SCHOOL OF ENGINEERING

Data Evaluation and Control of Pollutants in the Air

School of Engineering: Chemical & Materials Engrng | *Poster - Capstone Project*

STUDENTS Hassaan Fahim | ADVISORS Sarwan S Sandhu

LOCATION, TIME RecPlex, 10:45–12:00

This project is about the data evaluation of the pollutants in the open atmosphere such as carbon monoxide, sulfur dioxide, nitrogen dioxide, particulate matter, etc. The main aim of this project is to evaluate the data for the pollutants mentioned above as well as to generate different curves with the help of data obtained for past couple of decades and to develop some curve-fit equations to predict the approximate emission values of the pollutants for upcoming future years.As environmental pollution is one of the biggest challenges we are facing now-a-days in the current technology-based world,this work also shows the different allowable exposure limits of the pollutants as per regulations provided by the United States Environmental Protection Agency. Also, this work presents the air quality index specifications with its (U.S.EPA) different zones, providing the ways to protect our health from the long term exposure of the pollutants which can cause various diseases and disorder for living organisms, especially, human beings.

Evaluation of Mammalian Stress and Inflammatory Response to a Novel Porphyrin

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

STUDENTS Thomas L Bennett | ADVISORS Kristen K Comfort, Jayne B Robinson, Shawn M Swavey

LOCATION, TIME RecPlex, 10:45–12:00

Porphyrins are a specific class of aromatic, heterocyclic compounds that are either naturally occurring orartificially synthesized. Porphyrins have demonstrated robust antibacterial properties, which arise from the generation of singlet oxygen. However, most porphyrins are photodynamic, meaning they require activation by light at an optimal wavelength. A novel porphyrin, developed by Dr. Shawn Swavey (UD Chemistry Department) has shown exceptional antibacterial efficiency against Pseudomonas aeruginosa, even without photoactivation. As P. aeruginosa infections are often the root cause behind lung diseases, such as cystic fibrosis, identifying a way to safely control bacterial presence is a major concern. The ability of this novel porphyrin to effectively work in the dark identified this molecule as belonging to the rare group of porphyrins that hold potential for lung therapeutics. Therefore, this project evaluated the response of human lung co-culture model following exposure to the synthesized porphyrin. The lung co-culture was comprised of A549 epithelial and U937 macrophage cells, thereby allowing for the detection of inflammatory responses, in addition to cellular viability and stress induction. The viability of the lung co-culture model was assessed after a 24 hour exposure to the porphyrin at multiple concentrations, with no induction of cellular death identified. Looking beyond toxicity, the stress and inflammatory responses were investigated through evaluation of reaction oxygen species (ROS) levels and secretion of target cytokines, respectively. Taken together, these results will help support the development of novel porphyrins for lung therapeutics through determination of their safety within enhanced mammalian models.

Cooling with Sunlight: Proof-of-Concept of Solar-Driven Adsorptive Refrigeration Using Ethanol and Activated Carbon

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

STUDENTS Amnah M Altaher, Claudia J Labrador Rached, Jacob J Schlueter, Kathleen E Willard, Bjoern Oliver Winter, Matthew O Worsham | ADVISORS Jun-Ki Choi, Amy R Ciric

LOCATION, TIME RecPlex, 10:45–12:00

In locations without reliable electricity, refrigeration of critical medicines and vaccines is nearly impossible. Solar panels provide a possible source of electricity to power refrigeration units, but oftentimes, these solar panels are scavenged to serve other immediate needs. Solar thermal adsorptive refrigeration using ethanol and activated carbon as an adsorption working pair has been demonstrated to have significant potential for refrigeration in the areas of the world that lack access to reliable electricity. The ETHOS Program has been studying the potential of this working pair in Patna, India, for four years. As a working pair, ethanol and carbon have the advantage of being environmentally benign and locally available almost everywhere in the world. By using sunlight to drive the adsorption/desorption cycle, the refrigerator can provide cooling without electricity. Unfortunately, using ethanol as a vaporizing and adsorbing species means that that the system must operate at near absolute vacuum conditions. Once a vacuum of -29 in Hg was applied to the system, it was shown that liquid ethanol could cool itself down to 5 Â°C by evaporating and adsorbing to the activated carbon. Future work includes heating up the saturated carbon to force the ethanol to desorb which ultimately recharges the system. Once this step is confirmed, the complete refrigeration cycle can be completed and used to remove heat from a water bath that chills the medicine or vaccines.

Exposure to Metal Oxide Nanoparticles in Physiological Fluid Induced Synergistic Effects in a Keratinocyte Model

School of Engineering: Chemical & Materials Engrng | Poster - Independent Research

STUDENTS Deidre Simone Cathey, Kristen K Comfort, Jasmine N Whitaker | ADVISORS Kristen K Comfort

LOCATION, TIME RecPlex, 10:45–12:00

Nanoparticles (NPs) possess distinctive physicochemical properties that differentiate them from their bulk counterparts; making them attractive for application in a vast number of sectors, including medicine, consumer goods, industrial, and energy. However, these unique parameters have been associated with negative cellular consequences, including cytotoxicity, activation of stress pathways, and genetic modification. Standard in vitro techniques have been the primary means of evaluating NP safety, but suffer from a lack physiological relevance. One way to overcome this limitation is through the use of artificial physiological fluids, which mimic the composition and behavior of in vivo environments, thereby allowing for evaluation of NP characteristics under more accurate biologically conditions. In this study we identified that the behavior of copper oxide (CuO) and titanium dioxide (TiO2) NPs were substantially modified in artificial interstitial fluid (IF) versus traditional cell culture media, including extensive agglomeration and altered surface charge. When keratinocyte cells underwent CuO NP exposure, synergistic stress and toxicity responses occurred with IF experimental conditions. However, following IF incubation alone or concurrently with TiO2 NPs, which are not innately toxic, no combinatorial responses transpired. These results indicate that synergistic outcomes arise when toxic NPs undergo fluid-induced alterations to key physicochemical properties. This study highlights the necessity of characterizing NP behavior in physiologically-representative environments, as altered behavior patterns have the potential to induce bioresponses not identified within traditional cell culture models.

A Theoretical Model for a Lithium Ion Cell/Battery Electrode.

School of Engineering: Chemical & Materials Engrng | Oral Presentation - Course Project, CME 595 01

STUDENTS Srikar Pramod K Dudi | ADVISORS Sarwan S Sandhu

LOCATION, TIME Marianist Hall Learning Space Commons, 2:00–2:20

A theoretical model of a very thin platelet-like active material particle in contact with an electrolyte in a composite material electrode of a lithium ion cell/battery has been developed which predicts the lithium ion concentration profiles in the solid active material as a function of time for the case of lithium ion diffusion as the dominant mechanism for the lithium ion transport in a composite electrode active material and the assumption of uniform initial distribution of (lithium ion- electron) pairs in a thin platelet type particle of a composite electrode.

2016 Civil Engineering Senior Capstone Design Presentation

School of Engineering: Civil and Environmental Engineering and Engineering Mechanics

Oral Presentation - Capstone Project

STUDENTS Mai Mohammad Alhamad, Hasan A Alsaleh, Eelaf Aqeel, Thomas P Behr, Joshua C Bortmas, Matthew David Brown, Nabil N Challita, Robert M Greene, Cameron M Grim, Joseph R Gruensfelder, Kevin Ryan Gustafson, Jack R Hanson, Rachel E Hock, Nathan Thomas Jones, Danielle M Kearns, Anthony E Keene, Julie L Kolodziej, Kyle D Kotecki, Jessica Messick, Joseph C Obrien, Peter J Ogonek, Brett P Reese, Jonathan R Rose, Ryan M Schuerman, Maria Christine Schweiss, John Russell Shallahamer, Matthew D Svitak, Hung K Tran, Weidong Zhang, Zichen Zhang | ADVISORS Donald V Chase

LOCATION, TIME Miriam Hall 119, O'Leary Auditorium, 8:30–12:00

Civil Engineering Senior Capstone Design is the culmination of the Civil Engineering student's course of learning in the following fields: Project Management, Structural Design, Geotechnical Design, Transportation Design, Environmental Design, and Site/Civil Design. This year, the senior class, in collaboration with Sinclair Community College's Engineering Technology Department, designed an office park in Miami Township near the Wright Brothers Airport. The project consisted of a realignment of Austin Pike Blvd., the design of a recreational park, an office park, and a building design for the office park. The presentation will consist of each member of explaining a portion of the work they did to give the audience a more in-depth understanding of the construction plans we created.

Brain Machine Interface

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

STUDENTS Victoria Lynn Dicillo, Emma L Romstadt, Garrett C Sargent | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

An electroencephalography (EEG) signal recognition software suite is a popular tool used in a variety of applications dealing with brain activity. The UD Vision Lab has developed a use for EEG signal recognition software suite in the Brain Machine Interface (BMI) project. By collecting and recognizing EEG data, the suite can map the signals to actions. A non-invasive approach is taken in order to collect EEG data through the use of an Emotiv EPOC headset. The Emotiv EPOC headset has 16 electrode sensors and 2 reference sensors, which needs to be soaked with a saline solution before optimal performance is achieved. The recognized actions are then performed by a Robai Cyton Veta robotic arm with 7 degrees of freedom (DOF), which simulates a human arm. The arm utilizes commands from a custom C++ program to move the individual joints to perform an overall action. The work of previous students has developed a number of motions that can be recognized and performed with moderate to high success. There is still improvement that can be made for the current working motions, however, they provide a great building block for future work and can be incorporated into a set of activities. The current goal is to add more actions and activities by developing better encoding processes. By developing better encoding processes, significant advancement can be made in the project and open the doors to helping the disabled in a variety of ways. These ways include moving paralyzed limbs or synthetic limbs, and communicating simply by thinking a desire or action. Needless to say, the possible applications once an excellent encoding process is developed is far reaching. The BMI project provides a great deal of opportunity in the advancement of technology that can improve the lives of the disabled.

Electrical Characterization of Tungsten Oxide Based Memristor for Improved Resistive Switching

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

STUDENTS Ayesha Zaman | ADVISORS Guru Subramanyam

LOCATION, TIME RecPlex, 10:45–12:00

Memristor,the forth fundamental circuit element, has opened new phase in the realm of thin film semiconducting device. The non-volatility of memristors, used as Resistive switching RAM, is promising for applications such as DRAM, hard disks etc. The implementation of a memristor device with Tungsten Oxide (WOx) is presented in this work. The presentation addresses fundamental electrical characterization of the memristor devices for their switching performance. Resistive switching in WOx is bipolar in nature. The Pd/WOx/W made memristors become more conductive (resistive) when applied with a positive (negative) bias voltage. The conductance or resistance change is controlled by the re-distribution of oxygen vacancies (VOx) within the WOx film creating or removing conductive regions between the two electrodes. Here switching is analog type that refers to the incremental modulation of the device conductance. As a result the total change of resistance within the device goes higher which is in the range of 100. With the practical implementation of the suggested work we will be able to fabricate memristor devices with faster switching capability. Such Tungsten oxide based memristor provides better switching, assures non-volatile memory effect and also gives precise analog nature of a memory device for advanced neuromorphic application.

X-Corner Detection for Camera Calibration Using Saddle Points

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

STUDENTS Abdulrahman Saleh Alturki | ADVISORS John S Loomis

LOCATION, TIME RecPlex, 10:45–12:00

This paper discusses a corner detection algorithm for camera calibration. Calibration is a necessary step in many computer vision and image processing applications. Robust corner detection for an image of a checkerboard is required to determine intrinsic and extrinsic parameters. In this paper, an algorithm for fully automatic and robust X-corner detection is presented. Checkerboard corner points are automatically found in each image without user interaction or any prior information regarding the number of rows or columns. The approach represents each X-corner with a quadratic fitting function. Using the fact that the X-corners are saddle points, the coefficients in the fitting function are used to identify each corner location. The automation of this process greatly simplifies calibration. Our method is robust against noise and different camera orientations. Experimental analysis shows the accuracy of our method using actual images acquired at different camera locations and orientations.

Intention Based Upper-limb Exo-skeleton

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

STUDENTS Manoj Kumar Sharma | ADVISORS John S Loomis, David H Myszka, Raul E Ordonez

LOCATION, TIME RecPlex, 10:45–12:00

Exoskeletons, a wearable robot that intelligently augments the physical power of a human being. Lately these robots are finding their way towards the military and consumers as well. Our body has a skeleton that helps in maintaining the posture. Often times fatigue becomes an important issue, especially those who regularly carry heavy loads; one solution to this is to attach a structure that can cling to a human body that can bear the load on its own. One of the biggest challenge is to design a structure that can fits snugly and feels natural during operation. The approach proposed here, focuses on a simple 3DoF upper limb exoskeleton; to actuate the exoskeleton, pilot's intention is read and parsed through a Dynamic Intention Filter (DIF) and then to a feedback loops that eventually controls the torque of the motors. As a result, the final design feels so natural that there is, almost, no learning curve to its operation.

Robust Nonlinear Adaptive Control for Longitudinal Dynamics of Hypersonic Aircraft Vehicle Model

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

STUDENTS Turki Mohammed Alsuwian | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex, 10:45–12:00

A hypersonic aircraft vehicle is a highly complex nonlinear system, which includes uncertainties in the dynamics. This paper presents the design of robust nonlinear adaptive control for a hypersonic aircraft vehicle model. The complexity of the dynamic system is considered into the design structure of the control in order to address robustness issues. Design of a robust control system should decouple the longitudinal and lateral dynamics to handle the flight of hypersonic vehicle under certain specific conditions. In this paper, we only consider longitudinal dynamics, which are divided into aircraft speed subsystem and flight-path angle subsystem. A robust control design is implemented to provide asymptotic tracking regulation of aircraft speed and flight-path angle. In addition, it is employed in this study because the algorithm of control design exhibits better robustness properties. Based on the stability analysis, the adaptive control is derived for a Lyapunov function candidate of feedback closed-loop system. Simulation results of control design illustrate robustness and effectiveness.

Multi-Input Multi-Output Adaptive Control of 9-DOF Hyper-Redundant Robotic Arm

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

STUDENTS Xingsheng Xu | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex, 10:45–12:00

In this paper, multi-input multi-output (MIMO) direct adaptive torque controller is presented that uses conventional fuzzy system to provide asymptotic end-effector tracking of a reference path for a 9-DOF hyper redundant manipulator dynamic model. As a result, MIMO adaptive controller, which inputs torque of each joint to control end-effector dynamic variables, can highly improve the robotic performance considering both its kinetics and dynamics while executing motion control or tracking a reference in work space. Also, it increases the robustness with respect to disturbance, sensor noise and poorly understood dynamic model. The efficacy of our control algorithm affects the accuracy , stability and robustness of both motion control and path tracking.

Parameter Identification in Structured Discrete-Time Uncertainties without Persistency of Excitation

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

STUDENTS Ouboti Djaneye-Boundjou | ADVISORS Raul E Ordonez

LOCATION, TIME RecPlex, 10:45–12:00

Concurrent Learning has been previously used in continuous-time uncertainty estimation problems and adaptive control to solve the parameter identification problem without requiring persistently exciting inputs. Specifically selected past data are jointly combined with current data for adaptation. Here, we extend the parameter identification problem results of Concurrent Learning for structured uncertainties in the continuous-time domain to the discrete-time domain. Alike the continuous-time case, we show that, in discrete-time, a sufficient, testable on-line and less restrictive condition compared to persistency of excitation guarantees global exponential stability of the parameter error when using Concurrent Learning.

A novel Computer Aided Detection for identifying lung nodules on chest radiographs

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

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

LOCATION, TIME RecPlex, 10:45–12:00

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

On-chip Training of Memristor based Deep Neural Networks

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

STUDENTS Md Raqibul Hasan | ADVISORS Tarek M Taha

LOCATION, TIME RecPlex, 10:45–12:00

This research develops on-chip training circuits for memristor based deep neural networks utilizing unsupervised and supervised learning methods. As the training and recognition of deep networks are computationally intensive, specialized circuits capable of on-chip training of these networks could have significant advantages in speed and power consumption. Memristor crossbar circuits allow neural algorithms to be implemented very efficiently, but could be prone to device variations and faults. On chip training circuits would allow the training algorithm to account for device variability and faults in these circuits. We have utilized autoencoders for layer-wise pre-training of the deep networks and utilized the back-propagation algorithm for supervised fine tuning. Our design utilizes two memristors per synapse for higher precision of weights. Techniques to reduce the impact of sneak-paths in a large memristor crossbar and for high speed simulations of large crossbars were proposed. We performed detailed evaluation of the training circuits with some nonlinearly separable datasets which take crossbar wire resistance and sneak-paths into consideration. We also demonstrated successful training of memristor based deep networks for the MNIST digit classification and the KDD intrusion detection datasets. This work would enable the design of high throughput, energy efficient, and compact deep learning systems.

Automatic Building Detection in Wide Area Imagery

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

STUDENTS Almabrok Essa, Sidike Paheding, Daniel P Prince | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

Unauthorized construction can cause damage to public and private infrastructure, including utilities, public housing, telecommunication equipment, etc. Current construction analysis is performed by human analysts, who can become fatigued after reviewing large amounts of imagery and are expensive to employ. In order to improve efficiency and reduce cost in monitoring this unauthorized construction, there is a need for automating the detection of regions of interest in imagery. In this work, we focus on the automatic detection of buildings. Sources of aerial and satellite imagery can be used as sources of data in order to perform these detections. While standard visible imagery with red, green, and blue channels may be used, additional information can be extracted through the use of infrared data. In this research, we have created a building detection algorithm that utilizes texture, shadow, road, and edge information for use in detecting buildings from visible and infrared imagery in rural, suburban, and urban areas. Several examples of real-world satellite imagery are used in order to evaluate our building detection algorithm.

3D scene reconstruction and change detection using RGB-D sensor data

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

STUDENTS Ruixu Liu | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

In the past decade, novel sensor systems that provide both color and dense depth images became readily available. There are great expectations that this new technology will lead to a boost of new applications in the field of 3D scene reconstruction and change detection in unstructured environments and under real-world conditions. The change detection problems are not new; however, 3D change detection is a challenging problem that has developed in recent years. In order to get the high resolution 3D model, we need more voxels in the 3D model, like high resolution 2D pictures need more pixels. We acquire a point cloud model from video captured by a Microsoft Kinect, which provides the required RGB and depth information. Instead of using ICP (Iterative Closest Point) algorithm align the target frame with the reference frame, frame-to-model registration scheme has more resistance to noise and camera distortion, and is sufficiently efficient to allow real-time applications. Then 3D change detection will be completed on the created 3D point cloud models. There are two kinds of voxels model, point model and color model. A point voxel model defines voxel as surface or free space. The threshold for the voxels which define as the surface is the number of points estimated by computing the nearest neighborhood voxels. A color model defines each voxel that has a color by the Hue value of all points' HSV value in this voxel. Then using TSDF (Truncated Signed Distance Function) to detect surface of objects, we are able to find which voxels belong to the surface in the staggered voxel model. Combination of the point and color voxels model, and given the surface voxels more bigger weight, the difference between two scenes will presented by points in the voxels which are defined as scene changes.

Automated Oil/Gas Leak Detection System

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

STUDENTS Almabrok Essa, Sidike Paheding, Daniel P Prince | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

Monitoring oil and gas leaks along pipeline right-of-way (ROW) is an important task for locating damages in pipeline infrastructures and protecting our environments from pollution. It also provides essential information for decision making in the monitoring of pipeline ROW, and taking rapid response to damaging events. Data captured by advanced sensors in manned and unmanned aircrafts provide information about oil/gas leaks. However, analyzing the massive amount of data received from these media requires extensive effort if performed by human analysts. Therefore, we propose a novel technology to detect oil and gas leaks by analyzing aerial infrared (IR) data. It is observed that the presence of oil/gas leaks are more easily detected by analyzing the IR spectrum. It is envisaged that by extracting the oil/gas leak features using advanced computer vision algorithms, the leaks can be detected automatically. The proposed technique can assist human analysts for taking further decision by reducing the search space for locating probable leaks.

Image Interpolation Using Fourier Phase Features

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

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

LOCATION, TIME RecPlex, 10:45–12:00

Image interpolation has been widely used for enhancing spatial resolution of the input images. Generally, the spatial resolution enhancement techniques are categorized into single frame and multiple frame super resolution. Multi-frame super resolution techniques use a set of low resolution frames, while single image super resolution only requires one single input to reconstruct a high resolution image. In real life applications, single image super resolution is preferred when lacking of multiple frames in the data. In this work, we present a single image interpolation approach for reproducing high frequency missing components of the input low resolution images. The high frequency feature is first extracted in Fourier domain, and then the system is trained to regenerate better pixel values, which contribute to better resolution. We evaluate the method visually and quantitatively using several test images.

Shadow Detection Preprocessing for Computer Vision Technologies

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

STUDENTS Thomas C Sharp | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

In computer vision there are many preprocessing algorithms that can be utilized to enhance an image or video used in wide area surveillance. These enhanced images can be used to improve the results of segmentation algorithms that are used for object detection and object tracking. When a prominent shadow in an image merges with the region of interest, segmentation algorithms may only be able to extract weak object features. Weak feature extraction can lead to misclassification of the region of interest. Shadow detection preprocessing can improve object detection and tracking results by adding extra information to the object segmentation algorithms. In this study a method for shadow detection and image correction will explored.

Object Detection Through 2D–3D Visible and Hyperspectral Imagery

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

STUDENTS Almabrok Essa, Sidike Paheding, Daniel P Prince | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

In this research, we describe an information fusion system to integrate the classification outcomes in three different processing pipelines viz. a two-dimensional (2D) visible image processing to extract the 2D features and classify them based on similarity measures, a three-dimensional (3D) image reconstruction to detect the presence of objects above ground, and a hyperspectral image (HSI) processing to exploit finer details in the spectral signatures of targets and natural backgrounds. In 2D data, we develop a robust concatenated object classification technology to simultaneously detect multiple targets. In 3D data analysis, accurate dense representations of the scene is created by using a set of 2D images. Irrespective of lighting, seasonal and view point changes, the detected objects from 2D data can be reconfirmed in the 3D scene through their evaluation information or other 3D features. Finally, the miss detection or false detection can be further analyzed through HSI due to different materials have different spectral profiles or spectral signatures.

Frame Redundancy Elimination Technology for Big Data Analysis

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

STUDENTS Almabrok Essa, Sidike Paheding, Daniel P Prince | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

Rapid advances in the area of sensor technology have enabled the use of video acquisition systems to create large datasets for analysis. However, processing big data requires extensive effort for human analysts. On the other hand, it is observed that many data, such as high-frame rate video, contain redundancy that cause extra work for analysis. Therefore, there is a need to develop an automated frame selection technique to reduce work load. In this research, we develop a method that can extract the most important and meaningful video frames from a large amount of data, while removing the insignificant ones to ease further analysis. These key frames can be selected based on the statistical analysis such as computing the mean and variance among a set of frames or between subsequent frames. We believe this technology benefits the computational performance of many real-world data processing systems, especially in current big data problems.

An Efficient Brain-like Learning Machine to Mimic Human Perception

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

STUDENTS Md. Zahangir Alom, Sidike Paheding | ADVISORS Vijayan K Asari, Tarek M Taha

LOCATION, TIME RecPlex, 10:45–12:00

Human can rapidly process raw data with multiple levels of abstraction in highly interconnected neurons of the brain. To mimic such powerful processing system, a great deal of machine learning systems have been developed. Machine learning technology benefits many fields of our society, such as in biomedical science, agriculture, network security, economics, etc. Although human vision is still superior compared to computer vision in applications, recent studies show significant advancements in improving the capability of learning system on the basis of neural networks (NNs). Some popular NNs such as deep learning (DL) and extreme learning machine (ELM) have been widely applied in vast real-life applications. We describe an efficient ELM based learning system, which provides stable and non-decreasing recognition characteristics. Experiments on recognition of handwritten digits show very promising results when compared to other state of the art NN methods.

Object Tracking using Statistic-based Feature Fusion Technique

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

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

LOCATION, TIME RecPlex, 10:45–12:00

Object tracking in wide area motion imagery (WAMI) is challenging because of many factors including small target sizes, viewpoint changes, object rotation, occlusions, and shadows. One method to overcome these challenges is to fuse multiple features of different types to obtain a robust understanding of the object. For multi-feature fusion based tracking applications, the weighting of the features will highly affect the outcome. While obtaining a constant weighting scheme based on training sequences is possible, an adaptive method may better utilize the features. An adaptive weighting scheme should favor the most discerning features in the previous frames. A known way to determine a feature's ability to discern the target from the background is based on statistics analysis. We propose to use the statistics-based fusion method to better utilize rotation invariant based features to track objects. The effectiveness of the fusion method will be compared to a constant weighting scheme on eight sequences in two WAMI datasets.

Design and Fabrication of a Passive Barium Strontium Titanate (BST) Thin-Film Varactor-Based Phase Shifter for Operation within a 5–15 GHz Bandwidth

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

STUDENTS Devin William Spatz | ADVISORS Guru Subramanyam

LOCATION, TIME RecPlex, 10:45–12:00

Enabling next generation radar and telecommunications systems requires increasinglymore complex electronic components. In order to enable high performance, these componentsneed to have low power loss, quick switching times between device states, and highdevice state accuracy. One essential component, called a phase shifter, allows for the phaseangle of an electrical signal to be “shifted” relative to the input, or reference, phase angle.The ability to rapidly shift the phase angle of electrical signals enables these systems toencode information onto signals as well as to focus, or steer, the electromagnetic wavesthat they emit. This project developed a phase shifter which utilizes Barium StrontiumTitanate (BST) thin films in order to have a tuning capability that allows for the adjustmentof the phase shift angle. Through simulation, fabrication, and testing, this project studiesthe feasibility of using BST to achieve all of the qualities desired in a phase shifter andimprove on existing designs.

A Particle Reflector Accounts for the Electrical Energy Saving

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

STUDENTS Jun Jun Huan, Chethan Kanth Jalli, Arjun Krishnappa | ADVISORS Fahima Ouchen-Bouchendouka

LOCATION, TIME RecPlex, 10:45–12:00

As a ceiling fan consumes 75 Watts and is used day and night, it is not possible to ignore the power consumption of the fan. With a particle reflector, air flow in a room can be seen even after the fan in the room is turned off. A discrete way of turning the fan ON after every other 30 minutes saves the power supply of 75 Watts for 30 minutes periodically. Thus the particle reflector helps in reducing the power consumption of the fan.

Depth Perception for Obstacle Avoidance using Robust Artificial Intelligence-based Defense Electro Robot (RAIDER)

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

STUDENTS Brandon M Hampshire | ADVISORS Vijayan K Asari

LOCATION, TIME RecPlex, 10:45–12:00

All robotic navigation requires an awareness of surrounding environment to avoid potential collisions. To help aid the navigation of the Robust Artificial Intelligence-based Defense Electro Robot (RAIDER), we employ the use of a three-dimensional depth sensor (Xbox Kinect) to detect obstacles present in the path of the robot. The depth map created from the Kinect sensor provides necessary information to the obstacle locations. Navigation commands are then computed based on these locations to allow the robot to slow when approaching the obstacles and turn away from the obstacles. Communication is established with the robot using a wireless local area network and processing of Kinect is done on an off-board computer. This allows navigation processing requirements to be communicated to the robot remotely for communication and interaction with other robots and sensors.

Rechargeable Battery for Wearable Electronics and Sensors

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

STUDENTS Asha Palanisamy | ADVISORS Jitendra Kumar, Guru Subramanyam

LOCATION, TIME Kennedy Union 311, 1:20–1:40

Rechargeable Battery for Wearable Electronics and SensorsAsha Palanisamy1#, Jitendra Kumar2,* and Guru Subramanyam11Electrical and Computer Engineering (ECE), University of Dayton2Joint appointment with University of Dayton Research Institute (UDRI) and ECE, UD#palanisamya1@udayton.edu; *jkumar1@udayton.eduAbstract - Wearable electronics and sensors are being intensively developed in several forms; such as health monitors, watches, wristbands, eyeglasses, socks and smart clothing. Energy storage devices such as rechargeable battery make wearable devices to become more independent from power outlets or in other word improve device portability. Even the best commercial battery (i.e. lithium-ion battery, LIB) is limited in energy storage (energy density ~200 Wh/kg) and requires frequent battery charging. Also, the high cost of LIB is restricting mass adoption of these devices. Therefore, the energy density and cost of the battery need to be improved for the further development of wearable devices. Lithium sulfur battery (LSB) (energy density ~600 Wh/kg) is one of the most promising batteries for the future generation power storage, 2–3 times more energy storage in LSB than LIB. Since, sulfur is inexpensive, abundant and environmental friendly, LSB is expected to be more economical, safer and sustainable than LIB. However, performance (cycle life, thermal stability, liquid spillage, safety) of current LSB technology do not meet commercialization standards. Also, liquid electrolyte used in the commercial LIB or the state-of-the-art LSB can result in health hazards due to battery damage and liquid spillage. We present the development of novel materials and methods to improve overall performance of Li-S battery that can meet commercialization standards by combining thermal and dendrite-proof solid ion conducting ceramic based electrolyte (no liquid spillage) along with solid state and flexible S-cathode being developed in Electrochemical Energy Systems Laboratory at UD. Keywords: Wearable lithium sulfur batteries, flexible solid electrolyte, conformable sulfur cathode.

Modified Spiral-shaped Defected Ground Structure with Spurious-free Band Rejection Performance

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

STUDENTS Hailing Yue | ADVISORS Guru Subramanyam

LOCATION, TIME Kennedy Union 311, 1:40–2:00

A modified spiral-shaped Defected Ground Structure (M-DGS) loaded on Coplanar Waveguide (CPW) transmission line is proposed. By removing the inner spiral turns from the conventional spiral-shaped DGS (C-DGS), spurious-free band-stop performance is achieved in a wide passband. The final testing structure cascaded six M-DGS cells to enhance the band-rejection behavior. Repeated measurements show that the notch depth is greater than -50dB at 3.64GHz within an area of 1.5 by 13mm2. Insertion loss is under 3dB with no other harmonics up to 10GHz. For comparison purposes, C-DGS test structures with different numbers of removed spiral turns are also designed to validate the theory that the resonate frequency of a spiral-shaped DGS cell is dominantly controlled by the outermost spiral turn and each inner spiral turn contributes to the harmonics as well as some effect on the resonant frequencies and bandwidths.

Design and Fabrication of Fourier Spectral Filter Array for Multispectral Imaging

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

STUDENTS Chuan Ni | ADVISORS Andrew M Sarangan

LOCATION, TIME RecPlex, 10:45–12:00

Multispectral imaging has the capability to identify the state of objects based on their spectral characteristics. These are features not available with conventional color imaging based on metameric RGB (red, green and blue) colors alone. Current multispectral imaging systems use narrowband filters to capture the spectral content of a scene, which necessitates different filters to be designed and applied for each application. We have demonstrated the concept of Fourier multispectral imaging which uses filters with sinusoidally varying transmittance by time multiplexed switchable filter array in our previous paper [1, 2]. In this paper, we designed and built a five channel, spatially multiplexed pixel filter array. This enables single-shot images and makes it possible to capture scenes containing moving objects.[1] J. Jia, C. Ni, A. Sarangan, and K. Hirakawa, Fourier multispectral imaging, Optics express, Vol. 23, Issue 17, pp. 22649–22657 (2015).[2] C. Ni, J. Jia, K. Hirakawa, A. Sarangan, Design and fabrication of sinusoidal spectral filters for multispectral imaging, in SPIE Proceedings Vol. 9556: Nanoengineering: Fabrication, Properties, Optics, and Devices XII.

Metal films tapered fibers to enhance environmental sensing capabilities

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

STUDENTS Diego F Garcia Mina | ADVISORS Joseph W Haus

LOCATION, TIME RecPlex, 10:45–12:00

Using a tunable laser we analyze the optical signal transmission through a bi-tapered fiber sensor. The device sensitivity can be increased by depositing a gold metal film a few nanometers in thickness on the surface. By attaching selected molecules to the surface we can determine the presence of specific biomolecules. Keywords: Refractive index, taper fiber, optical fiber sensor, biomolecule detection.

Berreman Approach to Electromagnetic Wave and Beam Propagation in Anisotropic Metamaterials

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

STUDENTS Rudra Gnawali | ADVISORS Partha P Banerjee

LOCATION, TIME RecPlex, 10:45–12:00

Anisotropic metamaterials are widely acclaimed in the field of optics because of their intriguing electromagnetic properties. Such artificial materials can be constructed, for instance, as a multilayer structure comprising alternating layers of metal and dielectric, and modeled as a bulk anisotropic medium using effective medium theory. The effective medium may have dispersion relations which are elliptic or hyperbolic. Such anisotropic metamaterials display interesting properties, including negative refraction and super-resolution in the near and/or far-field. The objective of this work is to understand the transmission and reflection properties of stratified anisotropic media. In this work, the propagation of electromagnetic waves in anisotropic media is first resolved numerically for the case of oblique plane wave incidence. The Maxwell's equations for electromagnetic propagation are then represented as a set of coupled differential equations using the Berreman matrix. These coupled equations are then solved analytically and cross checked numerically using MATLABÂ® for plane wave propagation. Transmission and reflection coefficients are determined for different angles of incidence, incident polarizations and material parameters. The analysis is then extended to Gaussian beam propagation through such anisotropic metamaterials using the angular plane wave spectral approach.

DYNAMIC HOLOGRAPHY USING PHOTOREFRACTIVE MATERIALS: APPLICATIONS TO 3D VISUALIZATION AND IMAGE PROCESSING

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

STUDENTS Akash Kota | ADVISORS Partha P Banerjee

LOCATION, TIME RecPlex, 10:45–12:00

Digital holography (DH) has many applications in science and engineering, especially in the recreation and display of 3D images of objects. DH is able to reconstruct the three-dimensional surface by processing holographic data recorded on a charge coupled device (CCD). Holographic data can also be recorded in a photorefractive (PR) material. In fact, dynamic real-time holographic interferometry (RHI) can be implemented by using PR materials. To implement RHI using PR materials, two beams, one called a pump and one called the object beam are introduced onto a PR material to write the hologram of the object. During the hologram writing process, these beams can couple in intensity and/or phase which thereafter are responsible for self-diffraction of these incident beams, and can also give rise to Bragg and non-Bragg orders. In this work, the exact solutions to the interaction equations of Bragg and non-Bragg orders in a PR material for the case of interacting angular spectra are obtained by numerically solving them in MATLABÂ©. An iron doped lithium niobate crystal is used as an example of a PR material and an incident wavelength of 514 nm is assumed. Experimentally, it has been observed that when the angle between the two incident beams is small, typically a few degrees, multiple non-Bragg orders are generated. For numerical simulations, only the interactions between the spectra of two incident optical beams (Bragg orders) and two non-Bragg orders are considered. Different beam profiles such as Gaussian and flat-tops are considered as incident beams and the spatial evolution of both Bragg and non-Bragg orders as well as their relative phase shifts are numerically obtained.

Design, Fabrication and Testing Multi-Layered Metal Wire Grids Polarizer and Its Application in Polarization Imaging System

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

STUDENTS Pengfei Guo | ADVISORS Andrew M Sarangan

LOCATION, TIME Kennedy Union 311, 1:00–1:20

Sub-wavelength wire grids have a potential to be used in in micro-polarizers since they could provide information about the state of polarization of an image in a compact format. At the same time, the fabrication process for wiregrids is compatible with semiconductor technology. In this project, theoretical analysis, computation simulations will be conducted to investigate the influence of the design parameters on the performance of polarizers manufactured using a deep UV interference lithography. Simulations were also performed to determine if acceptable performance could be achieved using a CMOS back-end-of-line metallization process. In this process, multiple layers of the metallization could be used separated by dielectric films.
In the experimental process, we will demonstrate the pixelated polarizers with 0, 45, 90, 135 degree polarization orientations as a "˜super pixel' which repeat over entire array and integrate it with a photo-detector array. The transmission, extinction ratio, spectral and angular bandwidth will be measured to evaluate the polarization imaging system and compare to the single layer polarization imaging system.

Quantum Tunneling in Metal-Insulator-Metal Nanoantennas

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

STUDENTS Mallik Mohd Raihan Hussain | ADVISORS Imad Agha, Joseph W Haus, Andrew M Sarangan

LOCATION, TIME Kennedy Union 311, 2:40–3:00

The goal of this research is to experimentally examine the optical properties of nanometer-sized metal-insulator-metal (MIM) structures. A set of experiments are designed to measure the second and third-harmonic waves scattered from the nanostructured MIM antenna when illuminated with different lasers and, also, to quantify the current/voltage characteristics of carefully fabricated MIMs. The MIM sample geometry is designed so that there is a nanometer-sized gap between two metals that is filled with an insulator (dielectric) material. The prediction of higher-order optical harmonics generation related to the MIM geometry is predicated on the photon-assisted, electronic quantum tunneling process. The quantum tunneling process calculates a set of conductivities that is used in our numerical simulations to describe the electromagnetic properties of the MIM. The initial results from numerical simulations were compared to other numerically intensive methods available in the literature to validate them.
For this research, we extend the validation process by performing more numerical simulations to compare with data from our optical experiments. Our research is guided by numerical calculations to find the optimal conditions for generating the optical harmonic waves.

U.S. Aviation Accidents and Incidents, 2013

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

STUDENTS Megan R Aponte, Emily K Strobach | ADVISORS Philip Appiah-Kubi

LOCATION, TIME Kennedy Union 310, 1:20–1:40

Since its establishment in 1958, the Federal Aviation Administration (FAA) and the National Transportation Safety Board (NTSB), have helped to improve aviation safety in the United States. The FAA has introduced several regulations, which have positively contributed in making air transportation the safest in terms of fatalities per mile. However, "the only acceptable safety goal of zero accident," proposed by former Secretary of Transportation (Federico Pena) is yet to be achieved. In 2013 alone, there were about 1,222 civil aviation accidents in the U.S. which, is one of the highest in recent years. This paper, therefore, reviews the aviation accidents and incidents in 2013. Using data from the NTSB database, factors such as flight phase, weather conditions, pilots in command's flight hours, etc. were analyzed to identify trends, and provide recommendations on how aviation safety can further be enhanced. Preliminary results indicate that human error and mechanical failure contribute the most to these accidents and incidents. However, it is sometimes difficult to attribute the root cause of an accident or incident to a particular source since they are not always mutually exclusive.

Toward Achieving Renewable Energy Targets in Saudi Arabia

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

STUDENTS Saud Abdullah Alalawi, Mustafa A Almashari, Devin Alexander Mallett, Zack Valigosky | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

According to the Energy Information Administration, electricity consumption in the Kingdom of Saudi Arabia (KSA) has increased 53% from 2000 to 2012. During this same period, KSA's Gross Domestic Product (GDP) has nearly quadrupled. Internal estimates of growth indicate a doubling in demand for electricity by 2032. In response to this, the KSA proposed meeting the demand for electricity through renewable energy and established the King Abdullah City for Atomic and Renewable Energy (K.A. CARE) in April of 2010 to form this sustainable future for Saudi Arabia. The energy portfolio proposes that in 2032, 50% of all electricity generated shall come from renewable energy, consisting of: solar, nuclear, wind, waste-to-energy, and geothermal. The goal of this study is to analyze the environmental, social, and economic impacts and benefits of the K.A. CARE's proposed portfolio on the KSA. Environmental impact will be measured through a summation of CO2 emissions in production, operation, and maintenance of specific renewable technologies. Economic impacts will be measured through cost-benefit analyses specific to Kingdom of Saudi Arabia. Social benefits are examined through human capital improvements: income, health, and education. Different technology scenarios will be proposed and examined based on environmental, social, and economic impacts and benefits. Some parameters for this analysis include: (a) productivity of future power sources with the combination of energy source, (b) innovating preexisting, large scale energy models and (c) taking a look at updating the total energy system, using an economic benefit analysis.

Creating a Sustainable Process for Recycling Lithium Ion Car Batteries

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

STUDENTS Jabrel Abrahem, Tarik S Alkharusi, Justin T Dickman, Saehan Lenzen | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

In the near future, lithium ion batteries will be in 70% of electrical vehicles, which make up 7% of the world's transportation market. It's important to focus on a way to recycle Lithium Ion batteries in order to prevent them from being thrown away and to create a sustainable process similar to what exists for lead-acid batteries. Since electric cars are a newer technology, raising awareness for recycling Lithium-Ion batteries will help the average consumer be aware of their environmental footprint specifically related to their specific car choice. Recycled lithium costs five times more than lithium produced from the least costly brine based process. We aim to develop a framework for companies to recycle Lithium-ion batteries in a cost-effective manner will set a benchmark for the importance of recycling batteries used by electric cars worldwide. The organization of this paper will be split into four sections. We will first explore the advantages of lithium ion batteries over lead-acid batteries. Second, will be to delve into the current difficulties in recycling lithium ion batteries. Third, compare the current recycling process of lead-acid batteries with the recycling processes we can find for lithium ion batteries. Fourth, will focus on our proposal of a process through which companies can recycle lithium-ion batteries profitably.

Tired of rubber landfills: From environmental hazard to sustainable use potential of discarded tire materials

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

STUDENTS Keith Brian Abankwah, Abdulelah Bajbair Bajbair, Feras A Melibari, Bjoern Oliver Winter | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

How do you dispose of your used car tires? Although answering this on an individual level doesn't seem to be hard, the sheer amounts of old tires disposed of as a byproduct of a growing car market in the United States have grown to make a significant impact on the environment. Each year, over 350 million tires are consumed and only about 70% of the accruing waste is properly recycled at their end of life. The storage of tires in landfills, or improper methods of disposal, such as burning and waterbody displacement causes hazardous emissions and health problems. For instance, the improper storage of tire stockpiles can lead to potential breeding grounds for mosquitoes and other disease-carrying insects and rodents as stockpiled tires are often holding water for long periods of time. Burning tires can negatively affect air, water and soil and produce toxic chemicals, such as benzene and polycyclic aromatic hydrocarbons (PAH). Tire stockpiles set on fire, whether by chance or on purpose, produce enormous amounts of heat and are so hard to extinguish that some fires have been continuing to burn for extended periods. A prominent example was a fire in Rhinhart, Winchester, Virginia that continued to burn for nine months on end.Against this background, an assessment of the magnitude of tire disposal related impacts in the near future is performed within different scenarios while providing insight into current practices of tire disposal. In contrast to this, alternative processes that process tires into fuel and activated carbon are looked upon. In a subsequent life-cycle analysis, the production of fuel and carbon from tires is compared to the fabrication of the same products from natural resources in order to show environmental advantages of recycling tires in these processes.

Investigating Pathways Towards Energy Efficient Glass Recycling

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

STUDENTS Mohammed Alqahtani, Ahmad Y Baba, Kyle P Gruss, Janna K Jenan | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

An investigation of various scenarios of glass recycling reveals that end product characteristics drive the critical factors in evaluating the many alternatives. When recycling glass, many issues must be investigated, however the focus here will be investigating energy consumption and the goal is to make a decision on which process is most energy efficient when dealing with glass recycling. To reduce energy consumption we identify the best combination of scenarios of glass recycling. Critical factors of glass recycling include methods of recycling process and the use of different furnaces to reduce the energy consumption, geographic locations / transportation by taking into account multiple aspects of different locations, the use of glass recycling to reduce energy use of new raw materials to produce new glass. After analyzing these critical factors of energy investigation, significant factors will be combined to make an ideal hypothetical energy efficient glass recycling plant, by considering the process, geographic location, transportation, and materials. The best combination of these factors will have the most favorable impact on the environment because of its ability to be energy efficient.

Building Recycling: The Reconstruction from Deconstruction

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

STUDENTS Mohammed A Alharbi, Zhening Cui, Ryan William Schwenke, Daniel P Wiese | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

AbstractBuildings, both large and small, are getting constructed and demolished every day. A lot of the time after getting demolished, the different materials that were used in the structure still have potential to be reused or recycled, but the material is instead thrown away into a landfill. This not only wastes resources that still have value but also adds to a growing waste problem. The topic for this research paper consists of analyzing different methods and solutions of recycling and reusing old building material. The four goals of this paper is to analyze: 1) the different types of recyclable materials used in construction; 2) the process of recycling concrete; 3) the process of recycling metal; and 4) the benefits of deconstruction versus demolition of a building. This work aims to identify current usage of different metals and materials, such as copper, steal, glass and concrete, in the construction of multiple buildings. In addition, it will analyze what percentage of these metals and materials can be recycled for future use. The economic impact will be compared between recycling and wasting building material either by sending it to a waste land or letting the building stand unoccupied. The emissions for mining material, processing new materials, demolition of buildings, recycling processes for new material will be analyze to see which path produces the most emissions and how it can be reduced to have a more positive impact. Our result shows that recycling building material will save money, resources, and help reduce harmful emissions into the land and atmosphere.

VectorWorks for Light Design

School of Engineering: Mechanical and Aerospace Engineering | *Poster - Course Project, MEE 499 01*

STUDENTS Mary F Lamperis | ADVISORS Margaret F Pinnell

LOCATION, TIME RecPlex, 10:45–12:00

VectorWorks is a 3-dimensional modeling program like Autodesk or SolidWorks, yet unlike these, it excels when dealing with light design. Integration of Autodesk files into VectorWorks is currently possible, yet not adaptable when working with the further light design tools that VectorWorks has to offer. Being adept in this program while working in theatrical lighting design will be a tremendous advantage. One of these main tools lets you output a data chart necessary when implementing the lighting layout in the theatre itself. Normally transferring the data from an Autodesk file to a usable chart takes several hours and includes multiple human errors. With these advantages in mind, I created a layout of Boll Theatre that not only gives me experience, but also provides a updated model to aid future light designers.

RE (CELL) LCD: A Feasibility Study on Recycling Cell Phone LCD

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

STUDENTS Abdulaziz Alotaibi, Christopher C Beaschler, Siddharth N Rathod, Matt S Shea | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

Liquid Crystal Displays (LCD) are used in a magnitude of devices and have now become the norm in products that require a screen, such as, cell phones, computers, televisions, tablets, and more. However, many of these technologies are becoming outdated leading towards the issue of exponential growth of waste with a lack of technology set in place for proper recycling. Most of research literatures on LCD recycling are of electronic products and e-waste in general rather than cell phones in particular. Few studies on recycling of cell phone LCD have been accomplished. Since everyday around 300,000 mobile phones are sent to trash in United States alone, the recycling of LCD of cell phones is still a challenge for recyclers. In this paper four main topics will be discussed: Establishing need of recycling of LCD due to its environmental impacts, increasing number of LCD usage with time, current EoL (End of Life) process and challenges associated with it in terms of environment, economy and social aspects. By our findings, we are aiming to examine the sustainable feasibility of recycling LCD of cell phones comparing with other LCD products. Our approach for obtaining data for LCD of cell phones is to simulate details from other LCD products (LCD Monitor, LCD PC, LCD TV) such as main elements, recovery of substances, energy required to produce, etc.Finally, we will conclude with the observations with important considerations for a holistic approach to make LCD recycling of cell phones feasible. The results aim to enable recyclers to add confidence in LCD recycling of cell phones and also for researchers to extend this work with innovative ways and cost-effective approach in future.

Toward Sustainable Carpet Recycling in the United States

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

STUDENTS Ahmad H Alkankouni, Brett C Bass, Robert D Stachler, Robert A Wehrli | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

Carpet has been used in everyday life since our ancestors. It is virtually utilized in any building, residential and commercial, and has various colors, designs, and style among its traditional uses. The carpet industry is a $12 billion industry, with approximately 45% of production rates from the United States alone (Wang, 2006). A large industry of carpet with roughly 5 billion pounds of post-consumer waste per year and recycle ratio of 14% warrants consideration of end use, recycling potential, and sustainable design from the beginning of the product life (CARE, 2014). These considerations can remedy shortages in nylon among recovering energy potential from materials in the carpet in general. Current methods and strategies for carpet recycling will be explored in a life cycle analysis including pre and post-life and environmental impact. Economic impact of carpet with respect to the recoverable material in the product will be investigated as it will provide insight to the economic viability of carpet recycling and lay the foundation for any legislation that would be necessary to make the processes economically viable. Strategies for reverse logistics between the carpet manufacturers and recyclers will be discussed given the economic impact. Research of current public awareness on current carpet recycling and the effectiveness of the programs is included in this preliminary investigation on carpet recycling. This work will provide insight to the life cycle of carpet, economic viability of carpet recycling and reverse logistics, while creating a foundation for how manufacturers and recyclers can work in unison towards sustainable design for the future.

Can Airplane Recycling Take off?

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

STUDENTS Mariana E Aboujaoude, Tyler D Knoblauch, Christian Alexander Lohmeier, Zhuochen Shi | ADVISORS Jun-Ki Choi

LOCATION, TIME RecPlex, 10:45–12:00

As of 2015, the worldwide air transportation industry is expected to contain an estimated 10,000 aircraft ready for retirement. In order to offset the introduction of waste from aircraft disposal into landfills, as well as to cope with the depletion of natural resources, the recycling of airplanes is becoming more prevalent. Aircraft Recycling is a process of highly variable economic revenues. Often, the difference between having a loss and a profit is with the resale of aircraft parts, namely the engines. Recycling companies often have to charge the owner of an aircraft for the recycling process in order to make up for their labor costs, and at the same time, not all that could be recycled is actually recycled in practice. This study introduces the current processes associated with aircraft recycling and disposal. This study identifies current estimated costs and revenues behind the recycling and disposal of an aircraft and formulates a baseline. This study then introduces suggested improvements in specific waste streams (metals, parts, hazardous materials, insulation and aircraft lining, textiles, etc.) and the economics associated with these improvements. A cost-benefit analysis will determine economic feasibility of suggested improvements.

The Relationship Between the Wingtip Vortex, the Free Shear Layer and Aerodynamic Efficiency

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

STUDENTS Sidaard Gunasekaran | ADVISORS Aaron Altman

LOCATION, TIME RecPlex, 10:45–12:00

The interaction between the free shear layer, the wingtip vortex and the aerodynamic efficiency was quantified based on previous experimental Particle Image Velocimetry (PIV) results of the wingtip vortex and the free shear layer. These preliminary results showed signs of interaction between the free shear layer and the wingtip vortex. This analysis was extended to more completely understand the interaction of the free shear layer in the wingtip vortex evolution process and the correlation of this interaction to the aerodynamic efficiency of the wing. The streamwise, cross-stream and spanwise plane oriented PIV of the wingtip vortex showed clear signs of free shear layer interaction with the wingtip vortex at lower angles of attack. This interaction was reflected in the normalized azimuthal velocity profile of the wingtip vortex as well. The composite of velocity profiles from multiple different planes showed a transfer of momentum from the free shear layer to the wingtip vortex in the vicinity of the maximum (L/D) lift condition. This result was correlated with the variation of the parasite and the induced drag of the wing.

Wingtip Vortex Behavior in the Vicinity of the Maximum Lift to Drag Ratio Lift Condition

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

STUDENTS Muhammad Omar Memon | ADVISORS Aaron Altman

LOCATION, TIME RecPlex, 10:45–12:00

Adverse effects of lift induced drag on the aerodynamic efficiency of aircraft are well known. Lift induced drag is generated as a byproduct of downwash from the wingtip vortices. The flow physics associated with wingtip vortex core axial flow transformation from wake-like (velocity less-than the freestream) to jet-like (velocity greater-than the freestream) behavior in the vicinity of the maximum lift to drag ratio (L/D) lift condition is explored. Particle Image Velocimetry (PIV) experiments were performed in the UD Low Speed Wind Tunnel in the near wake of an AR 6 wing with a Clark-Y airfoil to investigate the characteristics of the wingtip vortex at angles of attack ranging from 2 and 8 degrees. Results showed changes in the velocity distributions in the vortex inner and outer cores. Vorticity and exergy distributions indicated the existence of the wake-like to jet-like transformation in the range of 4Â° to 6Â° angle of attack. This range corresponds with the maximum L/D angle of attack of the Clark-Y tested. A relationship between the vortex core axial velocity profile changeover and the angle of attack at maximum L/D was identified. Improved understanding of this relationship could be extended not only to improve aircraft performance through the reduction of lift induced drag, but also to air vehicle performance in off-design cruise conditions.

Spatial Mechanism Analysis and Synthesis by Dual Special Unitary Matrices

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

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

LOCATION, TIME RecPlex, 10:45–12:00

Numerical algebraic geometry is the field that studies the computation and manipulation of the solution sets of systems of polynomial equations. The goal of this work is to formulate spatial mechanism analysis and design problems via a method suited to employ the tools of numerical algebraic geometry. Specifically, equations are developed using dual special unitary matrices that naturally use complex numbers to express physical and joint parameters in a mechanical system. Unknown parameters expressed as complex numbers readily admit solution by the methods of numerical algebraic geometry. This work illustrates their use by analyzing the spatial RCCC and RRRCClinkages. The specialization to pure rotations using special unitary matrices is also presented and used in the analysis of the spherical four-bar and Watt I linkages. The motion curves generated in this work are validated by comparison to other published work.

Integrated Systems Plus Principles Approach to Industrial Energy Efficiency

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

STUDENTS Michael Ralph Ising, Kathleen Rose Sturtevant | ADVISORS J Kelly Kissock

LOCATION, TIME RecPlex, 10:45–12:00

In today's global economy, fierce competition, volatile energy costs and a sharedmotivation to reduce the environmental impacts of energy use drive improvements inmanufacturing energy efficiency. This poster presents a systematic approach for improvingindustrial energy efficiency that breaks complicated manufacturing processes down into distinctenergy systems that can be addressed using seven fundamental principles of energy efficiency.This “Integrated Systems plus Principles Approach”

(ISPA), based on the experience of 950industrial energy audits, focuses on the electrical distribution, motor drive, lighting, fluid flow,compressed air, process heating, process cooling and space conditioning systems that make upvirtually all manufacturing processes. Targeting these systems, rather than individualman-ufacturing processes, makes it possible to develop expertise in a finite group of energysystems rather than a nearly infinite number of manufacturing processes. In addition, sevenprinciples of energy efficiency have been identified that apply across all sys-tems and provide aunified way of understanding and approach-ing energy saving opportunities. The sevenprinciples of energy efficiency are “think inside out”, “maximize control efficiency”, “employcounter-flow”, “avoid mixing”, “match source energy to end use”, “benchmark againsttheoretical minimum energy use”, and “consider whole systems over whole time frames”. Thisposter explains ISPA, discusses the use of ISPA for conducting energy assessments and teachingenergy efficiency. Finally, it presents a public-domain, open source, spreadsheet-based “EnergyEffi-ciency Guidebook” based on ISPA that combines the principles of energy efficiency, systembest practices and energy saving examples with spreadsheet calculators and energy simulation-software to quantify savings.

Creating Value through Sustainable Manufacturing

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

STUDENTS Ryan S Schuessler, Zack Valigosky | ADVISORS Jun-Ki Choi, J Kelly Kissock

LOCATION, TIME RecPlex, 10:45–12:00

To support movement toward a more sustainable worldview, increasing manufacturing efficiency or productivity to improve business profitability and return to shareholders alone is no longer sufficient. Today, leading manufacturers employ busi-ness practices that generate sustainable value””that is, creating economic, environmental, and societal value for all stakehold-ers. Progressive company culture, environmental and energy management systems, carbon neutrality, and becoming landfill free are all valuable outcomes of sustainable manufacturing. This poster outlines the the value of these outcomes as well as methods to achieve sustainable manufacturing.

Enhancing Industrial Sustainability by Improving Material Efficiency

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

STUDENTS Daniel J. Kelley | ADVISORS Jun-Ki Choi, Robert B Gilbert, J Kelly Kissock

LOCATION, TIME RecPlex, 10:45–12:00

The rising costs of energy and materials along with stringent environmental regulations, force industries to improve their energy and material efficiency. This poster presents a roadmap to improve material efficiency in manufacturing industries. We developed a publicly available computational tool with a sys-temized methodology called the “Material Efficiency Guidebook (MEG).” The MEG provides an Integrated Materials plus Principle Approach (IMPA) methodology that integrates six types of materials: raw material, water, chemical agents, process scrap, packaging waste, and equipment, along with seven principles of material efficiency to guide manufacturers to become more materially efficient. The purpose of the MEG is not only to assist industries in becoming more materially efficient but also to provide the reader with real world examples and computational resources. In addition to real industry examples and savings calculations, the MEG includes industry’s best practices and a streamlined life cycle analysis tool to quantify the environmental impact of material savings.

Objective Function Choice Influences Muscle Muscle Force Predictions During Human Walking

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

STUDENTS Elijah C Kuska | ADVISORS Allison Kinney

LOCATION, TIME RecPlex, 10:45–12:00

The knowledge of forces in muscles and joints inside the human body may help to improverehabilitation for individual patients. However, the human body is complex and theseforces are unmeasurable. Through the use of motion capture technology, 3D modeling,and computational methods in the field of biome-chanics we are able to simulate motion bypredicting these forces. One challenge to biomechanical simulation is that we do not understandthe strategy humans use to coordinate their mus-cles to walk. The purpose of thisstudy was to examine muscle coordination strategies used to simulate walking. Differentmuscle coordination strategies are attained in a simulation by altering a quantity calledthe objective function. Simulation output data can be compared between strategies and toexperimental data to determine the strategy that best represents human muscle coordination.In the future this knowledge may be applied to rehabilitation techniques: changingthem from generalized to patient-specific.

Nonlinear Analysis of Balance Data in the Easter Seals Adult Day Services Population

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

STUDENTS Taylor Marie Schemmel | ADVISORS Kimberly E Bigelow

LOCATION, TIME RecPlex, 10:45–12:00

81.1 million adults are expected to be affected by dementia in 2040. Individuals with dementia are twice as likely to fall as healthy individuals and three times as likely to sustain an injury during a fall. Unfortunately, current fall prevention techniques in place for the cognitively healthy elderly are not as effective for those with dementia. The objective of this study was to examine balance differences between individuals of varying cognitive ability utilizing Easter Seals Adult Day Services.All individuals utilizing Easter Seals Adult Day Services were invited to participate in this study. All study participants completed the Montreal Cognitive Assessment (MoCA), which provides a quick clinical assessment of cognitive ability. Clinical assessments were done in conjunction with static posturography data collection on a balance plate. Four different quiet standing test conditions were used to assess the three sensory systems contributing to postural control. Of the 19 individuals that decided to participate, 11 were able to complete all balance testing conditions.Nonlinear techniques were used to analyze the balance data for this study because of its heightened sensitivity to subtle differences in postural control that traditional measures of analysis don't always express. The nonlinear techniques look past the amount of sway given by traditional measures to provide insight to physiological patterns of postural control.Due to multiple confounding variables, it was difficult to identify a specific correlation between MoCA scores and balance parameters. When clinical and balance assessments were compared with age-matched norms, noticeable deficits were observed. It is hoped that this study can contribute to a better understanding of balance limitations in the adult day services population and inform future interventions.

Research Experience for Teacher (RET) program: Inspire the Next Generation in Advanced Manufacturing and Materials

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

STUDENTS Caroline Margaret Boeckman, Emma A Cipriani | ADVISORS Margaret F Pinnell

LOCATION, TIME RecPlex, 10:45–12:00

This research was conducted at the University of Dayton through a research program for teachers. The goal of this program was to have pre-service and experienced teachers gain more knowledge about engineering concepts so that they could incorporate them into their classroom. The objective of this research was to perform tensile testing of Fused Deposition Modeling materials to determine variability due to orientation and print machine. The Ultem samples tested were produced on six different printers. Within these samples, there were three different orientations tested; ZXY, YZX, and YXZ. We tested the tensile strength using an Intron 4486. Each member of the group was involved in the testing process, which included sample testing, recording data, placing extensometer, analyzing data, and running the Bluehill program. During the analysis of our data, we calculated the Ultimate Tensile Strength (UTS), Stress at Failure, Strain at Failure, and Elastic Modulus. After testing multiple samples of each orientation and the different printers, we found that YZX has the highest ultimate tensile strength (UTS) and strain of all orientations tested. ZXY had the weakest UTS and strain. Statistically, each orientation from the various printers has similar tensile properties.

Design and Prototyping of a Variable Geometry Extrusion Die to Exhibit Significant Alteration in Shape

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

STUDENTS David C Bell | ADVISORS Andrew P Murray, David H Myszka

LOCATION, TIME LTC Team Space, 1:00–1:20

Extruded parts are conventionally made by forcing melted plastic through a steel die having a fixed opening that matches the shape of the part. Plastic parts made by extrusion include weather stripping, PVC pipe, and composite lumber. Variable geometry dies can change their opening shape during the extrusion process. Developing shape-changing dies technology offers the possibility of making parts with varying cross-sections that currently need to be made through injection molding. This is desirable as, compared to molding, extrusion tends to be faster and less expensive. Variable geometry extrusion dies have been designed and prototyped by the University of Dayton research team that confirms the validity of the concept. This research explores the limits of this new technology by creating a die that has substantial movement of components that form the die opening.

A Study of Surrogate, Conventional, and Alternative Fuel Emissions Using a Well-Stirred Reactor

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

STUDENTS Robert D Stachler | ADVISORS Joshua Heyne, Scott D Stouffer

LOCATION, TIME LTC Meeting Space, 1:00–1:20

In response to United States and European Union legislative orders, industrial and government organizations are actively pursuing strategies to reduce pollutant emissions and promote alternative energy fuels in gas turbine combustors to combat climate change and mitigate market volatility. Current goals for the US government include carbon neutral growth for US commercial aviation by 2020, with a 9-34 megatons reduction in CO2 due to alternative fuels alone. This pursuit requires novel technologies to cultivate renewable fuels, certify fuel safety and operability, and optimize future use in gas turbine engines. Here we examine the pollutant emissions of fuel mixtures and identify performance characteristics such as lean blow off and combustion efficiency using the Well-Stirred Reactor (WSR) facility operated by UDRI and AFRL. The WSR illuminates the controlling kinetics of the combustion process at temperatures of 1350”“1600 K and near 1 atm for various surrogate, conventional, and alternative fuels. n-Dodecane based blends with m-xylene, iso-octane, methylcyclohexane, and n-heptane are compared and contrasted with conventional and alternative fuels while approaching leaner conditions for the use of simulating kinetics experiments, predicting emissions, and studying hazardous air pollutants (HAPs). This data provides preliminary framework for n-dodecane based fuel mixtures and alternative fuels applicable to full scale combustor testing.

Reduced Order Experimental Configuration Studies of Wood Combustion

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

STUDENTS Sari Mira, Robert D Stachler | ADVISORS Joshua Heyne

LOCATION, TIME Kennedy Union 207, 4:20–4:40

Wood is one of the largest biomass energy resources used today. Yet, the combustion process of wood is still largely unoptimized. While theoretically wood is a renewable source of energy, it is not necessarily a clean source as the process of wood combustion is inherently multidimensional and multi-phase, and the formation of emissions such as CO, NOx, and other particulates are results of both deficient and copious mixing. Thus, standard experiments characterizing the emissions/speciation and performance of wood combustion using various fundamental and applied experimental configurations can contribute in part to the reduction of emissions and increases in efficiency. Previous studies towards this aim have focused on experimental configurations similar to so-called stove combustion (i.e. multiphase, multidimensional). This model has been developed to reduce the computational and experimental complexity and cost of simulating and validating wood combustion apparatus designs. Here, we discuss an experimental configuration in which the initial/boundary conditions are both well characterized and entirely gaseous, and the geometry can be modeled as zero or one dimensional. Thus, a preliminary study of gas-phase wood specific species was conducted in order to design and speculate the potential benefits of these reduced order experimental configurations. The study consists of two parts: the first part is building a model capable of producing results for one of these configurations, a counterflow diffusion flame experiment, validated by existing and established experimental results using non-biomass-based fuels, such as propane, hydrogen/oxygen, etc. The second part is using that model to produce results for dry hardwood following the work Ranzi et al. (Ranzi, Couci, Faravelli, et al., 2008). A future continuation of the work will be building the established experimental counterflow diffusion flame apparatus to validate the dry hardwood model and to build more comprehensive biomass kinetic mechanisms.

Applications of Model Predictive Control in Hybrid Power Systems

School of Engineering: UD Reaserch Institute | *Poster - Graduate Research*

STUDENTS Seyed Ataollah Raziei | ADVISORS Zhenhua Jiang

LOCATION, TIME RecPlex, 10:45–12:00

As the design of Electric Hybrid Systems (EHS) become more and more complicated, more advanced control theories is needed in order to control and optimize the performance of them. Model Predictive Control (MPC) is one of the promising methods to achieve optimal control of EHS. In this research design steps of applying MPC to the electric hybrid systems have been discussed. Furthermore, the effect of each design parameters on the system's behavior has been evaluated.

Characterizing the Interaction of Mytilus edulis Foot Protein-5 with HY80 Steel

School of Engineering: UD Research Institute and Chemical and Materials Engineering

Poster - Graduate Research

STUDENTS Brooke N Bennett | ADVISORS Douglas C Hansen

LOCATION, TIME RecPlex, 10:45–12:00

Mytilus edulis foot protein-5 (Mefp-5) is an adhesive protein found in the adhesive plaque of the byssal thread of the common blue mussel, Mytilus edulis (L). While to date there have been eight proteins isolated from the byssal structure, this protein contains the greatest amount (27 mol %) of a unique amino acid, L-3,4-dihydroxyphenylalanine (L-Dopa), which is a posttranslational modification of the amino acid L-tyrosine. This protein has been shown to confer significant corrosion inhibition to a high strength, low alloy steel (HY80) when adsorbed onto the metal surface and the steel subsequently exposed to accelerated corrosion environments. To characterize how Mefp-5 interacts with the HY80 steel and thus provide corrosion inhibition, a variety of analytical techniques were implemented. Energy dispersive spectroscopy (EDS) was performed using a scanning electron microscope (SEM) on HY80 steel with three different treatments of Mefp-5 dissolved in deionized water, 0.05 M potassium phosphate buffer with a pH of 5.5, and the same buffer containing mushroom tyrosinase to facilitate the oxidation of the L-Dopa and subsequent intramolecular cross-linking. Fourier transform infrared spectroscopy (FT-IR) and Nanoscale infrared spectroscopy (Nano-IR) were performed on both a HY80 steel coupon and a glass slide containing Mefp-5 dissolved in deionized water. The results indicate that the amino acid L-Dopa in the Mefp-5 protein is intimately involved in the adsorption of the protein onto the two substrates tested. The SEM-EDS data indicate that the Mefp-5 adheres mostly through auto-oxidation and cross-linking, but when dissolved in buffer or buffer with enzyme, the protein interacts with the HY80 surface via a mixture of enzyme and metal mediated cross-linking and complexation, respectively. FT-IR and Nano-IR data for Mefp-5 adsorbed onto HY80 and glass steel exhibits similar results suggesting that the Mefp-5 adsorbed on the HY80 involves metal ion complexation by L-Dopa at the protein-metal interface.