School of Engineering

Design and Fabrication of Composite I-Beams for Bending Load Applications

STUDENTS Punit Gupta
ADVISORS Donald A Klosterman
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP CME 595 03

Abstract:Composite is a special type of material that combines the properties of two different constituents thereby, enhancing its mechanical properties. These constituents are generally a fiber and matrix. Fiber imparts stiffness and strength to the composite while the matrix holds the fiber in place, so that fiber property translation into composite properties is achieved. The objective of this poster is to establish a basic understanding of how to design and fabricate a composite I-beam i.e a carbon-fiber composite I-beam that can be used for bending load applications. It also focuses on the analysis of stresses in beam bending. By beam theory, I-beam is shown to be a very efficient form for carrying both shear and bending loads in the plane of the web but the inefficiency of the I-beam is because of its cross-section which has a reduced capacity in the transverse direction, and also its inefficiency in carrying torsion. The I-beam consists of a carbon fiber unidirectional and woven laminas, as well as high density polystyrene foam to stiffen the structure. It is manufactured using a wet layup technique and cured with the help of vacuum. Composite beams are tested using the 3 point bending test. The limit load for a composite I- beam under pure bending is determined experimentally and theoretically. Through analysis and testing, it is determined that web stability was the driving failure mode and many aspects can be improved through manufacturing techniques. Use of an autoclave as well as using metal molds for curing the beam dramatically increases load carrying capability.

ETHOS A review on the importance of maintaining standards in Appropriate Technology

STUDENTS Candida Crasto, Marcy A Prendergast
ADVISORS Candida Crasto
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP EGR 330 P1

A review of Appropriate Technology evolution as it applies to the practical implementation of ETHOS Immersion contributions. This is pre-work for an upcoming ETHOS immersion in Auroville, India.

ETHOS A Translation of Biodigestion Feasibility across Continents

STUDENTS Candida Crasto, Anirban Mandal
ADVISORS Candida Crasto
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP EGR 330 P1

Taking an existing technology in one region and transplanting it successfully in another region. The is pre-work to an upcoming ETHOS immersion in Managua, Nicaragua.

ETHOS Appropriate Solar Technology for Bihar, India

STUDENTS Aaron M Ramsey, Jose C Panameno, Matthew O Worsham
ADVISORS Candida Crasto
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP EGR 330 P3

An investigation of the potential for appropriate solar technology in Bihar, India, including solar thermal refrigeration systems. Both current applications and potential opportunities will be examined.

ETHOS Coconut Oil Extraction Optimization

STUDENTS Thomas L Bennett, Candida Crasto
ADVISORS Candida Crasto
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP EGR 330 P1

This will explore the optimization of the virgin coconut oil production. This process will extend to oil extraction of other plants and the methods

by which this is happening in cottage industries. This is pre-work for an upcoming ETHOS summer immersion in Dominica, West Indies.

ETHOS Water Technologies in Underdeveloped Regions

STUDENTS Chris B Baxter, Jose M Canabal, Candida Crasto, Chinedum A Ukandu
ADVISORS Candida Crasto
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP EGR 330 P1

Exploring water as it applies to underdeveloped regions in Africa and Central America. This is a pre-work scope and literature review for 3 upcoming ETHOS Immersions to Uganda, Cameroon, and Guatemala. This poster will address the water needs such as delivery, collection, and purification, and the proposed approach for each area of impact.

Application of Cobalt Porphyrins as Catalysts in Microbial Fuel Cells

STUDENTS Weilong Wang
ADVISORS Donald A Comfort
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Graduate Research

A microbial fuel cell (MFC) is a renewable energy device in which microorganisms consume organic matters to generate electricity. These devices have potential utility in wastewater treatment facilities to dually clean the water and generate part of the electricity needed for water treatment. The last decade has seen tremendous advancement in MFC technology, but many challenges remain, particularly with improving performance and efficiency of cathodes. The cathode reduces oxygen to water and traditionally has utilized precious metals as the primary catalytic compound. In these studies, the precious metal in the cathode has been replaced with alternative catalysts, cobalt porphyrins. Porphyrins may serve as an effective, low cost oxygen reducing catalyst capable of operating in air-cathode MFCs. Here, a cobalt-porphyrin complex compounded with carbon black support (porphyrin/C) was fabricated into an air-cathode for the MFC and its performance was tested. Various porphyrin loading densities were investigated in order to determine the optimal catalyst loading as determined by power production in MFCs. The cathodes were further examined by polarization curves and voltammetry tests to exam electrochemical performance of the cathodes.

Characterizing the Adsorption Behavior of a Bovine Serum Albumin and A Novel Amino Acid onto Iron and Aluminum

STUDENTS Yaqiu Zhang
ADVISORS Douglas C Hansen
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Capstone Project

The US Navy currently utilizes ultra-high pressure water jetting (UHPWJ) or grit-blasting for preparing steel surfaces for painting. Before a new coating/protective surface treatment can be applied, the cleaned surface usually is exposed to a humid environment for a significant amount time, which can cause corrosion. This corrosion activity is known as "flash rusting". The corroded surface will shorten the lifetime of the new coating/surface treatment. The aim of the study is to have an aqueously soluble biopolymer based corrosion inhibitor system that can protect exposed steel surfaces during the paint removal process from the flash rusting, which is also environmentally friendly. In order to do this, it is first required to understand the adsorption behavior of biopolymers onto metal alloy surfaces. Using adsorption isotherm measurements, the adsorption behavior of biopolymers onto the metal substrates will be monitored using bulk solution concentration determinations. Based on the Langmuir theory, the maximum number of adsorption sites and the affinity constant can be calculated for each biopolymer-substrate interaction, thus the optimal solution concentration for maximum substrate coverage will be determined. The adsorption characteristics of Bovine Serum Albumin (BSA) and a novel amino acid (L-dopa) onto high strength steel (HY80) and 5083 aluminum alloy powders suspended in a buffer solution were measured by the Arnow assay for diphenols and the Bradford protein assay, respectively, to detect the bulk solution concentration of non-adsorbed protein as a function of time; the amount adsorbed from solution at equilibrium can then be determined. With the surface area of the metal powders known, it is then possible to calculate the amount of protein or amino acid adsorbed from solution per unit area of metal. Thus the number of adsorption sites and binding affinity for each adsorbate can be established.

Controlling the Corrosion of Metals with Polyphenolic Proteins

STUDENTS William F Nelson

ADVISORS Douglas C Hansen

LOCATION, TIME RecPlex, 11:00AM-12:30PM

School of Engineering: Chemical and Materials Engineering, Poster- Graduate Research

Flash rusting is a corrosion process in which steel rapidly oxidizes upon contact with air at a high relative humidity. The ultimate goal of this research is to develop a water-soluble and environmentally friendly corrosion inhibitor that will inhibit flash rust on high strength steel (HY80). Several proteins involved in the formation of the adhesive byssal threads by the blue mussel Mytilus edulis L have been identified for their potential as corrosion inhibitors. The most important feature of these biomolecules for corrosion prevention applications is the presence of a post-translationally modified amino acid L-3, 4 dihydroxyphenylalanine (L-dopa). L-dopa has a well characterized ability to form strong bonds with metal ions, thus stabilizing the metal surface and inhibiting corrosion. In addition, enzymatically treated L-dopa containing proteins can participate in crosslinking reactions, which have been shown to lead to a thicker and more durable protein layer. In this study, HY80 steel coupons were treated with varying amounts of MAP-1, the largest and most well-characterized of the five mussel proteins, in 0.05M phosphate buffer at pH 7.0 and exposed in an accelerated atmospheric corrosion chamber maintained at 40°C and 100% relative humidity. For comparison, identical HY80 samples were treated with a commercially available flash rust corrosion inhibitor under identical exposure conditions. The results indicate that the corrosion inhibiting behavior of the cross-linked protein may be contingent on the presence of an air-formed oxide layer. Current results suggest that the mussel protein is nearly as effective as the commercial inhibitor at a similar concentration, which shows that the protein could potentially serve as an environmentally friendly replacement for current flash rust inhibitors.

DMSO and temperature contributions to synthesis of silver nano-particles by the bacterium Shewanella Oneidensis

STUDENTS Wei Zhong

ADVISORS Donald A Comfort

LOCATION, TIME RecPlex, 11:00AM-12:30PM

School of Engineering: Chemical and Materials Engineering, Poster- Capstone Project

Nanomaterial are widely used in different areas such as optical device, drug delivery, chemicals, mechanics, magnetics, catalysis, energy science, Nano therapeutics and space industries depend on the special physical properties. However, most methods to produce nanoparticles are expensive or environmental unfriendly which can involve in toxic chemical. Another reason is that the nanoparticles from bio-based protocols are hydrophilic which is compatible with biological materials. In this project, we chose Shewanella oneidensis which is Gram-negative bacterium as the organism to produce sliver nanoparticles from sliver nitrate solution. The mechanism of bacterial of ion metal ion reduction to stable metal nanoparticles is unclear, but the NADH-dependent reeducates, quinines, and soluble electron-shuttles are thought to play an important role in metal reduction. This research focused on the temperature and DMSO affects the synthesis of silver nanoparticles by Shewanella Oneidensis. At various temperatures, the bio-activity of bacterium is different which can affect the silver nanoparticles reducing rate and the spherical size and nanoparticle geometry. DMSO is an aprotic, polar solvent which can penetrate skin and other membranes without damaging the cells. Due to this property of DMSO, DMSO was utilized as a co-solvent, which may change biosynthesis of silver nanoparticles. The synthesis processes were carried out at different temperatures and DMSO concentration and the nanoparticle formation monitored by using UV-vis spectrometer scans of the aqueous layer of reaction at 0 hr, 24 hr and 48 hr.

ETHOS Earthen Stoves in Rural Africa

STUDENTS Candida Crasto, Juliana I Lawniczak, Kyle Slone

ADVISORS Candida Crasto

LOCATION, TIME RecPlex, 11:00AM-12:30PM

School of Engineering: Chemical and Materials Engineering, Poster- Course Project, 14 SP EGR 330 P1

This will explain the unique application of earthen stoves in varying rural communities. Presenting the challenges of available resources, balance of efficiency, and the trade offs in comparison to the traditional 3-stone fire. This poster is the pre-work for the upcoming ETHOS summer immersions in Malawi and Uganda.

Growth Kinetics of Carbon Microcoils

STUDENTS Muneaki Hikita
ADVISORS Khalid Lafdi
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Graduate Research

Carbon is one of the most versatile materials of the periodic table and exists in various allotropic forms and shapes including fullerene, carbon nanotube, graphene. Coiled carbon filaments exhibit very attractive morphology and properties such as absorption of electromagnetic waves and high conductivity because of their shape and carbon structure. Bidirectionally grown double helical carbon microcoils (CMCs) are one type of coiled carbon filaments with unique catalytic activity. In this study, CMCs were synthesized using a chemical vapor deposition method. Growth mechanism of CMCs was explained by a simple exponential catalyst decay model.

Heat Transfer Coefficient Correlations for Pumparound Sections of Petroleum Fractionation Towers

STUDENTS Bryan L. Sigward
ADVISORS Amy R Ciric
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Honors Thesis

The accuracy of several empirical correlations for estimating heat transfer coefficients within pumparound sections of atmospheric and vacuum petroleum fractionation towers was investigated. The heat transfer coefficients were estimated according to the C.F. Braun correlation for trayed pumparounds and the atmospheric and vacuum Glitsch correlations for packed pumparounds. From these correlations, heat transfer coefficients were estimated for 43 different petroleum fractionator pumparounds based on operating data gathered from nine refineries around the globe. The accuracy of the correlations was evaluated by comparing the estimated heat transfer coefficients to actual values calculated from operating data. Results showed that while the C.F. Braun correlation did not have any accuracy biases, it was also not very precise and had a large amount of variation in how well it could predict actual heat transfer coefficient values. Results also showed that while the two Glitsch correlations were both relatively precise, they both had accuracy biases. The atmospheric Glitsch correlation has a conservative underprediction bias, while the vacuum Glitsch correlation has an optimistic overprediction bias for heat transfer coefficients.

Identification of Modified Nanomaterial Characteristics and Cellular Responses in Artificial Alveolar Fluid

STUDENTS Kristen K Comfort, Yingde Zhu
ADVISORS Kristen K Comfort
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Capstone Project

The rapid expansion of nanotechnology and inclusion of nanomaterials (NMs) into everyday objects have introduced benefits in many areas, including energy, electronics, cosmetics, medical procedures, and household items. It is due to their unique physicochemical properties, such as enhanced surface area to volume ratio and increased reactivity that make NMs attractive for these applications. Recently, however, concerns have been raised regarding the safety of NM exposure. To address these concerns, scientists and engineers have sought to identify the root cause of nano-bioresponses, with conflicting reports presented between in vitro and in vivo studies. While in vitro models retain the advantages of quick-screening and low effectiveness, a traditional cell culture environment does not accurately represent an in vivo setting. One mechanism to overcome this discrepancy is to incorporate artificial physiological, which in addition to being more biologically relevant allow for full NM characterization and evaluation in a more representative environment; a critical component in order to identify true NM behavior during targeted applications. As such, our goal was to elucidate the impact of physiological fluids on the characteristics and induced biological responses of select NMs. As inhalation is a primary mode of NM entry, our in vitro model consisted of a human alveolar cell line (A549), artificial alveolar fluid, and NMs that possess increased likelihood of exposure via inhalation (aluminum dioxide, copper oxide, and silicon dioxide). Following dispersion in alveolar fluid the NMs displayed dramatically increased rates of agglomeration and modified surface charge. Additionally, stress activation and cytotoxicity were evaluated and varied between standard culture media and alveolar fluid. These results indicate modified NM and resultant cellular behavior following adaptation of an in vitro environment to more closely mimic an in vivo surroundings

Low Alloy Steel Susceptibility to Stress Corrosion Cracking in Hydraulic Fracking Environment.

STUDENTS Ezechukwu Anyanwu
ADVISORS Douglas C Hansen
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Graduate Research

The pipelines used for the process of hydraulic fracturing (aka. "fracking") process are constantly operating at very high pressure and thus are highly susceptible to Stress Corrosion Cracking (SCC). This is primarily due to the process of carrying out fracking at a shale gas site, where the hydraulic fracking fluid is pumped through these pipes at very high pressure in order to initiate fracture in the shale formation. While the fracking fluid is typically more than 99% water, other components are used to perform various functions during the fracking process. Research into the occurrence of SCC reveals that SCC is engendered by a number of factors, of which two main contributors are stress in the pipe steel and a particular type of corrosive environment that exist around the pipeline in the service setting. The variety of fracking fluid formulas which could be used and the insufficient information about the fracking fluid chemistry makes it very important to carry out analysis to ensure the integrity of the pipeline used for this process. The current research described here is focused on the evaluation of the susceptibility of low alloy steel (C4340) to stress corrosion cracking in different environments as it relates to hydraulic fracking fluid chemistry and operating conditions. These different environments are achieved by varying the solution pH, the pH adjusting agent and the applied stress. Electrochemistry measurements using AISI 4340 samples in various solutions and applied stress conditions will be presented and discussed.

Purification and Biochemical Characterization of a Cellulolytic Glycoside Hydrolase from Caldicellulosiruptor saccharolyticus

STUDENTS Caroline E Wise
ADVISORS Donald A Comfort
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Chemical and Materials Engineering, Poster- Honors Thesis

In response to the current global energy crisis, biofuels have become a viable renewable energy solution and require a carbohydrate source to begin their production. One such carbohydrate source option is biomass, which is comprised of complex sugars that can be broken down into simple sugars and then fermented for the production of bioethanol. The bacterium called Caldicellulosiruptor saccharolyticus contains many glycoside hydrolase enzymes that have the potential for metabolizing the complex sugars in several carbohydrate sources, including those in biomass. This project is focused on the cloning of the Csac 2410 gene from C. saccharolyticus, expression of the gene as a protein, purification of the protein, and biochemical characterization of the protein. The biochemical characterization determines the substrate specificity, pH optima and temperature optima of Csac 2410, and the results are used to determine the effectiveness of Csac 2410 in metabolizing complex sugars for the upstream processing of biofuels.

Save More Money on Natural Gas Vehicle

STUDENTS Zhenghao Luo
ADVISORS Donald A Klosterman
LOCATION, TIME LTC Meeting Space, 2:00PM-2:20PM
School of Engineering: Chemical and Materials Engineering, Oral Presentation- Independent Research

With population and economy projected to rise, the global challenge is to manage and meet energy demand affordably, sustainably and securely. Suitable energy resource is helpful to save energy and solve the challenge. Natural gas is a lower-carbon fuel that is increasingly secure and affordable. When used in place of coal for power, it can reduce CO2 emissions by half. It could offer the most effective pathway to a secure, lower-carbon future. The goal of this project is to discuss about the application of natural-gas engines in the cars and compare couple ways to reduce the cost.

Characterization of Iron Phthalocyanine As the Active Material for Lithium Batteries

STUDENTS David T Anneken

ADVISORS Sarwan S Sandhu

LOCATION, TIME Kennedy Union 207, 3:00PM-3:20PM

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

Results on the determination of the lithium-ion coefficient in the iron phthalocyanine (FePc) active material as a function of intercalation level, using modified electrochemical impedance spectroscopy technique, will be presented. Also, developed thermodynamic functions such as the Gibbs free energy, entropy, and enthalpy changes for the lithium insertion reaction with FePc, derived from cell voltage measurements as a function of intercalation level, are presented. Also presented, are estimates of the maximum amount of lithium that can be intercalated into the FePc based on constant volume and temperature conditions.

Large-scale exfoliation of hexagonal boron nitridenanosheets in liquid phase

STUDENTS Sadra Emami

ADVISORS Khalid Lafdi

LOCATION, TIME Kennedy Union 207, 3:30PM-3:50PM

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

Hexagonal boron nitride (h-BN), the structure analogue of graphite, has many potential applications owing to its superb thermal, electrical and mechanical properties. In this study, a novel facile mixture solvents strategy (ammonia water solution/isopropyl alcohol) was developed for the preparation of h-BN nanosheets (BNNSs) in large scale, and the results demonstrated the exfoliated BNNSs were very stable in isopropyl alcohol solution. Lewis acid-base interaction was considered to be the mechanism for the exfoliation of h-BN due to the electrondeficient boron atoms. This simple and low cost exfoliation approach could provide a promising platform for preparation and applications of BNNSs in the future.

Civil Engineering 2014 Senior Capstone Design - Buckeye Motor Speedway

STUDENTS Mariana E Aboujaoude, Tj J Bernard, Andrew M Bernhard, Jacob L Bertke, Paul J Biancone, Zachary E Borchers, Leigha R Brisco, Robin A. Brownrigg, Andrew F Doerfler, Longxing Dong, Edward M Farrell, Brian James Gitzinger, Alec W. Goodall, James L. Gross, Sa

ADVISORS Donald V Chase

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

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

Every year the senior Civil Engineering class presents their Senior Capstone Design. This year our class will be presenting our design of a brand new, state of the art NASCAR facility which has been named Buckeye Motor Speedway. This hypothetical stadium will be located south of Columbus, Ohio in Madison County, and will hold approximately 110,000 race day attendees. The facility incorporates many features including a hotel, casino, track and roughly 40,000 RV and regular parking spots for fan tailgating. All facets of Civil Engineering will be represented in our design and presentation. Structural Engineers will be presenting their design of the hotel and casino, the signs and towers throughout the facility, the grandstands encompassing half of the track, and bridge upgrades along Interstate 71. Environmental Engineers will display their designs of a green roof, water treatment facilities and oil water separators within the track. The Geotechnical group will present on their foundations, tunnel, and track embankment designs. Site/Civil Engineers will discuss grading for the facility, storm water management, and water distribution throughout the facility. The Transportation group will discuss efforts to increase the capacity of the surrounding roads, the design of the track itself, lighting throughout the facility, and all of the newly designed access roads to facilitate traffic movement throughout the site. The Project Managers will highlight the overall design of the facility to open the presentation and will conclude with a discussion of the schedule produced for both the design and construction of the facility, as well as a breakdown of the cost estimate for the project.

Operational Performance and Safety Comparison of Roundabouts vs. Traditional Intersections

STUDENTS Vincent E Spahr

ADVISORS Deogratias Eustace

LOCATION, TIME RecPlex, 11:00AM-12:30PM

School of Engineering: Civil and Environmental Engineering and Engineering Mechanics, Poster- Honors Thesis

As roundabouts become increasingly popular in Ohio, this study assesses their performance as a safe and functional alternative to traditional intersections. Focusing on three roundabout locations in Dublin, Ohio, the study compares accident reports with traditional intersections in the

area as well as with the traditional intersections that existed before the roundabouts were installed.

3D Anomaly Detection using Structure from Motion

STUDENTS Yakov Diskin
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

We present a 3D anomaly detection technique designed to support various applications in changing environmental conditions. The novelty of the work lies in our approach of creating an illumination invariant system tasked with detecting anomalies in a changing environment. Previous efforts have focused on image enhancement techniques that manipulate the intensity values of the image to create a more controlled and unnatural illumination. Since most applications require detecting anomalies in a scene irrespective of the time of day, (lighting conditions or weather conditions present at the time of the frame capture), image enhancement algorithms fail to suppress the illumination differences enough for Background Model (BM) subtraction to be effective. A more effective anomaly detection technique utilizes the 3D scene reconstruction capabilities of structure from motion to create a 3D background model of the environment. By rotating and computing the projectile of the 3D model, pervious work has been shown to effectively eliminate the background by subtracting the newly capture dataset from the BM projectile leaving only the anomalies within the scene. Although previous techniques have proven to work in some cases, these techniques fail when the illumination significantly changes between the capture of the datasets. Our approach completely eliminates the illumination challenges from the anomaly detection problem. The algorithm is based on our previous work in which we have shown a capability to reconstruct a surrounding environment in near real-time speeds. The algorithm, namely Dense Point-cloud Representation (DPR), allows for a 3D reconstruction of a scene using only a single moving camera. Utilizing the 3D models, we compute the volumetric changes between two reconstructed scenes. We measure the success of our technique by evaluating the detection outputs, false alarm rate and computational expense when comparing the two state of the art anomaly detection techniques.

A Computer Based Detection of Lung Nodules in Chest Radiographs

STUDENTS Barath Narayanan
ADVISORS Russell C Hardie, Temesgen M Kebede
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

Lung cancer is the leading cause of cancerous disease in the United States. Lung cancer 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 nodules 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 of the CAD system include: (i) local contrast enhancement of chest radiographs; (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 new set of features and other classifiers. The publically available dataset was created by Lung Image Database Consortium (LIDC) and Image Database Resource Initiative (IDRI). LIDC-IDRI dataset is comprised of 276 patient chest radiographs containing nodules of various types and sizes. The centroids of the nodules are provided by at least one of four board certified radiologists. Local contrast enhancement of chest radiographs is achieved using a Gaussian low pass filter. Automated 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 the delineated lung fields. Later, a set of features are computed for each potential candidate. Based on those tailored features, a learning based system such as neural network can be used to classify the candidates into true or false positives. This CAD system could serve as an express way for processing an x-ray and would aid in providing a second opinion to radiologists.

A Novel High Quality Factor Tunable Band-stop Filter for Microwave Applications

STUDENTS Hailing Yue
ADVISORS Guru Subramanyam
LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

A band-stop filter is used to remove a narrow band of frequencies from the signal path of a receiver or a transmitter. For a conventional notch filter, the maximum attenuation (notch depth) occurs at a single frequency midway between the specified edges (3dB) of the lower and upper pass-bands, and the selectivity can be described as the ratio of the notch depth to the bandwidth between the edges of the pass-bands. The unloaded quality factor Q (Qu) of the filter's resonators limits both notch depth and selectivity. This proposal suggests an optimized version of varactor-tuned microwave band-stop filter designed using a novel inductive spiral signal line incorporated with shunt varactors featuring an expected Qu of ~110 and notch depth of ~30dB at center frequencies from 2GHz to 8GHz.

Advanced Image Processing for Automatic Pipeline Right-Of-Way Threat Detection

STUDENTS Sai Babu Arigela, Chen Cui, Yakov Diskin, Binu M Nair, Sidike Paheding

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Rapid advances made in the area of camera and sensor technology has enabled the use of video acquisition systems to monitor the right-of-way of pipelines. Huge amount of data is thus made available for analysis. However, it would be very expensive to employ analysts to scan through the data and identify threats to the right-of-way in the vast amount of wide area imagery. This warrants the deployment of an automated mechanism that is able to detect threats to the right-of-way and send out warnings in the event of detection of a threat. A novel algorithmic framework for the robust detection and classification of objects on pipeline right-of-way (ROW) is designed in four directions: visibility improvement, context-based segmentation, change detection, and part-based object recognition. In the first part of the framework, an adaptive image enhancement algorithm is utilized to improve the visibility of aerial imagery the can aid in threat detection. In this technique, a nonlinear transfer function is developed to achieve the enhancement process for the extremely non-uniform lighting conditions. In the second of the proposed scheme, the context-based segmentation is developed to eliminate regions from imagery that are not considered to be a threat to the pipeline. This segmentation algorithm allows to accelerate threat identification and improve object detection rate. Thirdly, a volumetric change detection algorithm utilizing dense point cloud representation flags changes in consecutive flights. The last phase of the framework is an efficient part-based object recognition model. This technique employs parts of the object with specific feature representative to characterize objects, which is robust to detect objects in partial occlusions and appearance variations. In other words, it is a stricter pre-trained classifier that searches imagery for specific targets that are considered threats. The classifier outputs location of threats and the severity of threat to pipeline.

An Interactive Robust Artificial Intelligence-based Defense Electro Robot (RAIDER) using a Pan-Tilt-Zoom Camera

STUDENTS Theus H Aspiras, Andrew D Braun, Chen Cui, Yakov Diskin, Solomon G Duning, Binu M Nair, Sidike Paheding

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

The Vision Lab's Robust Artificial Intelligence-based Defense Electro Robot (RAIDER) is an integrated electro-mechanical system equipped with an onboard processor and numerous imaging sensors. The RAIDER is built upon the Clearpath Husky A200 mobile base. In a multidisciplinary effort, the newly constructed robotic body houses the onboard laptop, GPU processor, LAN, IP cameras, and Kinect sensors. In our previous experiments and efforts, we shown the capability of computing a 3D model of the surrounding scene from motion imagery. We have tested autonomous navigation algorithms in which the RAIDER was to follow a particular person in a crowded environment. Algorithmic enhancements have integrated the 3D depth information into the person-tracking technique to allow for following a person around sharp corners. These navigation and controls algorithms call for an accurate face detection and recognition system as well as a human body detection and recognition system. Additionally, we have integrated a Play Station 2 wireless controller to remotely maneuver the RAIDER and activate various autonomy modes. In this poster, we present our latest effort in integrating face detection with the Pan-Tilt-Zoom (PTZ) base of an Axis camera. Positioned on top of the RAIDER, the PTZ-base will allow for the RAIDER to mimic a human's ability to "look around" or "follow a person with only the eyes," specifically without physically turning the robotic body. The face detection algorithm provides the location of a face within the images, the PTZ is constantly tracking the face and adjusting to keep it in the center of the image. Additional RAIDER projects work on integrating a speaker system that would vocalizes pre-defined phrases triggered by the recognition of specific persons. This would allow the RAIDER to vocalize

"Hello" to people trained into its recognition system. These new artificial-intelligence RAIDER innovations create a more interactive human-like robotic system.

Blur Processing Using Double Discrete Wavelet Transform

STUDENTS Yi Zhang
ADVISORS Keigo Hirakawa
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

We propose a notion of double discrete wavelet transform (DDWT) that is designed to sparsify the blurred image and the blur kernel simultaneously. DDWT greatly enhances our ability to analyze, detect, and process blur kernels and blurry images—the proposed framework handles both global and spatially varying blur kernels seamlessly, and unifies the treatment of blur caused by object motion, optical defocus, and camera shake. To illustrate the potential of DDWT in computer vision and image processing, we develop example applications in blur kernel estimation, deblurring, and near-blur-invariant image feature extraction.

Brain Machine Interface for Controlling a Robotic Arm

STUDENTS Theus H Aspiras, Kelly Cashion, David Fan, Yicong Gong, Carly A Gross, Nathaniel J Maas, Ahmed H Nasrallah
ADVISORS Vijayan K Asari, Weisong Wang
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Capstone Project

This project takes Electroencephalography (EEG) data and correlates it with specific robotic actions. The process is implemented using a 3 phase system that includes EEG signal acquisition, data classification, and robotic action encoding. This project utilizes the Emotiv EPOC headset that uses 14 electrodes which detects brain activity and wirelessly transmits raw data to a personal computer. The project utilizes Emotiv software to classify and translate and encode this raw EEG signal into a command to control a robotic arm. This Brain Machine Interface (BMI) research has many potential applications; for example, it could help the handicapped use robots to complete various task, or help the user use only their mind to control multiple devices like Google Glass, cell phones, wheelchairs and air conditioners, etc.

Exploring the Capabilities of Large Scale Memristor Crossbars

STUDENTS Roshni Uppala
ADVISORS Tarek M Taha
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

The memristor considered to be the fourth passive electronic element after the resistor, conductor and inductor has been a very powerful nanotechnology device used by several researchers in fields such as circuit theory, logic and memory circuits, neuromorphic systems and applied analog circuits. Their applicability as synapses in neuromorphic systems provide even further surprising properties in electric circuits. Their immediate use in mimicking the human brain cortex has proved to be possible mainly because of their nanometric size. Memristors are basically resistors with memory which have the capability to perform logic operations as well as store information. Various breakthroughs of memristive devices have shown the potential of memristive crossbar designs for their ultra-high density and low-power memory. The principal objective of this paper is to evaluate large scale memristor crossbars that allow high density layout of synapses and thus enable to build highly capable neuromorphic systems. Much work in evaluating large scale memristor crossbar has not been presented by anyone yet as its computation goes beyond the capacity of today's existing simulation tools. In order to achieve this, the simulations will be performed with the help of a newly released parallel simulator, Xyce developed by the Sandia Labs. We also aim to bring out the reliability issues of such cortical crossbar design in events of noise, write disturbances and radiation and hence provide an effective solution in avoiding these limitations that would contribute in overheads such as performance, area and energy consumption. Therefore, the results from these simulations will be crucial in understanding the future of the memristor crossbar in developing highly reliable and extremely low power processors and neuromorphic systems.

High Resolution 3D Reconstruction Using a Hexacopter Drone

STUDENTS Yakov Diskin, Evan W Krieger, Lauren Marissa Milliken
ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

One of the greatest challenges in developing automation algorithms for aerial surveillance applications is the difficult of gathering data. Algorithm developers rely on infrequent and expensive test flights for obtain imagery datasets. As a result of the status quo, algorithms tend to be gear towards and perform well on specific imagery sets. We present the Hexacopter Drone, the Vision Lab's newly acquired unmanned aerial vehicle (UAV), used for inexpensive collection of aerial imagery data for various research activities. The UAV, a TurboAce Cinewing 6 hexacopter, carries a Canon 5D Mark III mounted to a separately controlled gimbal and has a flight time of up to 25 minutes. The body is a triple deck carbon fiber structure that is durable and lightweight, foldable arms allow for easy transport and the 15 inch extra heavy duty carbon fiber propellers are resistant to flexing and warping under heavier payloads. A transmitter allows the operator to view a live feed of the video during flight, and the hexacopter and the camera gimbal can both be separately controlled during flight with 2 transmitters. The Naza V2 GPS on board of the UAV allows for auto-stabilization, GPS course-lock, and Return-to-Home features for flying. While using GPS control, the pilot can keep the hexacopter at a certain position using the auto-stabilization feature in order to focus on the camera controls and the image capturing. Utilizing those components, the objective of this project is to create high resolution 3D reconstruction model of vehicles. The hexacopter has the ability to capture a 360° view of vehicles or other objects, and this data can be used as the input to a 3D reconstruction algorithm, namely Dense Point-cloud Presentation (DPR). We present 3D models of scenes that are computed using video captured by the hexacopter.

Human Re-Identification in Multi-Camera Systems

STUDENTS Kevin C Krucki, Binu M Nair

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

This research involves live human re-identification on multi-camera systems. Each frame of multiple cameras needs to be captured and analyzed with image processing methods. First, a histogram of oriented gradients (HOG) is performed to identify a person in each frame. Next, Local Binary Pattern (LBP) descriptors are used on each person to determine certain set features about then. Lastly, a red, green, blue (RGB) color histogram is performed on a specific body mask. Each body is then given a label based on their LBP and color histogram information and that label will be sent to a database. This label should be the same across all the cameras. The process should also happen live. The research will include analysis of the difference between using a static body mask and using pose estimation for a more accurate color histogram. Also, regional descriptors will be used to better describe the human body. Lastly, the difference between YCrCb and RGB color histograms will be shown.

LiDAR Data Analysis for Region Segmentation and Object Classification

STUDENTS Nina M Varney

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

A LiDAR point cloud is 3D data which contains millions of data points represented in the form I (x, y, z) that stores the spatial coordinates and possibly RGB color information. This method of data collection is especially useful in collecting large scale scene information. The goal of this project is to develop a self-adaptive and automated methodology to extract features which effectively represent object regions, specifically man-made objects and vegetation regions. The point cloud will be initially segmented using a strip histogram grid approach. Once significant features are extracted, region refinement by surface growing will be performed. Finally after the regions of interest have been segmented a cascade classifier approach will be used for object classification.

Nonlinear Image Enhancement and Super Resolution for Enhanced Object Tracking

STUDENTS Sai Babu Arigela, Evan W Krieger

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Tracking objects, such as vehicles and humans, in wide area motion imagery (WAMI) is a challenging problem because of the limited pixel area and the low contrast/visibility of the target objects. We propose an approach to make automatic tracking algorithms more effective by incorpo-

rating image enhancement and super resolution as preprocessing algorithms. The enhancement process includes the stages of dynamic range compression and contrast enhancement. Dynamic range compression is performed by a neighborhood based nonlinear intensity transformation process, which utilizes a locally tuned inverse sine nonlinear function to generate various nonlinear curves based on pixel's neighborhood information. These nonlinear curves are used to select the new intensity value for each pixel. A contrast enhancement technique is used to maintain or improve the contrast of the original image. Local contrast enhancement using surrounding pixel information aids in extracting higher number of features a detector can find in the image, and therefore, improves the automatic object detection capabilities. Secondly, the super resolution technique is performed on an area surrounding the object of interest to increase the size of the object in terms of pixels. The single image super resolution process is performed in the Fourier phase space which preserves the local structure of each pixel in order to estimate the interpolated pixels in the high resolution image. As a result, super resolution increases the sharpness of edges and allows for addition tracking features to be extracted. The combination of these two techniques provides the necessary preprocessing enhancement to increase the effectiveness of tracking algorithms. A quantitative evaluation is performed to compare the results of the tracking with and without the proposed techniques. The analysis is based on results of an automatic detection and tracking technique, Gaussian Ringlet Intensity Distribution (GRID), evaluated using wide area motion imagery data.

Numerical study on the characteristics of metal-insulator-metal diode integrated with spiral optical antenna

STUDENTS Zhijun Yang

ADVISORS Qiwen Zhan

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Metal-insulator-metal (MIM) diode structures attract increasing interests in many technical areas including the solar cell technologies because of their capabilities to directly convert optical energy into electric current. During the process of energy transfer, surface plasmon polaritons (SPPs) play an important role due to their intriguing properties such as high local field enhancement and short effective wavelength. As an important figure of merit, the field enhancement arising from the SPPs excitation is limited by the relatively large mode volume in the traditional MIM structure. A potential way to improve the field enhancement factor is to introduce an optical antenna in the design of MIM diode structure to efficiently couple the energy of free-space radiation into a confined region of subwavelength size with highly enhanced field. In this project, I present the numerical studies on the characteristics of a novel device design that integrates MIM structure with a spiral slot optical antenna. As a spin sensitive structure, the response of the spiral slot antenna strongly depends on the optical spin state of the illumination. Three-dimensional finite element method model has been built to numerically simulate the performance of the proposed structure. Modeling results show that this hybrid structure has the ability to achieve both extremely high field enhancement and circular polarization extinction ratio simultaneously. A field enhancement of 150 and circular polarization extinction ratio of 200 can be obtained with this design. Such a device may find useful applications in polarimetric imaging and remote sensing.

Optical flow based Kalman tracker for body joint prediction and tracking using HOG-LBP matching.

STUDENTS Binu M Nair

ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

We propose a real-time novel framework for tracking specific joints in the human body on low resolution imagery using optical flow based Kalman tracker without the need of a depth sensor. Body joint tracking is necessary for a variety of surveillance based applications such as recognizing gait signatures and identifying the motion patterns associated with an action. The proposed framework consists of two stages; the initialization stage and the tracking stage. In the initialization stage, the joints to be tracked are either manually marked or automatically obtained from other joint detection algorithms in the first few frames within a window of interest and appropriate image descriptions of each joint are computed. We employ the use of a well-known image coding scheme known as the Local Binary Patterns (LBP) to represent the joint local region and a HOG descriptor to represent the edge information. Next the tracking stage can be divided into two phases: Optical flow based detection of joints in corresponding frames of the sequence and prediction/correction phases of Kalman tracker with respect to the joint coordi-

nates. Lucas Kanade optical flow is used to locate the individual joints in consecutive frames of the video based on their location in the previous frame. The mismatches are then determined by comparing the joint region descriptors using Chi-squared metric between a pair of frames and depending on this statistic, either the prediction phase or the correction phase of the corresponding Kalman filter is called. The framework has been successfully tested on a private dataset provided by Air Force Institute of Technology where this consists of a total of 21 video sequences. The challenges associated in this dataset are the very low-resolution imagery along with some interlacing effects. and designed based on a linear approximation of the joint trajectory where its true form is mostly sinusoidal in fashion. The framework is tested on a private dataset provided by Air Force Institute of Technology. This dataset consists of a total of 21 video sequences, with each sequence containing an individual walking across the face of the building and climbing up/down a flight of stairs. The challenges associated in this dataset are the very low-resolution imagery along with some interlacing effects. The algorithm has being successfully tested on some sequences of this dataset and three joints mainly, the shoulder, the hip and the elbow are tracked successfully within a window of interest. Future work will involve using these three perfectly trackable joints to estimate positions of other joints which are difficult to track due to their small size and occlusions.

Phase-shifting Holography Using Bragg and non-Bragg Orders in Photorefractive Lithium Niobate

STUDENTS Ujitha A Abeywickrema
ADVISORS Partha P Banerjee
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

The refractive index (RI) of a material can be changed due to several effects such as the optical Kerr effect and the photorefractive (PR) effect. The use of PR materials for implementing real time phase shifting holographic interferometry is discussed in this work. Holographic interferometry (HI) is an effective and rich method for measuring very small (order of a wavelength) displacements and it is widely used for non-destructive testing. Bragg and non-Bragg orders can be generated during two-beam coupling in a PR material due to the induced RI in the material and can be used to retrieve the phase information of the object, as well as the deformation of the object. In previous work, we have shown how object deformation can be determined from monitoring a Bragg order. Furthermore, we have reported on preliminary experiments for determining the depth profile of an object and provided approximate analytic solutions for the Bragg and non-Bragg orders for the case of interacting plane waves. In this work we numerically calculate the exact solutions for the intensities of the Bragg and non-Bragg (higher orders) orders for the case of two incident plane waves, as well as for the case when one of the incident fields is a profiled or image bearing beam. We show how the information from the diffracted order intensities can be used to determine the amplitude and phase of the 3D object. Similarities with phase shifting holography will be discussed. Numerical results are compared with experimental results performed using lithium niobate as the photorefractive recording material. Key words: Photorefractive materials, Photorefractive effect, Bragg and non-Bragg orders

Real-Time Object Segmentation from Network Camera using Touch Screens

STUDENTS Fatema A Albalooshi, Yakov Diskin
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

Touch screens interfaces have become the quicker, more intuitive way to interact with surround technologies. We present an interactive object region segmentation technique that leverages the touch screen technology to the detection and identification of objects in images captured in real environments. Our algorithmic work addresses one of the most challenging tasks in image processing and computer vision research fields, specifically, the segmentation of objects that have non-homogeneous body textures. The proposed segmentation method employs Seeded Region Growing (SRG) segmentation algorithm to extract the precise and accurate object region from other surrounding objects and backgrounds. In region growing segmentation, three key factors are satisfied such as choice of similarity criteria, selection of seed points, and stopping rule. The choice of similarity criteria is accomplished through texture descriptors and connectivity properties. The selection of seed points is determined interactively by the user when they choose the object of interest. The definition of a stopping rule is achieved using a test for homogeneity and connectivity measures, therefore, a region would stop growing when there are no further pixels that satisfy the homogeneity and connectivity criteria. The segmentation region is iteratively grown by comparing all unallocated neighboring pixels to that region. Seeded region growing factors would change interactively according to the intensity levels of the chosen object of interest. In our experimentation, we

have setup an interactive touch screen that projects a live feed from a network camera. The human input via touch screen is used to select the seed point on the object of interest within the video. Our algorithm uses the seed points as the initialization for the seeded region growing technique. The proposed system is evaluated by observing its capability to correctly segment the selected objects, while simultaneously performing invariant to the user's choice of the object.

Regression based Time-Invariant Modeling of Motion-Shape based Features for Human Action Recognition.

STUDENTS Binu M Nair
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

A novel human action recognition framework is proposed which extracts local flow based motion and shape descriptors and computes the underlying action distribution through regression-based time invariant modeling. The action models are designed to be independent of time so as to incorporate action sequence length normalization, motion speed in-variance and non-initialization of the action states. We formulate an action descriptor based on the fusion of motion features, HHOF and LBFP, and body posture features based on the R-Transform. By applying a feature selection technique using symmetrical uncertainty, a subset of relevant and non-redundant features are obtained thereby getting a discriminatory action descriptor. Using these descriptors, a time independent orthogonal action basis using EOF analysis is computed for each action class where the projections of the features on this space vary with time. Due to one-to-one mapping between the action feature space and the action basis projections, the time series is modeled by computing the mapping between them using GRNN networks. The class of the test sequence is determined by the action model which has less discrepancy between the GRNN estimations and the feature projections on the corresponding action basis. This framework has successfully been tested on two kinds of datasets ; One set being the Weizmann and the Cambridge Hand Gesture dataset which has binary silhouettes and the other being the KTH and the UCF sports dataset where motion history images can be computed. Experimental results prove that the algorithm works both on the binary silhouettes as well as motion history images and classifies action sequences accurately from a few frames without any need for the normalization of sequence length and motion speed and initialization of the action states.

Rotation-Invariant Feature Tracking using Gaussian Ringlet Intensity Distributions (GRID)

STUDENTS Theus H Aspiras
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

Many feature tracking methodologies do not incorporate rotation-invariance or low resolution imagery as possible testing scenarios, for example Wide Area Motion Imagery (WAMI). We propose using a new technique called Gaussian Ringlet Intensity Distribution (GRID), which uses a ring partitioned histogram with Gaussian weighting for a set of features. These features are also center weighted to provide more importance towards the center of the object rather than the outside of the object, which most likely contains background information. The GRID features provided the best average tracking ability against several state of the art algorithms across several different scenarios in two databases.

SHG in 1D PBG Structures for Arbitrary FF Incident Angles

STUDENTS Han Li
ADVISORS Partha P Banerjee
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

General transfer matrix method is developed to analyze the phenomenon of second harmonic generation in a multilayer nonlinear photonic bandgap structure. Under the pump nondepletion assumption, the fundamental monochromatic plane wave incident on the multilayer nonlinear structure with arbitrary angle is counted. The corresponding type 0 second harmonic frequency wave then is generated by the dielectric polarization of the fundamental plane wave with its specific angle. The proposed transfer matrix method takes into account the reflections and the interferences between forward and backward propagation waves. Different conversion efficiency is obtained by various angle of the incident

wave and various thickness of the nonlinear material. Specific incident angle and thickness of nonlinear structure may generate relatively high conversion efficiency inside of nonlinear material. Then the pump nondepletion assumption is no longer valid. Therefore, the effectiveness of the nondepleted pump assumption is analyzed before any optimization for designing the appropriate nonlinear structure, and it's indispensable.

Visibility Improvement through Hyperspectral Band Integration

STUDENTS Sai Babu Arigela, Yakov Diskin, Sidike Paheding
ADVISORS Vijayan K Asari
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Electrical and Computer Engineering, Poster- Graduate Research

The science of hyperspectral remote sensing is based on taking a fraction of the electromagnetic spectrum and breaking it into numerous bands for theoretical analysis and computations. The combination of all wavelengths in a given spatial area builds complete spectral signatures for each specific material in the scene. Based on the spectral signature obtained from hyperspectral imagery, one can detect and identify objects more precisely compared to using only three bands information provided by a RGB camera. Hyperspectral sensors can also assist in automatic target detection in noisy backgrounds since objects vary uniquely from the natural background in absorbing and reflecting radiation at different wavelengths. In many cases, the objects that the human eye fails to capture can be differentiated and identified based on the unique hyperspectral signature. Unfortunately, the spatial resolution for hyperspectral sensors is still extremely coarse compared to modern high definition camera. Thus, we present a visibility improvement technique that will increase the spatial resolution of the captured hyperspectral image and improve the image contrast. In the proposed algorithm, the image spatial resolution is increased by integrating intensity information from multiple related spectral bands. Leveraging our prior expertise with single image super-resolution on RGB imagery, we exploit the band information of the hyperspectral image and develop an adaptive contrast enhancement technique to construct a high spatial resolution image. Specifically, the enhancement algorithm selects the pixel-wise intensities to maximize the pixel's neighborhood contrast. To verify the effectiveness of the proposed technique, we use the Resonon Pika II hyperspectral camera, which provides 240 spectral channels that ranges from 400-900nm with 2.1nm spectral resolution, to capture real-life images and test the visibility improvement methodology in a variety of environments such as low illumination or over-exposure regions. The proposed technique aids in real-world applications such as object detection, recognition, and tracking.

Multiframe Adaptive Wiener filter Super Resolution with JPEG2000 Compressed Images

STUDENTS Barath Narayanan
ADVISORS Eric J Balster, Russell C Hardie
LOCATION, TIME Kennedy Union 311, 1:00PM-1:20PM
School of Engineering: Electrical and Computer Engineering, Oral Presentation- Graduate Research

Historically, Joint Photographic Experts Group 2000 (JPEG2000) image compression and multiframe Super Resolution (SR) image processing techniques have evolved separately. In this paper, we propose and compare novel processing architectures for applying multiframe SR with JPEG2000 compression. We propose a modified adaptive wiener filter (AWF) SR method and study its performance as JPEG2000 is incorporated in different ways. In particular, we perform compression prior to SR and compare this to compression after SR. We also compare both independent frame compression and difference frame compression approaches. We find that some of the SR artifacts that result from compression can be reduced by decreasing the assumed global signal-to-noise ratio (SNR) for the AWF SR method. We also propose a novel spatially adaptive SNR estimate for the AWF designed to compensate for the spatially varying compression artifacts in the input frames. The experimental results include the use of simulated imagery for quantitative analysis. We also include real video results for subjective analysis. The applications of combining SR with compression are mainly focused in the field of aerial mapping and airborne imaging. Also, SR and compression can be combined effectively in the images/videos with affine and global motion such as remote sensing/mapping, satellite imaging and other civilian applications such as video surveillance in unmanned aircraft systems.

Blind Full Reference Quality Assessment of Poisson Image Denoising

STUDENTS Chen Zhang
ADVISORS Keigo Hirakawa
LOCATION, TIME Kennedy Union 311, 1:30PM-2:10PM
School of Engineering: Electrical and Computer Engineering, Oral Presentation- Graduate Research

The distribution of real camera sensor is well approximated by Poisson, and the estimation of the light intensity signal from the Poisson count data plays a prominent role in digital imaging. It is highlydesirable for imaging devices to carry the ability to assess the performance of Poisson image restoration. Drawing on a new category of image quality assessment called corrupted reference image qualityassessment (CR-QA), we develop a computational technique for predicting the quality score of the popular structural similarity index (SSIM) without having the direct access to the ideal reference image.We verified via simulation that the CR-SSIM scores indeed agrees with the full reference scores; and the visually optimal denoising experiments performed on real camera sensor data give credibility tothe impact CR-QA has on real imaging systems.

Brain Machine Interface Collection of EEG Signals for Controlling a Robotic Arm

STUDENTS Theus H Aspiras, Kelly Cashion, David Fan, Yicong Gong, Carly A Gross, Nathaniel J Maas, Ahmed H Nasrallah
ADVISORS Vijayan K Asari, Weisong Wang
LOCATION, TIME Kennedy Union 311, 2:30PM-2:50PM
School of Engineering: Electrical and Computer Engineering, Oral Presentation- Capstone Project

The Brain Machine Interface (BMI) project converts Electroencephalograms (EEGs) to actions for the robot. This project's purpose is to explore the limitations of the current interface and to improve its performance. Specifically, various thoughts are experimented with to test the precision of the Interface. There are many ways of expressing actions and how they are represented as signals, for example, thinking 'left' and clenching your left fist produce different EEG signals. Since EEG signals varies from person to person, profiles for each user can be generated to provide better readings for a user and improve future readings upon multiple uses. Further, the Interface offers the ability to use the Universal User profile or to use the user's own personal profile. The Universal User is a profile that contains data for all of the users' who participated in experiments. The Interface has a goal of being able to perform at least 7 unique actions that can be combined in unique and complex ways. Filtering multiple expressions within the EEG signals bring up a challenge as it reduces the ability to produce clear signals and requires a great deal of concentration. EEG signals are also dependent upon the user's state of mind including their mood, tiredness, and other various factors during the time of the reading.

Dayton Most Metro Chef's 10 Questions

STUDENTS Rebecca P Blust, Gracelyn M Key, Sushmitha Rayinadi, Emily K Strobach, Daniel L Williams
ADVISORS Rebecca P Blust
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Engineering Technology, Innovation Center, Poster- Course Project, 14 SP IET 323 01

Dayton Most Metro (DMM) is an online regional magazine which has created a ten question interview with local chefs. Currently 20 chef interviews have been completed and uploaded onto the website. DMM's goal is to add to the amount of interviews posted online this spring 2014, but has run out of the manpower required to do so. The goal behind incorporating the Dayton IET 323 team is to aid DMM in accomplishing its goal. Our team will be conducting interviews with a minimum of eight Dayton area chefs which will be featured on the Dayton Most Metro site. In the interviews, the intention is to gain insight on the chef's story and personality, relaying it in the report and sharing it with the people of Dayton.The project is to be completed in a seven phase process which includes; completing preliminary operation requirements for project direction, creating email, phone and in-person contact templates to support and make the effort flow easily, dividing the work into two person teams to equally distribute the work load, contacting chefs (if required, restaurant management for major food chain approval) and scheduling interviews, completing the interviews whether it be by email, phone or in-person, formatting and organizing all information for transfer to DMM.

Dermatopatholligy Lab - Improve Turn a Round Time!

STUDENTS William E Blount, Rebecca P Blust, Michael P Bodde, Linda M Moodie, Christopher Ryan Patzelt
ADVISORS Rebecca P Blust
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Engineering Technology, Innovation Center, Poster- Course Project, 14 SP IET 323 01

The purpose of this proposal is to present the University of Dayton project management group's plan of optimization methods. The optimization methods are to improve efficiency of the lab reporting techniques and retrieval at the University of Cincinnati's Dermatology Lab. Currently, the time from the date the biopsy is completed to the date the report is posted and available to the client and physician is too long. While the aver-

age time the results are reported is around six days, it is not uncommon for the results not to be posted for over a week or more. The program management group was contacted in order to improve efficiency so that UC Health may continue to carry out its mission to serve the Cincinnati community. In addition, the methods will provide an understanding of the issue and the best methods to correct the turnaround time.The objective of this proposal is to describe process in which the team will optimize the University of Cincinnati Health lab turnaround time. The optimization will be done in several steps. The first will be the analysis of the labor needed and the analysis of the operation and technology. A hard copy of all the analysis is to be reported for further action. Once that is established, execution of an alternative itself will begin. The general plan is for all variables and possibilities to be considered with a full and complete understanding, followed by execution of a corrective plan.

Dispense A Roll Project for PM Company

STUDENTS Ibrahim Abdul-Karim, Rebecca P Blust, Garret P Ervin, Kevin M Eversole, Ryan Patrick Shea, Matthew R Srnoyachki
ADVISORS Rebecca P Blust
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Engineering Technology, Innovation Center, Poster- Course Project, 14 SP IET 323 01

The current method of shipping receipt paper is very wasteful in regards of packaging and leads to inadequate storage. The inadequate storage of the rolls wastes time and energy when consumers have to reach in difficult, inaccessible places to refill the machine with a roll.The PM Company has contracted the University of Dayton Project Management Team to develop a roll dispenser. The Dispense-A-Roll dispenser will bring a convenient, sustainable, and cost saving method to dispense electronic transaction receipt paper rolls at the point of sale location for our client. The ease of use of the dispenser will allow for the consumer to quickly and effectively change the receipt paper roll when needed. In addition, the dispenser will enable customers to buy the receipt paper in bulk, reducing the waste associated with unnecessary packaging.The project will start upon acceptance of this project proposal and end on April 25th. Our team's plan is to survey point of sales users to collect data for the product, develop three conceptual designs, select a final design concept from those designs, and create a prototype Dispense-A-Roll. Manufacturing the final dispenser will be outsourced. It is the clients request that each dispenser will cost about $8 with the budget for the prototype to cost approximately $25. Once made, the Dispense-A-Roll will be found in a variety of places that use PM Company's paper for point of sales service, such as convenience stores, gas stations, retail stores, and restaurants.

Enhancing Our Campus Community

STUDENTS Megan R Aponte, Abdulelah Bajbair Bajbair, Rebecca P Blust, Gabriel Jesus Diaz, Chuanchuan Zhou
ADVISORS Rebecca P Blust
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Engineering Technology, Innovation Center, Poster- Course Project, 14 SP IET 323 01

The Ryan C. Harris Learning Teaching Center (LTC) fosters a culture of transformational learning through professional and leadership development, educational technologies, and student learning support. As part of this program, the LTC focuses a portion of its staff and resources to teaching a global student community. With over 1400 international students from 40 different countries, the University of Dayton welcomes undergraduate and graduate students from all over the world. The departments at the University benefits from the rich cultural, ethnic, and linguistic diversity these students and scholars bring from around the globe.In the past there was another team who did a similar project and took similar surveys about how to help our native students to be more effective at working, interacting, and communicating with the international students. We plan to work off of what they have found to better implement a solution.

Madison County Equine Arena Improvement

STUDENTS Rebecca P Blust, Nathaniel L Decamp, Reid Daniel Fuente, Jesse Lee Hester, Matthew J Soto, Andrew W Spirk
ADVISORS Rebecca P Blust
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Engineering Technology, Innovation Center, Poster- Course Project, 14 SP IET 323 01

The Madison County Fairgrounds Equine Center is in need of repair in order to provide a more safe and enjoyable experience for its patrons. The Equine Facility can gain aesthetic value and functionality by improving the conditions and characteristics of the show arena. The improvement of the Equine Facilities will not only increase the aesthetic value, but will also help to enrich the Equine experience of the youth and citizens of Madison County. To assist Madison County Fairgrounds with this endeavor, the team will provide technical information to Madison County Fairgrounds in order to improve the quality and functionality of the Equine Facility by focusing on the design, placement and costs associated

with the Arena. The project officially begins with the submittal of this proposal and will be completed by the 26th of April 2014. In order to the complete this task, the team will first conduct research concerning equine facilities. After the analysis of Madison County. Equine Facility, the team will create dimensional schematics of the grounds. The team will then develop and determine costs associated with the designs. Upon completion of cost estimation the team will present the conceptual designs. Upon deciding a final design, the team will prepare final costs associated with the project and make a final presentation to the client. The team will be located at the University of Dayton. The majority of the tasks will be completed on campus, however, on site observation and analysis will be necessary. The team will strive to provide an in depth plan of action concerning the design, placement and cost analysis of the Arena in order to increase the functionality and appeal of the Madison County Fairgrounds Equine Center.

Northwest Lead Track Railroad Analysis for the City of Dayton

STUDENTS Rebecca P Blust, Marc S Ferere, Joseph P Nagy, Clayton Michael Sanchez, Zhaofeng Xie
ADVISORS Rebecca P Blust
LOCATION, TIME RecPlex, 9:00AM-10:30AM
School of Engineering: Engineering Technology, Innovation Center, Poster- Course Project, 14 SP IET 323 01

In 1993 the City of Dayton purchased a four mile stretch of the NorthWest Lead Railroad Track from CSX Transportation. In the years since the track was purchased it has played a major role in bringing new companies to the west end and Trotwood. The goal of this project is to promote business growth by producing a set of drawings using computer aided design (CAD) software for the 4 mile stretch NorthWest Lead Railroad Track. These drawings will include measurements of all of the intersections along the Tracks as well as the access points for the companies that use the tracks. These drawings will allow the city to show possible new companies what kind of access the new companies would have to the track. These drawings would also allow the City of Dayton to show possible companies the crossings in greater detail than are currently available. After the drawings are completed if time allows the team will create a marketing package with the drawings. The start date for the project will be February 16 and the end date will be April 20. The team is comprised of five University of Dayton Engineering Technology Students: Joe Nagy (Project Manager), Marc Ferere, Mike Harper, Clayton Sanchez, Jeffrey Xie. The location of this project will take place along the 4 mile stretch of the NorthWest lead Railroad Track in Dayton, Ohio.

A Geometric Study of the Discharge Port used in Scroll Compressors

STUDENTS Yu Liang
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Independent Research

A scroll compression has become the prevalent technology used air-conditioning and refrigeration systems. The compression chamber consists of two spiral shaped vanes that form pairs of chambers. A crankshaft imposes an orbital translation on one of the vanes, which reduces the volume of the chambers, thereby compressing the gas trapped within the chamber. A hole is placed at the center of the fixed spiral. The moving spiral will uncover the hole, which serves as an exhaust port. This project studies the exhaust flow area as a function of crank angle. Additionally, the project assesses the sensitivity of the exhaust flow area to the defining spiral parameters, along with the size and placement of the port.

A Novel, Elastically-Based, Regenerative Brake and Launch Assist Mechanism

STUDENTS Joshua E. Nieman
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Graduate Research

This project involves a spring-based mechanical regenerative brake and launch assist system to increase vehicle fuel economy. When a vehicle slows, traditional brakes waste the kinetic energy by dissipating it to the environment as heat. Regenerative brakes, by comparison, store this energy for later use. A novel mechanical system has been designed that stores the energy in a spring and then uses that energy to later propel the vehicle. Hybrid electric vehicles have a successful electrical regenerative braking system but it is only beneficial for hybrid and electric vehicles, about 3% of the market. The proposed mechanical system could be incorporated in the design of most conventional vehicles with internal combustion engines. Preliminary estimations predict fuel efficiency improvements between 5-10% in the city. The modeling, mechanism design, optimization, and a dynamic simulation validate further investigation of the concept.

A Semi-Empirical Prediction Model for the Discharge Line Temperature of Hermetic Compressors

STUDENTS Chen Guan
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Independent Research

Predicting the discharge line temperature (DLT) of air conditioning and refrigeration compressors is important to ensure sufficient lubricant properties and proper performance of components that are positioned in the exhaust stream.Numerous comprehensive prediction models have been developed with excellent accuracy, but require many details of a particular compressor. This paper assesses various DLT prediction methods that do not compressor-specific parameters. It presents a semi-empirical model with a accuracy that significantly exceeds the other established methods. The model is applied to both traditional refrigeration and vapor-injected, economizer cycles. Lastly, a study was conducted to determine the relationship between the accuracy of the model and number of experimental points used to produce the model.

Advancing Segmentation Techniques for Rigid-Body Shape-Changing Mechanism Design Specific to Variable Geometry Extrusion Dies

STUDENTS Bingjue Li
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Graduate Research

This research is part of a larger project on designing extrusion dies that create parts with complex variation in cross section. The research presented is on segmentation theory, the realization of a set of rigid bodies and joints that best approximate a set of curves that define a shape change. These curves differ from each other by a combination of planar displacement, shape variation, and notable differences in arc length. Among various shape-changing technologies, rigid-body mechanisms composed of traditional machine elements offer many advantages including carrying large loads while achieving large displacements. Although some of the theory for synthesizing rigid-body shape-changing mechanisms is well established, segmentation that utilizes a significant number of prismatic joints remains to be addressed and is the contribution of this work. Additional examples of applications of the developed theory include airfoils, car seats, and light reflectors that can alter their shapes during use.

Assessing the Energy Requirements of Actuators during Common Automation Tasks

STUDENTS Mohamed A Eltaeb
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Graduate Research

Manufacturing operations is a major consumer of energy, with a large proportion being used to operate motors. The objective of this project is to create principles for the design of automation mechanisms that have reduced energy needs. As part of the project, an experimental study was performed to assess the energy required by industrial actuators for common automation tasks. The energy consumption is mapped to torque, motion and time on task. Using this information, the influence of mechanism architecture and dimensional synthesis of single-degree-of-freedom manufacturing devices can be assessed and design guidelines can be formulated.

Community Residential Energy Reduction

STUDENTS Kelly C Vogeler
ADVISORS Kevin P Hallinan
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Honors Thesis

This research evaluates the effectiveness of residential energy reduction programs aimed at cost effective, collective action. One of these energy reduction programs is Dropoly.com, an online game developed by the University of Dayton that aims to connect neighbors and allow them to

compete against one another. The guiding question behind the research addresses how to reduce energy consumption in a community. My research presumes that effective community engagement is a central factor in achieving success and evaluates a variety of energy reduction programs based on certain criteria. The chosen criteria assess the programs' effectiveness by focusing on different means of engaging the community. Results of this evaluation indicate the most successful programs at community engagement and opportunities for improvement.

Cost Optimization with Solar and Conventional Energy Production, Energy Storage, and Real Time Pricing

STUDENTS Seyed Ataollah Raziei
ADVISORS Robert J Brecha, Kevin P Hallinan
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Graduate Research

Research is presented that investigates the potential for solar power generation with battery energy storage for reducing the effective cost of energy delivered to residential customers if real time pricing is present. A linear optimization approach is developed based upon a two-step process. In step one, given a specified solar array area and battery capacity, the optimal means to meet loads based upon grid power, solar power, and/or battery power is determined. This analysis considers an expected lifespanof the solar panel. With these results established,in the next step, the capital costs for the solar arrays and batteries are considered for each point (solar area and battery capacity) in the design space. Ultimately, the results illuminate the most cost effective means to provide power to customers for the chosen system.

Design and Assembly of a Spring-Powered Engine Starter Prototype

STUDENTS Linda M Leben
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Independent Research

Automotive starting systems require substantial amounts of mechanical energy in a short period of time. Lead-acid batteries have historically provided that energy through a starter motor. Springs have been identified as an alternative energy storage medium and are well suited to engine-starting applications due to their ability to rapidly deliver substantial mechanical power and their long service life. This project involves the development of a prototype of a spring-powered starter for a motorcycle engine. The focus was on the design and assembly of the complete system, including the design challenge of interfacing the starting mechanism with the motorcycle, designing the assembly such that all parts are aligned, manufacturing necessary parts, and assembling the mechanism.

Design of Variable-Geometry Dies for Polymer Extrusion

STUDENTS Mary Joy Frances Cardilino, Wesley P Kramer
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Independent Research

Polymer extrusion is the process of forcing a melted plastic through a die to create a continuous part with a constant cross-section dictated by the die's shape. The goal of this project is to develop a die that can change the cross-section created in the plastic during extrusion. This technology introduces extrusion to a host of products that historically have been manufactured by more expensive and time-consuming techniques like injection molding. Variables considered in order to make the dies both practical and efficient include limiting the degrees of freedom, managing unnecessary die openings, and creating joints that can act as revolute as well as prismatic joints. Design challenges include addressing the high pressures and temperatures present in extrusion die systems, minimizing material leakage in the die assembly, and creating the methodology and practice for designing dies that create the desired shape changes in the extrusion.

Effect of Compliant Flooring on Postural Stability in an Older Adult Population and in Individuals with Parkinson's Disease

STUDENTS Renee Lynn Beach
ADVISORS Kimberly E Bigelow, Kurt J Jackson
LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Balance is affected by the brain's ability to process sensory information from an individual's visual, vestibular and proprioceptive inputs. Neurological and elderly patients, including those with Parkinson's Disease (PD), often have problems in these systems and therefore struggle with balance, putting them at a higher risk of falling. Initial studies have shown compliant floors are able to absorb energy from a fall, reducing injuries, but have not looked at how individuals recover from functional movements on the floors. It was the objective of this study to determine whether compliant flooring has an effect on postural stability during quiet-standing for a more diverse and more impaired population than previously studied as well as examine the effect of compliant flooring on postural stability following a dynamic, functional movement. Thirty healthy older adults and ten individuals with PD performed tasks such as the sit-to-stand transition while standing on a balance plate. From the collected center of pressure (COP) data A/P Sway Range, M/L Sway Range, Mean Velocity and Area of 95% Confidence Ellipse were calculated. It was found that compliant flooring caused increased sway ($p<0.05$) in all four parameters during quiet standing in healthy older adults and increased sway ($p<0.05$) in A/P Sway Range during quiet standing in older adults with PD. Stabilization immediately post-transition displayed increased sway upon completion of the movement, but there was no statistical differences between the flooring ($p<0.05$) for healthy older adults and older adults with PD. Overall although quiet standing differences were small in magnitude and the stabilization post-transition were non-significant, no clinical implications have been found for fall frequency on compliant floors. More work is necessary to determine the implications of compliant flooring during natural gait or transition areas.

Identification of any Aircraft by its Unique Turbulent Wake Signature

STUDENTS Sidaard Gunasekaran

ADVISORS Aaron Altman

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

The objective of this research is to identify any turbulent generator (Example: Aircraft) by the turbulent wake it leaves behind. It was a wide spread belief in turbulence community that the turbulence generated by an object forgets its origin as it goes far downstream. In late 80's and 90's, scientists and engineers did experiments in the wake of a turbulent generator and found that the turbulent characteristics in the wake such as velocity defect and turbulent intensities are dependent on the initial conditions (i.e. the turbulent generator) and different turbulent generator gave different turbulent characteristics in the wake (analogous to fingerprint in humans). These results paved the way to make the current research of identification of aircraft by the turbulent wake possible because it has been proven that the wake does not forget its origin and it is unique to each turbulent generator. Through this technology, low observable aircraft (stealth) which deceive modern radars and use radar absorbing materials can be detected because all objects displace a fluid medium. It also allows the fighter pilots to promptly identify the "friend" or "foe" status of the incoming aircraft in an aerial war. This technology also has a potential application in National Airspace systems where the wake of the landing aircraft can be detected and tracked so that the oncoming aircraft can be cleared to land with shorter distances between aircraft thus increasing airport capacity without the need to expand runways. Most importantly, no present capability exists to detect and identify aircraft by their turbulent wakes.

Investigation and Optimization of a Mechanical Regenerative Braking and Launch Assist Device

STUDENTS Vijay Krishna

ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Fuel efficiency has become a major concern in the automotive industry. A mechanically-based, Regenerative Braking Launch Assist (RBLA) is a kinetic energy recovery system that helps us to improve fuel efficiency in vehicles. A prototype of one concept has been previously created. In the existing RBLA prototype, an extension spring is used as strain energy storage component. The effectiveness of prototype will be evaluated with the extension spring along with a torsion spring and spiral spring. The desired configuration is one where a large amount of energy can be stored with a low weight and low volume spring.

Serial Chains of Spherical Four-Bar Mechanisms to Achieve Design Helices

STUDENTS Kevin S Giaier
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Graduate Research

This research presents a methodology for designing mechanical chains comprised of a large number of identical spherical four-bar mechanisms. Such a mechanical chain can achieve up to five prescribed helices. A spherical four-bar mechanism is a single degree of freedom device consisting of four revolute (R) joints whose rotational axes intersect at a common point. The mechanical chains are created by connecting the coupler of the prior spherical mechanism to the base link of the subsequent spherical mechanism. An extension on each mechanism will lie along the prescribed helices as the device moves. The methodology introduces a companion helix to each prescribed helix along which the intersection locations of each spherical mechanism's axes must lie. As the mechanisms are connected by rigid links, the distance between the intersection locations along each companion helix is the same. Additionally, an approach to actuating this mechanical chain with a single rotating input is presented.

Singularity Maps that Describe the Motion Characteristics of a Mechanical Linkage

STUDENTS Saleh M Almestiri
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Graduate Research

Understanding the motion characteristics of a mechanism is an important step toward designing machinery to accomplish a give set of tasks. The purpose of this research is to understand the motion characteristics of a linkage as a design parameter is altered. This research implements kinematic analysis theory utilizing isotropic coordinates to allow for the construction of 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 linkages called a singularity map. The singularity map provides a visual snapshot of the effects of the altering a design parameter of the linkage by including the number of assembly circuits and the location of locked configurations. Bertini, a powerful tool for working with large algebraic systems of equations, allows for the solution to the complex systems arising in this design challenge. MATLAB is then used to integrate from the Bertini solutions to plot the complete singularity map.

Singularity-Free Synthesis of Coupler-Drivers for Actuating Single Degree-of-Freedom Mechanisms

STUDENTS Hameed Juma
ADVISORS Andrew P Murray, David A Perkins
LOCATION, TIME RecPlex, 11:00AM-12:30PM
School of Engineering: Mechanical and Aerospace Engineering, Poster- Independent Research

The goal of this research is to advance the synthesis methodology for designing coupler-drivers for actuating single degree of freedom mechanisms. A planar coupler-driver is a chain consisting of a fixed revolute joint, an actuated prismatic joint, and a moving revolute joint connected to an ideal location on a previously synthesized planar mechanism. Although such a chain may be connected between any fixed point and any moving point on the mechanism, the synthesis challenge is determining the locations of these points such that the mechanism moves over its desired range of motion without reaching a singularity. A singularity is a configuration of the mechanism at which it ceases to move. A spatial coupler-driver is defined by a chain consisting of a fixed spherical joint, an actuated prismatic joint, and a moving spherical joint connected to an ideal location on a previously synthesized spatial mechanism. This work addresses both planar and spatial coupler-drivers and uncovers challenges unique to each case.

Statically Equivalent Serial Chain Modeling With Kinect and Wii Balance Board

STUDENTS Ali Almandeel
ADVISORS Andrew P Murray, David H Myszka
LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Identifying the center of mass location provides a significant aid in controlling the balance of humanoid robots. Additionally, in humans this location is an essential parameter in postural control and is critical in assessing rehabilitation. Anthropometric tables have been complied for this identification but their accuracy is readily questioned. This research presents an estimation technique that uses the statically equivalent serial chain (SESC), a representation of any multilink branched chain whose end-effector locates the center of mass. In order to construct the SESC for center of mass prediction, a Kinect and Wii balance board are used. The Kinect provides joint location information while the Wii balance board provides the center of pressure. The utility of the presented method as compared to other common methods is that the center of pressure, and hence, the Wii balance board, is no longer needed after the SESC is constructed.

The Acute Effect of a Sensory Integration Therapy Intervention on Postural Stability and Gaze Patterns of Children with Autism Spectrum Disorder: A Feasibility Trial

STUDENTS Senia I. Smoot

ADVISORS Kimberly E Bigelow, Kurt J Jackson

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

The Effect of Input Parameters on Detrended Fluctuation Analysis of Postural Control Data

STUDENTS Melissa R Taylor

ADVISORS Kimberly E Bigelow

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

Biological variability is critical for healthy function and is present in all types of physiological movements. Variability exists on a spectrum in which the optimal amount falls between two extremes: a lack of variability indicating rigidity and limited adaptability and excessive variability indicating instability and random, uncontrolled motion. It is believed that nonlinear analyses provide insight into variability that can help predict future movements based on current movements. Detrended fluctuation analysis (DFA) is a widely used nonlinear analysis tool for postural control research. A limitation of DFA is that the results are heavily dependent on input parameters (data length, window size, and scaling region) used to determine the scaling exponent α; however, the input parameters are selected by the researcher and little published guidance exists to aid in their selection. The aim of this research is to examine the effects of changing input parameters on DFA of postural control data and to determine best practices for their selection in order to improve the consistency of the analysis and ensure that important effects in postural control data are not lost or skewed. MATLAB will be used to create theoretical chaotic and white noise time series with random initial conditions and known α values, and center of pressure sway measures will be taken for healthy adults using a balance plate. The theoretical and experimental data will be subjected to DFA where data length, window size, and scaling region will be varied independently. The value of α will be determined for all combinations of input parameters and the effects of varying these parameters will be explored. Statistical significance ($p<0.05$) of any of the main effects or interactions will indicate the extent to which α is dependent on the input parameters, allowing suggested guidelines for future researchers to be determined.

Zero Structural Error Function Generating Mechanisms

STUDENTS Hessein Ashour

ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME RecPlex, 11:00AM-12:30PM

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

A slider-crank mechanism consists of an input crankshaft, a connecting rod, and an output piston. As the crankshaft makes full rotations, the output piston produces periodic curves similar to a sine wave. A drag link mechanism consists of four links with the input and output links capable of making a complete rotation. Using the output of the drag link to drive the input of the slider-crank distorts the periodic output curve it produces. Function generation addresses the design of mechanisms to create desired output curves. As the addition of a single drag link to a slider-crank distorts the output curve a modest amount, the addition of a large number of drag links (with the output of one driving the input

of the next) can distort the original curve a significant amount. This research aims to generate chains of drag link mechanisms connected to a final slider-crank device capable of producing any periodic curve. The match between the desired curve and the curve produced by the chain of mechanisms is called the structural error. As the chain of drag link mechanisms increases in number, the structural error reduces.

Design Optimization Under Uncertainty Using Surrogate Models

STUDENTS Komahan Boopathy
ADVISORS Markus P Rumpfkeil
LOCATION, TIME Kennedy Union 311, 3:30PM-3:50PM
School of Engineering: Mechanical and Aerospace Engineering, Oral Presentation- Graduate Research

A deterministic design optimization process assumes no variations in the design variables and other parameters. This can easily lead to sub-optimal performance or failure of many deterministically optimized designs. Therefore, given the uncertainties in input parameters and operating environments, one would always like to have some measure of confidence placed on the output quantities of interest and would like to prevent the failure of such designs. We present a stochastic optimization framework involving surrogate models to quantify and propagate the uncertainties and account for them in the optimization process leading to robust designs.