that creates high output at low cost when compared to injection molding. The overarching goal of this project is to develop dies capable of changing cross sectional area during the extrusion process. Preliminary dies have been designed, created and operated in a production process. In order to test the shape repeatability of these dies, a laser scanner was used to capture cross sections at numerous locations along the resulting parts. A numerical process was then developed to accept the data from the scanner and create a representation of the profile. These profiles were then compared to the profiles at other locations. The repeatability of the sections from these variable geometry parts has been found to be similar to fixed-geometry parts. Further, the extruded parts have also been compared to the die exit geometry to examine expansion that occurs during the process.

Enhancing Industrial Sustainability by Improving Resource Efficiency

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

STUDENTS Dillip Thangamani | ADVISORS Jun-Ki Choi, J Kelly Kissock

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

With ever increasing energy and raw material costs, coupled with environmental regulations and increasing customer awareness of corporate sustainability efforts, industries are seeking to increase energy and resource efficiency. Over the past

decade, the University of Dayton's Industrial Assessment Center (UD-IAC) has developed a systematic methodology and analysis tool to help industry become more energy efficient. The publicly-available Efficiency Guidebook (EEG) is a comprehensive tool that integrates examples and computational resources for improving energy efficiency. This study describes a parallel effort to improve industrial resource efficiency by developing a methodology for improving resource efficiency and incorporating it into a free publically-available software tool called the Resource Efficiency Guidebook (REG). The methodology focuses on six types of resources: water, raw material, chemical agents, process scrap, packaging waste, and equipment and applies seven principles of resource efficiency to these resources. The result is a prioritized Integrated Resource plus Principles Matrix that guides manufactures through the resource efficiency process. REG combines the Integrated Resource plus Principles Matrix with real-world saving examples and spreadsheet calculators. Case studies with scenario analyses demonstrate the effectiveness of the REG at cost-effectively improving resource efficiency and reducing waste.

Error in Off-Axis Loading of Off-the-Shelf 6 Component Force Transducers:A Cautionary Tale

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

STUDENTS Sidaard Gunasekaran | ADVISORS Aaron Altman

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Significant, repeatable errors can result when loading off-the-shelf 6-component force transducers at relatively short distances off-axis. The availability of low-cost high-precision 6-component force transducers has resulted in their wide adoption in aerodynamic testing of small unmanned aircraft and their propulsion systems. Companies such as ATI Industrial Automation (www.ati-ia.com) offer a comprehensive range of force transducers. These transducers are robust, have excellent overload protection, provide good frequency response, weak temperature sensitivity (and integral compensation), are available with an array of different interface options (Ethernet, Differential Voltage), have NIST traceable calibrations, and many are available in waterproof form. For the most part, these sensors have evolved from sensing elements in robotic end-effectors and as such are extremely accurate when the applied loads are in close proximity to the sensor face and axially aligned with the transducer center. This paper will describe an instance where such axial alignment is not possible. The endeavor of loading the sensor off of the balance center resulted in error in force and significant error in torque. As a result, a number of permutations of off-axis loading were investigated to better elucidate the cause of the error. The magnitude of the measurement error provides substantial incentive to produce an independent sensor interaction matrix when test circumstances dictate similar off balance center loading.

Joint Design and Analysis of Leakage in Movable Extrusion Dies.

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

STUDENTS Suresh Kumar Kanathala | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

This project presents an analysis of various joint types used in variable geometry dies that enable the extrusion of plastic parts with a varying cross section. Extrusion accounts for 40% of all manufactured plastic parts because it is a relatively low-cost and high-production-rate process. Conventional polymer extrusion technology, however, is limited to fixed dies that produce continuous plastic products of constant cross section defined by the die exit profile. A shape changing die allows the cross section of the extruded part to change over its length, thereby introducing the capacity to manufacture plastic faster and with lower tooling costs than injection molding. To allow movement within the die components, various joint designs have been developed. Clearance between the mating parts are required to properly function. These clearances create leakage paths for the plastic melt to escape the die and potentially degrade the quality of the plastic part. Computational fluid dynamics models have been constructed and used to assess the effect of the clearance size on the leakage through the joints. The goal of this analysis is to optimize the geometry of the joints.

Morphometric Skull Analysis Using Jointed Chains of Rigid Bodies

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

STUDENTS Bingjue Li | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Morphometrics seeks to quantify shapes for the purposes of comparison. This work investigates two morphometric problems by applying the theory of shape-changing rigid-body mechanisms. The first problem is the analysis of a head growth in children. The second problem is the spatiotemporal evolution of the longitudinal human skull shape. These problems are specified with a set of curves that represent the cranium shapes as they change over time, in the child's head as it grows and in the skull as it evolves. Using the rigid-body shape-changing mechanism design methodology, a chain of rigid links connected by revolute and prismatic joints is generated to approximate the set of curves. The advantage of approaching morphometrics in this way is that a modest number of physical parameters describes the changes between the curves.

Multi-segment foot biomechanics with varying foot orthotic postings

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

STUDENTS Hilary F Feskanin | ADVISORS Joaquin A Barrios, Kimberly E Bigelow

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Foot orthotic devices are often used to treat overuse injuries, over- or under- pronation of the foot, knee pain, and other foot disorders. Clinical documentation shows the effectiveness of foot orthoses but there is little understanding of the mechanisms behind these outcomes. Existing studies of foot orthoses focus on rearfoot biomechanics, yet these devices are aimed at changing whole-foot mechanics. Additional research on the mechanical effects of orthoses is often suggested.The main goal of this study was to evaluate the effects of different foot orthotic devices on foot mechanics. In order to assess the effects foot orthoses have on the midfoot, we placed reflective markers on the participant's lower limbs and right foot and recorded the leg mechanics as the participant walked across a 75 ft walkway.We expected directional movement patterns based on the location and type of orthotic posting or lift. It is possible that a better understanding of the effects of orthotic devices can lead to more effective treatments for patients with foot disorders.

Multistage Flash Desalination with an Integrated Solar System

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

STUDENTS Mishal Barki Alsehliv | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Desalination is considered to be a promising solution to overcome the problems of water shortage especially for countries that have dry weather conditions with less rainfall around the year. Thermal processes have the highest capacity among all other desalination processes but it consumes significant amount of fossil fuel which severely affects the environment in diverse aspects. On that end, the importance of using renewable energy source such as solar desalination has increased in the present time. In solar desalination, the energy can be transferred in the form of either thermal energy as used in thermal storage technologies or electrical energy used in photovoltaics (PV) technologies. This research presents a novel design scheme of the solar multistage flash-thermal storage tank (MSF-TST) system. In the designed Solar MSF-TST, the brine heater is eliminated and stages are connected to thermal storage tanks. Storage tanks system is capable of running a desalination plant for all day at full load. The system is consisted of two tanks where the sea water is heated and stored. On one day, one tank is filled up with sea water and heated by solar collectors (i.e. charging/storage mode) while the other tank provides the desalination stages with hot brine water stored from the previous day (i.e. discharging/feeding mode). On the following days, alternative processes continues. In this research, a mathematical model is developed to predict the Top Brine Temperature (TBT) of MSF-TST under variation of operating parameters in different transient conditions. The MSF-TST system with 20 stages is modeled to produce 250 ton per hour of purified water with expected TBT 90-110^{o}C. The expected saving of fuel consumption is estimated to be eighty percent when compared with the conventional Multistage Flash Desalination.

Quantifying the Impact of Adding Renewable Energy on the Grid from Economic Point of View

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

STUDENTS Seyed Ataollah Raziei | ADVISORS Robert J Brecha, Malcolm W Daniels, Kevin P Hallinan

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Growth in renewable energy, particularly of wind power and solar photovoltaics (PV) has been rapid over the past decade, averaging 25-30% a year. There are several reasons for this growth, including recognition that mitigation of anthropogenic climate change, mainly due to emissions of carbon dioxide from fossil-fuel combustion will require a dramatic transformation in our energy system over the course of the next few decades. Renewable energy generation has several benefits not only for our generation, but for our children as well.However, the problems of adding more renewable energy, specifically from the point of view of the stability and reliability of the grids have gradually come to light. Nowadays rather than uncertainty behind the demand behavior, electricity entities have to deal with uncertainty behind the renewable energy generation. Because of this, stabilizing the electrical grids has become more complicated.Substantial research is going on in order to remedy the problems of stabilizing the grids having a notable percentage of renewable energy on the grid. One of the best offered solution is adding storage systems on the grids. However the main problem is a lack of consideration of the problem from the economic point of view.The primary aim of the proposed research is to pair the offered solutions of stabilizing the grid to the economic assessment of the grid. The main focus will be on the macro scale of the grid when distributed storage and renewable energy generation exist. Both short term and long term feedback of deploying each scenario will be considered.

Rapidly Locating and Accurately Tracking the Center of Mass Using Statically

Equivalent Serial Chains

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

STUDENTS Ali Almandeel | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Identifying the center of mass location (CoM) provides a significant aid in controlling the balance of humanoid robots. For human beings, the stability of motion is highly influenced by their ability to control their CoM and center of pressure (CoP). Additionally, computing the CoM can prove critical to assessing rehabilitation and in elite sports training. Human body segment parameters can be obtained from anthropometric tables. Their accuracy for a given individual is questioned due to differences in age, race, and fitness level from the sample population. This research presents an estimation technique that uses the statically equivalent serial chain (SESC). A SESC is a representation of any multilink branched chain, like a human or humanoid, whose end-effector locates the CoM. The SESC's construction during an experimental phase depends on the node positions from a motion capture system (like the Microsoft Kinect), and the total mass and CoP from a force plate (like the Wii Balance Board). Additionally, the presence of a static body in the workspace (a walker or chair, for example) to create stability in test subjects is presented. The utility of the presented method as compared to other common methods for CoM estimation is that the force plate is not needed to track the CoM after the SESC is constructed.

Reducing Structural Error in Function Generating Mechanisms via the Addition of Large Numbers of Double-Crank Linkages

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

STUDENTS Hessein Ashour | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

This research presents a methodology for synthesizing planar linkages to approximate any prescribed periodic function. The mechanisms selected for this task are the slider-crank and the geared five-bar with connecting rod and sliding output (GFBS), where any number of drag-link (or double crank) four-bars are used as drivers. A slider-crank mechanism, when comparing the input crank rotation to the output slider displacement, produces a sinusoid-like function. Instead of directly driving the input crank, a drag-link four-bar may be added that drives the crank from its output via a rigid connection between the two. Driving the input of the added four-bar results in a function that is less sinusoid-like. This process can be continued through the addition of more drag-link mechanisms to the device, slowly altering the curve toward any periodic function with a single maximum. For periodic functions with multiple maxima, a GFBS is used as the terminal linkage added to the chain of drag-link mechanisms. The synthesis process starts by analyzing one period of the function to design either the terminal slider-crank or terminal GFBS. A randomized local search is then conducted as the four-bars are added to minimize the structural error between the desired function and the input-output function of the mechanism. Mechanisms have been "grown" in this fashion to dozens of links that are capable of closely producing functions with a variety of intriguing features.

Rural Area Microgrid Implementation Repository (RAMIR): A tool for Integrating Economic, Environmental, and Societal Aspects of Microgrid Systems Implementation.

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

STUDENTS Jada Williams | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Installing an efficient power generation infrastructure requires sensible selection strategies to consider significant variations of planning requirements for specific geographical regions. There has been a growing effort of research to provide a technically sounds and economically feasible source of electricity to underdeveloped regions through microgrid systems. However, there has been little effort to provide information through easily accessible web spaces or repositories to locate relevant research for rural area microgrid development. The main intention of this research project is to generate an open source web based tool named the Rural Area Microgrid Implementation Repository (RAMIR) to support microgrid implementation for rural cities and towns. RAMIR is intended to compile, track, and present relevant and useable information about the intended site for policymakers and student researchers in academia while aiming to facilitate decision making process on planning the implementation of the rural microgrid system. In order to show the efficacy of the tool, a case study of Sourou, Burkina Faso is presented. Energy demand of the city was calculated by interpolating values from a renewable energy installation project. HOMER software was used to select the size of the system and other inputs such as energy generation, conversion, and storage technologies. In order to evaluate impacts outside of the technical aspect of the optimized microgrid system, a decision making software (DMS) is used to compare the environmental and societal impacts of the candidate systems. This effort bridges the gaps where HOMER lacks in functionality and allow decision makers to consider the broader impacts of microgrid implementation projects within a community.

School-Books on Tape: The Tensile and Adhesive Strength of Duct Tape in a College Backpack

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

STUDENTS Robin E Ker | ADVISORS Margaret F Pinnell

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Two general categories were used to assess the strength of duct tape constructions: adhesive strength and tensile strength. Previously made duct tape backpacks frequently suffered from adhesive failure around the narrowest portion of the shoulder straps, and where small cosmetic patches were applied. When a backpack is lifted, it experiences a force which is greater than the resting weight.The hypothesis states that there is an area of application between two pieces of duct tape such that they will behave as a uniform piece and experience tensile failure, that two sufficiently overlapped pieces can hold within 5% of the load carried by a single piece, and that there is a relationship between the resting weight of a loaded backpack and the load applied to the straps when lifted.Five types of tape underwent tensile and lap shear testing in an Instron 4486 load frame. The tension test specimens were of uniform length, the lap-shear specimens had lengths which varied with the areas of overlap. There were two types of lap shear specimens: with adhesive layers in contact (LSA), and with the adhesive layer of one half adhered to the backing layer of the other (LSN). Maximum load and extension data was collected.Three backpacks were tested to determine the apparent load carried by the shoulder straps and handles when various static loads were applied. The backpacks were lifted with a Desik analog push-pull gauge which recorded maximum load.The maximum loads for the lap shear specimens were within 5% of the tension test results for four types in LSA and three types in LSN. The results for static vs. apparent loading means that a 25 lb. backpack needs to withstand 40 lbs. when lifted. The type of duct tape which is recommended for future backpack construction is 3M 3900.

Singularity Traces of Planar Linkages That Include Prismatic and Revolute Joints

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

STUDENTS Saleh M Almestiri | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

The purpose of this research is to understand the motion characteristics of a linkage as a design parameter is altered. Understanding the motion characteristics of a mechanism is an important step in designing machinery. Kinematic analysis theory utilizing isotropic coordinates is implemented to construct mathematical models of planar linkages composed of rigid bodies, revolute joints, and prismatic joints. A graphical representation has been developed to represent the gross motion characteristics of a linkage called a singularity trace. The singularity trace provides a visual snapshot of the effects of altering a design parameter of the linkage by including the number of assembly circuits and the location of locked configurations. Bertini, software for solving large algebraic systems of equations, is used to determine the critical points of the singularity trace. MATLAB is then used to integrate from the Bertini solutions to plot the complete singularity trace.

Study on Graphene’s photovoltaic potential and its comparison with other conventional materials

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

STUDENTS Ashish Gogia | ADVISORS Kevin P Hallinan

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Graphene has unique optical properties that make it different from other materials that are used to turn light to electricity. Graphene when absorbs a photon, generates multiple electrons while materials like silicon and gallium arsenide, generate a single electron for each photon absorbed. This means that when these conventional materials are being replaced by Graphene, the efficiency of solar cells will be increased and it also reduces the light dissipation as heat. Graphene is one of the most diverse materials available and has a variety of other remarkable electrical and mechanical properties. It has applications in fields of biological engineering, optical electronics, ultra filtration, photovoltaic, sensors and devices, nanotechnology etc. Through this paper, we will study all such properties that make it different from all the materials available.

Synthesizing Coupler-Drivers as a Novel Method for Actuating Mechanical Systems

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

STUDENTS Hameed Juma | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Abstract:The objective of the proposed work is to change the mechanical design of an automated manufacturing or assembly process by introducing coupler drivers. Currently, the design of a mechanism to be included in a manufacturing or assembly process requires one of the joints in the mechanism to be used for actuation. That is, the desired motion of the device and how it will be moved are coupled and this complicates its design. The proposed work looks at decoupling the kinematic synthesis of a mechanical system from the actuation synthesis of the system. This is accomplished via a mechanical chain called a coupler driver. This work develop the kinematic synthesis theory needed to design a coupler driver for any single degree of freedom mechanical system. The research will develop the mathematical representation of coupler drivers. A MATLAB code for solving the mathematical model will be developed to validate and verify proposed solutions.During the kinematic synthesis of a single degree of freedom mechanism for a given task, a challenge is finding a solution mechanism that is not hindered by branch singularities relative to any of its driving joints. Trying to achieve the motion characteristics while avoiding the branch singularities severely limits the design space. This work approaches the problem of avoiding branch singularities by actuating a mechanism via an additional chain (set of links) attached to it.The challenge is identifying end point locations that is mechanically feasible and, drive the mechanism monotonically through its task thereby avoiding the branch singularities. The goal of this proposal is to develop the mathematical framework for identifying all possible end points for a coupler-driver for a user-defined mechanism.

Trends in Early Vortex Formation on a Wall-to-wall Plate in Pure Plunge

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

STUDENTS Sidaard Gunasekaran | ADVISORS Aaron Altman, Kenneth Granlund

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Discernible trends in early vortex formation have been in inter vortex-plate distance, circulation, and vortex maximum azimuthal velocity when plunging a wall-to-wall flat plate at fixed angles of attack ranging from 15o to 90o with two different accelerative profiles. Vortex formation and shedding continues to play an important role in unsteady aerodynamics with applications ranging from flapping wings to maneuvering flight to helicopter rotors. Above a relatively low angle of attack when a flat plate is plunged in a fluid a leading edge vortex (LEV) is formed close to the leading edge and a trailing edge vortex (TEV) is formed close to the trailing edge. The formation, growth and convection of the LEV and TEV strongly influence the pressure field surrounding the flat plate and ultimately the forces experienced by the plate. Experiments were performed at the United States Air Force Research Labs Horizontal Free Surface Water Tunnel (AFRL/HFWT) with linear and sinusoidal acceleration profiles. The formation of the LEV was investigated for both acceleration profiles using Particle Image Velocimetry (PIV). Trends were identified in both the LEV distance to the plate as a function of convective distance and with angle of attack. Similarly, trends were identified in maximum vortex azimuthal velocity. The LEV normalized azimuthal velocity profiles were compared with several vortex models in the literature. The existing models were unable to reproduce the asymmetric azimuthal velocity distributions resulting from vortex proximity to the plate. A new model based on experimental results is proposed for the LEV core azimuthal velocity distribution inclusive of plate proximity effects.

Variable Extrusion Dies that Exhibit Significant Change in Exit Area

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

STUDENTS Heather M Smith | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Conventional polymer extrusion is a common manufacturing process in which plastic resin is melted and pulled through a fixed-geometry die plate to produce a shape. This process creates long parts with a uniform cross-sectional area, including pipes, molding, and window frames. Shape-changing dies would expand the capabilities of extrusion by allowing the cross-sectional area to change over the length of the extruded part. This would allow for parts manufactured more quickly and at a lower tooling cost, as compared to other processes such as injection molding. A constant extruder screw speed is desired throughout the process due to the pellets being melted by friction within the screw. As the area of the orifice changes throughout the extrusion, problems arise which may be pacified by varying the line speed, or tracking differences between the final shape and the exit area of the part. The goal of this project is to design a series of variable extrusion dies that exhibit significant changes in area. Three types of die were created, each evaluating a different strategy, including bypass ports and shape modifying features beyond the die exit. The dies have recently been produced, installed, and tested to evaluate the various features of each design.

Wright B Flyer Silver Bird Replica Senior Design Project

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Capstone Project*

STUDENTS Domenic M Miccinilli, Matthew R Pulfer, Denton G Sagerman, Alex M Watt, Seth D Wieging | ADVISORS Aaron Altman

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

The Wright Model B Flyer was one of the first piloted aircraft produced by the Wright brothers in 1910. Wright B Flyer Incorporated specializes in fully functional Wright Model B replicas. The Silver Bird was an aircraft designed and manufactured by the company back in 2007. Unfortunately, the plane and its two pilots were lost due to a welding failure that caused the propeller mal-

function. The company has since commissioned another model to be designed and built. The overarching goal of this research is to verify the existing design and perform sensitivity studies to see if the performance can be improved given certain model constraints. Thus far, engineering drawings, as well as 3D models were used to extract crucial dimensions and aerodynamic locations. Other considerations including, but not limited to, airfoil design, constraint analysis, weight buildup, and CG envelope have also been investigated. Test pilots have flown the model to compare the flight characteristics of the simulated aircraft to the previous Silver Bird. The pilots' feedback, input from other Wright B Flyer Inc. personnel, and flight test data comparisons have been used to evaluate the accuracy of the model. Further investigations will involve looking into various geometric changes to the model and analyzing the effect of these deltas on various flight parameters. These cause and effect results will impact the future design of the Silver Bird, as Wright B Model Inc. looks to build a more effective and transportable model that encompasses the original Wright B Silver Bird model.

Enhancing Industrial Sustainability by Improving Resource Efficiency

School of Engineering: Mechanical and Aerospace Engineering | *Oral Presentation - Graduate Research*

STUDENTS Dillip Thangamani | ADVISORS Jun-Ki Choi

LOCATION, TIME Kennedy Union 311, 2:00 PM–2:20 PM

With ever increasing energy and raw material costs, coupled with environmental regulations and increasing customer awareness of corporate sustainability efforts, industries are seeking to increase energy and resource efficiency. Over the past decade, the University of Dayton's Industrial Assessment Center (UD-IAC) has developed a systematic methodology and analysis tool to help industry become more energy efficient. The publicly-available Efficiency Guidebook (EEG) is a comprehensive tool that integrates examples and computational resources for improving energy efficiency. This paper describes a parallel effort to improve industrial resource efficiency by developing a methodology for improving resource efficiency and incorporating it into a free publically-available software tool called the Resource Efficiency Guidebook (REG). The methodology focuses on six types of resources: water, raw material, chemical agents, process scrap, packaging waste, and equipment and applies seven principles of resource efficiency to these resources. The result is a prioritized Integrated Resource plus Principles Matrix that guides manufactures through the resource efficiency process. REG combines the Integrated Resource plus Principles Matrix with real-world saving examples and spreadsheet calculators. Case studies with scenario analyses demonstrate the effectiveness of the REG at cost-effectively improving resource efficiency and reducing waste.

Developing New Test Methods for Ceramic Matrix Composites using Digital Image Techniques

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

STUDENTS Brittanie M Rooths | ADVISORS Margaret F Pinnell

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

Ceramic matrix composites (CMCs) are a promising material for high temperature applications (1000-1500˚C) and are potential candidates for structural aerospace applications. A major concern when designing a CMC component is delamination due to their low interlaminar tensile strength. This work focuses on developing a new method which uses the coupon geometry to generate an interlaminar tensile load. Micro digital image correlation (DIC) was used to measure localized strains to identify discontinuities in the gage section of the test coupon. While this new ILT test looks promising, there are several challenges that need to be addressed. Computed Tomography (CT) scans were used to acquire detailed images of the internal structures of the CMC. Additionally, the CT images were used to determine the feasibility of conducting digital volume correlation (DVC) on Ox/Ox CMCs.

Additive Manufacturing Research of 3-D Printed Parts (Minority Leaders Program)

School of Engineering: Minority Engineering Program | *Poster - Independent Research*

STUDENTS Zakariye Issa Ali, Christopher Alexander Barrett, Lewis E Forman, Aaron F Lassalle, Lauren M Rivera

ADVISORS Maceo E Cofield

LOCATION, TIME RecPlex Main Gym, 10:45 AM–12:00 PM

After injury humans produce scar tissue as part of the wound healing process. This process does not generate new tissue, but prevent the remaining tissue from further damage. Without the ability to create new tissue, humans are limited in their capacity to regain lost function after severe injury. However, axolotls have the ability to regenerate a variety of organs within the first two weeks of hatching, allowing for complete recovery of tissue function. Specifically lens regeneration is studied due to the dynamic changes that occur in the surrounding iris tissue following lens removal. Dorsal and ventral iris cells proliferate and eventually regenerate the missing lens. Since axolotls are not able to regenerate the lens succeeding two weeks from hatching, this is the control group representing non-regenerating tissue. These axolotls contain the same genes which allows for specific manip-

ulation of iris tissues and examination of the different outcomes in hope of revealing the cause of regeneration. The goal of the current project is to study tissue regeneration at the molecular level, by influencing target genes through drug treatments within a specific biological pathway, in order to gain further insight about the mechanism of regeneration. When the mechanism of tissue regeneration is entirely understood, this research could be used to provide treatment in humans with severe tissue damage.