April 19, 2021

KNOWLEDGE
SOLUTIONS
TRANSFORMATION
DISCOVERY
RESEARCH

Innovation Day

UTA COLLEGE OF ENGINEERING

PROJECT ABSTRACTS AND PARTICIPANTS

Innovation Day Sponsors

Platinum

Raytheon Technologies

Gold

UTA Provost's Office

Silver

Americase

AYCO Charitable Trust on behalf of Janet and Mike Greene

BNSF

Chroma

FormFactor

Mouser Electronics/Analog Devices

Oncor

Bronze

Jacobs

Luna

M&S Engineering

State Farm

Tarrant Regional Water District

The Rios Group

Other

L3

Keysight Technologies

TesTech

TestEquity

Yaggi Engineering

Senior Design Partners

Alan Ritchey Transportation

Caliber Collision

Chartwells Higher Ed Dining Services

The Custom Box Company

Directed Energy Professional Society

Dollamur Sports Surfaces

Elbit Systems

Lockheed Martin Missiles and Fire Control

Luxottica

Niagara Bottling, LLC

Raytheon Technologies

Siemens (Grand Prairie Switchboard Group)

Ideal Plantation Shutter

TDIndustries

Table of Contents

Click on a project to go directly to its abstract

GRADUATE

RESEARCH EXPERIENCES FOR UNDERGRADUATES

OTHER UNDERGRADUATE

SENIOR DESIGN

Graduate

1 – Vehicle Configuration Compendium

Stenila Simon and Samuel Atchison
Advisor: Bernd Chudoba
Mechanical and Aerospace Engineering Department

There exists a need in the world of hypersonic vehicle design to easily access and reference past project data in order to avoid pursuing redundant errors or to keep designers better informed of the findings from generations past and make them better equipped to do efficient vehicle design. This paper presents a solution formulated by the members of UTA's Aerospace Vehicle Design Laboratory. The solution presented is a comprehensive compendium of past hypersonic vehicles, called the Vehicle Configuration Compendium. Seven hypersonic vehicles have been processed into the compendium of gathered information, using a carefully formulated data and knowledge compilation and review process. This data is in the process of being incorporated into a user-friendly software interface that will in the future encourage designers and design enthusiasts of all experience or proficiency levels to consider various vehicle configurations and forecast any new vehicle design performances by consulting past projects.

2 – Design Safe River Crossing Bridges for Texas

Shah Md Imran Kabir
Advisors: Habib Ahmari
Civil Engineering Department

There are more than 580,000 bridges in the United States, 83% of which span streams and rivers. Bridges are designed to withstand flood and debris loads; however, the most frequent causes of bridge failures are attributed to hydraulic events, including floods, debris, and drifts. Floodwater exerts significant hydrodynamic forces on the bridge that may result in bridge failure. The purpose of this study is to investigate the hydrodynamic forces acting on inundated bridges via small-scale model laboratory experiments. Physical models of bridges have been tested to estimate the force and moment coefficients for realistic flow conditions. In these experiments, lift and drag forces and overturning moments on bridge superstructures are measured and compared with existing design guidelines. The effects of flood velocity, bridge submergence, bridge deck types, and depth of the superstructure on the force and moment coefficients have been also investigated. The result of this study indicates that drag, lift force, and moment coefficients: 1) significantly vary with flood velocity and depth, 2) abruptly change, if the depth below the bridge is smaller than three times bridge height, and 3) differ based on the deck width and beam types.

3 – Solution to Bakoteh Open Dumpsite at Gambia

Ketan Shah, Aiswarya Acharath Mohanakrishnan, Opeyemi Adelegan, Hussain Ali, Mithila Chakraborty, Sunakshi Hada, Asma Akter Rony, Kothai Villavan, Sabarish Dravid
Advisor: Melanie Sattler
Civil Engineering Department

Improper disposal of waste has been an exigent problem in the developing world. This research work is a case study of Gambia. The plan of this project is to curb the environmental and social effects caused due to the Bakoteh Dumpsite in the Gambia region. To achieve this, we worked out a design plan for the closure of the Bakoteh Dumpsite and to determine the use for this large piece of land. Along with that, we found an alternative site to landfill the waste and gave the detailed design for the development of the new site. Objectives were the closure of Bakoteh Dumpsite, to prevent fire hazards, slope stability, and create a safe environment for the community, and the development of new site which would follow the three Cs (Control – Contain – Cover). Control unregulated dumping and organized waste collection, contained disposal at a localized location in the site and then move to the next once that is filled, and covering the landfilled waste to control odor, pests, and prevent illegal activities. Design of the technically engineered scientific landfill was carried out. The overall design ensures good public health, a better environment to live in, and savings of resources.

4 – Development of Solid Waste Management Life Cycle Assessment Tool for Developing Countries

Ketan Shah
Advisor: Melanie Sattler
Civil Engineering Department

Solid waste management (SWM) is a pressing problem for many cities in developing countries. In low-income and middle-income countries, open dumpsites are used to dispose of over 80% solid wastes, currently serving around 3.5-4 billion people. (ISWA, 2015). Decision support tools can help communities in developing countries replace open dumps with the most environmentally friendly or economical waste management option. Most existing SWM decision support tools, however, have built-in data default values for developed countries. Thus, the overall goal of this research was to develop a SWM decision-support tool for developing countries. Specific objectives were to develop the Solid Waste Assessment Tool (SWAT), to illustrate the use of the tool by conducting case studies for two municipalities in Gujarat, India, and to analyze the results to understand how optimizing for the lowest cost, greenhouse gas emissions, and diesel consumption can affect SWM decisions. SWAT is a user-friendly Excel spreadsheet tool, which includes SWM collection and processing/disposal options common in developing countries, such as vermi-composting, regional landfills, and open dumps.

5 – Determining Downstream Ecological Impacts of Sediment Derived from Bridge Construction

Saman Baharvand
Advisor: Habib Ahmari
Civil Engineering Department

Erosion is a natural process that could be accelerated by anthropogenic activities. Sediment delivery due to anthropogenic erosion is one of the highest threats to the health of river systems. Disturbing the native soil by excavation, grading, sloping, trenching, and backfilling at the stream-crossing sites significantly increase the risk of overland and in-stream erosion. Release of sediment due to the construction of stream-crossings such as pipelines, culverts, and bridges may change sediment regime and geomorphology of the receiving streams causing short- and long-term effects on water quality and aquatic habitat. In the present paper, a novel GIS-based predictive tool is developed to quantify the potential release of sediment during bridge construction activities and provide flow and sediment information required for aquatic habitat assessment. Runoff, rainfall, and streamflow for this site are used to estimate over-land and in-stream erosion and sedimentation processes. The toolbox's architecture is flexible so that its functionality can be expanded to other construction activities, for example, culvert construction impacts. The sedimentation process and hydraulic criteria will be imported to the Habitat Suitability Model embedded inside the GIS-toolbox to investigate the river's suitability for native mussel species for different case studies.

6 – Electrothermal Sensitivity of Semiconducting Nanoengineered Concrete

Myrsini Maglogianni and Michail Margas
Advisor: Maria Konsta-Gdoutos
Civil Engineering Department

In this study, well-dispersed carbon nanotubes (CNTs) were used for the development of semiconducting cementitious materials with high electrical to thermal energy conversion ability. The heating rate and electrothermal efficiency of mortars reinforced with CNTs at amounts of 0.05-0.2 wt% of cement were investigated by applying AC, over a frequency range of 1mHz-1 MHz. The results indicate that the nanoengineered mortars exhibit a sufficient for deicing heating rate of 0.24 oC, and high dissipation energy and dielectric loss tangent values that ensure electrical to thermal energy conversion efficiency. We found that the electrothermal sensitivity is greatly affected by the dispersion state of nanotubes and nanofibers: Results from spectroscopic experiments confirmed a correlation between the energy dissipation and dielectric loss tangent values and the capacitive phase of the nanoreinforced mortars.

7 – 2D Mix-Compression Inlet Sizing of Supersonic Vehicles

Jose Medina
Advisor: Bernd Chudoba
Mechanical and Aerospace Engineering Department

With hypersonic vehicle design becoming a focus for reusability, high flight rates, and benefit to civilian transportation systems, understanding propulsion and airframe integration is key. It is of interest to know how changing the mission requirements of a vehicle has an impact on the geometry of the inlet. By understanding the flow path that is needed for an inlet to operate at the needed pressure recovery and match the needed conditions of the engine, a relationship between the airframe geometry and propulsion system can be made. As a result, several vehicle configurations have been selected that are designed for high-speed flight and will provide cases for understanding the design of their intakes. This development has started with the XB-70 and Concorde and major characteristics of their inlet is discussed. From these findings, we developed a method that provides the design of a 2D mix-compression inlet and outputs the dimensions of length, heights, Mach number along inlet, deflection angles, and shock angles. The method was then extended by taking the geometry of the XB-70, Concorde, and Tu-144 and modeling the dimensions of the inlet. The effects of the inlet on the airframe will be investigated.

8 – Understanding Distracted Driving Behaviors

Juana Perez
Advisor: Kate Hyun
Civil Engineering Department

Distracted driving increases the crash frequencies in the road and subsequently leads to fatalities involved with crashes. As stated on the NHTSA website, a total of 2,841 people were killed in crashes on U.S. roads in 2018 involving a distracted driver. Now that drivers are exposed to more technology in their vehicles and applications on their phones, technology represents one of the main secondary tasks that distract the drivers. The level of disruption from distractive behaviors can be different for groups of drivers. Young drivers may be more distracted through their smartphones but still able to multitask and maintain safe driving due to their shorter reaction times. In addition, the impact of distraction appears to be different by the type of distraction, since a secondary task that can be exceedingly distracting to the driver causes a higher impact in the driver's reaction time. These distractions cause an impact in the driver's behavior, for example: reducing travel speed, increasing reaction time, or performing unsafe lane changes or departure. Therefore, the distractions that are caused by secondary tasks combined with unsafe driving habits and lack of information on the road could significantly elevate crash risks.

9 – Developing a Sustainable Solid Waste Management Strategy Framework for Developing Countries

Hussain Ali
Advisor: Melanie Sattler
Civil Engineering Department

Solid waste management (SWM) indicators are considered essential for monitoring, evaluating, and understanding the prevailing problems in a SWM system. On the other hand, decision support tools are required to come up with a strategy to implement changes or expanding the current waste management system. Sustainability indicators consider three pillars of sustainability and convey information about one or more of these pillars i.e. social, environmental, and economic. These indicators are powerful tools to assess impacts on environment, society, and economy. Our research looks into developing a decision-making framework to assess the sustainability of SWM sector using a fuzzy analytical hierarchy process. We have assigned variable weightage to all three dimensions of sustainability as well as all the indicators based on the survey conducted with the help of experts in SWM industry.

10 – Domain Adaptive Transfer Learning on Visual Attention Aware Data Augmentation for Fine-grained Visual Categorization

Ashiq Imran
Advisor: Vassilis Athitsos
Computer Science and Engineering Department

Fine-Grained Visual Categorization (FGVC) is a challenging topic in computer vision. It is a problem characterized by large intra-class differences and subtle inter-class differences. In this poster, we tackle this problem in a weakly supervised manner, where neural network models are getting fed with additional data using a data augmentation technique through a visual attention mechanism. We perform domain adaptive knowledge transfer via fine-tuning on our base network model. We perform our experiment on six challenging and commonly used FGVC datasets, and we show competitive improvement on accuracies by using attention-aware data augmentation techniques with features derived from deep learning model InceptionV3, pre-trained on large scale datasets. Our method outperforms competitor methods on multiple FGVC datasets and showed competitive results on other datasets. Experimental studies show that transfer learning from large scale datasets can be utilized effectively with visual attention based data augmentation, which can obtain state-of-the-art results on several FGVC datasets. We present a comprehensive analysis of our experiments. Our method achieves state-of-the-art results in multiple fine-grained classification datasets including challenging CUB200-2011 bird, Flowers-102, and FGVC-Aircrafts datasets.

11 – Unsupervised Hyperspectral Unmixing Via Nonlinear Autoencoders

Kazi Shahid
Advisor: Ioannis Schizas
Electrical Engineering Department

This work derives a novel unsupervised neural network-based scheme for unmixing hyperspectral pixels. A novel autoencoder structure was combined with a kernelization layer, mapping the mixed pixels in a higher dimensional space for easier separability, along with a novel cross-product layer to account for nonlinear mixing mechanisms. K-means clustering is utilized to estimate endmembers, and radial basis functions (RBF) are employed to measure distances in a kernelized space to estimate abundances that provide a preliminary pixel unmixing stage to be enhanced by an autoencoder structure. A novel layer is introduced that accounts for nonlinear mixing terms by forming pertinent cross-products across the abundances of each mixed pixel. This enables accurate reconstruction of the mixed pixel adhering to different nonlinear mixing models, while using the abundances and endmembers' estimates obtained via the decoding stage weights. The novel network structure is flexible since not only can it accommodate higher degree cross-products of abundances and the corresponding endmember weights, but it can also consider other mixing models like the polynomial post-nonlinear model (PPNM). Extensive testing across semi-synthetic and real-world datasets shows that the proposed method, while being highly versatile in structure, also outperforms recent state-of the-art unmixing methods.

12 – Therapeutic Potential of Targeted Nanoparticles to Induce Angiogenesis in Peripheral Artery Diseases

Vy Tran, Tam Nguyen, Priyanka Iyer, Na Nguyen
Advisor: Kytai Nguyen
Bioengineering Department

Peripheral arterial disease (PAD) is the obstruction of blood flow in the lower body parts, causing sores/ulcers and pain when walking. According to recent statistics, more than 200 million people suffer from PAD worldwide. Current treatments include surgical revascularization, anticoagulant therapy and, in extreme cases, amputation. All these methods have several limitations, and this brings an urgency to develop therapeutics that will form another route for the blood to flow through the hindlimb. We aim to develop and formulate nanoparticles (NPs) loaded with cDNA plasmids of the Epo receptor (EpoR) to enhance angiogenesis and/or restore vessel functions. Although nanodrug formulation by itself had a good therapeutic efficacy, in order to improve the bioavailability of the drug at the injured site we bio-conjugated the anti-ICAM-1 (Intercellular Adhesion Molecule) antibody on the surface of nanoparticles. During the inflammation, the endothelial cells are known to express ICAM-1 receptors on their surface. This targeting strategy would help in specific availability of the nanodrug at the injured site leading to increased angiogenesis process. The in vitro studies gave promising results in restoring vessels at the ischemic site and gave us green light for further studies in animal models.

13 – Assessment of Factors that Affect Hydrogen Sulfide Corrosion of Manhole Shafts

Sunakshi Hada, Mithila Chakraborty, Aiswarya Mohanakrishnan, Ketan Shah, Ankita Sinha, Natasha Wooten
Advisor: Melanie Sattler
Civil Engineering Department

Manhole shafts in sewers are prone to deterioration due to microbially-induced concrete corrosion (MICC), which can reduce their life from 100 years to 30-50 years. MICC is facilitated by sulfuric acid formed by the generation and volatilization of hydrogen sulfide (H_2S). Corrosion of manholes on roads can create safety hazards. Accordingly, this project sponsored by the City of Arlington aims to identify factors that contribute to hydrogen sulfide corrosion of manholes so that these factors can be mitigated, or so that manholes most vulnerable to corrosion can be lined with protective coatings. The initial phase of the project involved collection of data from 350 manholes in the city, including liquid- and gas-phase parameters that influence corrosion, as well as corrosion depth. The manholes were divided into 5 categories based on their characteristics: presence of drop, pipe diameter, type of flow, inlets and bends, and control. Our results showed that manholes with >2-foot drop or a hydraulic jump had the highest H_2S concentrations, and lowest was observed in manholes with subcritical flow. This indicates that turbulent flow increases rates of corrosion. Based on the field data, a multiple linear regression equation was developed to predict corrosion rates.

14 – Evaluation and Retrofitting of Prestressed Concrete Bridge With Excessive Vibration

Ikram Efaz
Advisor: Nur Yazdani
Civil Engineering Department

Though the vibration of highway bridges is one of the primary reasons for deck cracking, it's often ignored by codes and researchers. Due to the excessive vibration and deck cracking, the SH-75 SB bridge over Wilson Creek in McKinney, Texas, was evaluated with non-destructive evaluation (NDE) and diagnostic load tests. Ground penetrating radar showed adequate cover on the top of the deck while impact echo revealed significant delamination of the top of the deck prevalent of the top of the girder lines. Results of the diagnostic load test indicated a significant loss of the composite action between the girders and the deck/panel system. A unique combined NDE and load test technique was used to rate the girder and the deck of the bridge which was never applied before. Besides, dynamic vibration testing was also conducted on the SB bridge to determine the maximum acceleration and natural frequency. The SB bridge exhibited significantly higher lateral and vertical accelerations and lower natural frequency due to loss of lateral stiffness. Finally, a calibrated finite element model was prepared in ABAQUS and several retrofitting and stiffening methods were studied to improve the composite action and reduce the vibration. Based on field data, a multiple linear regression equation was developed to predict corrosion rates.

15 – MultiSorb: A Low-Cost Approach to Remove Multiple Metals and Organics From Leachate

Mithila Chakraborty
Advisors: Melanie Sattler
Civil Engineering Department

Landfills are facing a challenge in removal of heavy metals and recalcitrant organics from leachate. Even if leachate is sent to a municipal wastewater treatment plant (WWTP), metals and organics (natural organic matter, including humic and fulvic acids), and per- and poly-fluoroalkyl substances, or PFAS, must first be removed. Adsorbents have proved to effectively remove heavy metals and organics, using fewer chemicals and energy than many competing techniques (e.g., advanced oxidation processes). Adsorbents made from wastes like rice husk (RH), rice husk ash (RHA), sewage sludge (SS), and sewage sludge char (SSC) are more sustainable than traditional activated carbon, which is made from coal. Reusing waste materials reduces waste disposal costs and is typically cheaper. A single type of adsorbent, however, is not effective in removing the variety of heavy metals and organics present in leachate. The principal goal of this project is to develop a multiple sorbent mixture, "MultiSorb," from readily available waste materials to cost-effectively remove different types of pollutants from leachate. LEAF Method 1314 showed release of heavy metals and organics from RHA and SSC to be within drinking, irrigation, and aquatic standards/guidelines nationally and internationally, except for slightly elevated arsenic levels from RHA.

16 – Implementation of Forward Error Correcting Codes in UTA Coherent Optical Communication Testbed

Kamanashis Saha
Advisor: Michael Vasilyev
Electrical Engineering Department

Our approach is to incorporate a forward error correction algorithm into our LeCroy coherent optical modulation analyzer system. We have applied a low-density-parity-check (LDPC) based error correcting codes with a 7% and 25% overhead rate to minimize the bit error rate after decoding at the receiver.

17 – Food and Flora Waste to Fleet Fuel: Development and Application of the F4 Framework

Mithila Chakraborty, Azam Boskabadi, Nic Raven, Ali Behseresht, Ardeshir Anjomani
Advisor: Melanie Sattler
Civil Engineering Department

Renewable fleet fuel is a choice for cities' sustainable transportation systems. Composed primarily of methane, biogas can be cleaned and upgraded to use in natural gas vehicles or burned to generate electricity for electric vehicles. Wastewater treatment plants already have anaerobic digesters that convert sewage sludge to biogas. Co-digesting food and flora (yard) waste at these digesters can boost biogas production for fleet fuel and free up landfill space.

The abundance of food and yard waste in landfills is of concern to the U.S. EPA. The comprehensive project goal was to facilitate food and yard waste conversion to vehicle fuel by helping interested cities choose among existing digesters for producing vehicle fuel and quantify and calculate payback time for capital investments. The Food/Flora Waste to Fleet Fuel Framework was developed, including: Tools for input data collection, a cost optimization model, a Food/Flora-Waste-to Fleet Fuel Model, and a City Guidebook. As output, an Excel model was developed, which can be used in conjunction with GIS and limited user inputs, to estimate the lowest optimized cost of converting food/yard waste via AD to fleet fuel. The City Guidebook will help interested cities with rules and regulations.

18 – Beamforming Using Quasi-Optical Approach for 5G Backhaul

Pratik Ghate
Advisor: Jonathan Bredow
Electrical Engineering Department

In electromagnetics and communications, beamforming is one of the important concepts capable of enabling high-data-rate wireless trafficking of a large number of users/sensor devices simultaneously. It greatly increases capacity for wireless sensing of multiple objects and features, including aircraft, weather events, atmospheric particulates, and pollutants. Beamforming is a technique that directs and shapes the beam in specified directions, rather than having the signals spread in all directions. Beamforming controls the directionality and improves signal to noise ratio of the transmission and reception of the desired signals. Adaptive beamforming networks are currently used which use a digital beamforming approach. This approach is not feasible at mm-wave frequencies because it requires extensive processing power and substantial post-processing. A quasi-optical approach will be an effective way to reduce the size, cost and improve the efficiency of the beamforming process. To make this approach realizable, a lens-type structure is being studied and analyzed using partially reflective surfaces using metamaterial structures. This approach enhances the gain of the radiating source, resulting in a highly directive pencil beam, and will reduce the overall size of the composite structure and give enough degrees of freedom to electronically tune its properties.

19 – CoWiz: Interactive Covid-19 Visualization Based on Multilayer Network Analysis

Arpana Bhat
Advisor: Sharma Chakravarthy
Computer Science and Engineering Department

Covid Wizard, or CoWiz, is a Covid-19 visualization dashboard based on Multilayer Network (MLN) analysis underneath1. Online dashboards typically plot/visualize statistical information gleaned from raw data, such as daily cases, deaths, recoveries, tests, etc. However, for a better understanding, we need aggregate analysis (e.g., community, centrality) and its visualization, which is the purpose of CoWiz. As an example, grouping counties across a country/region based on similarity of increase/decrease in cases, deaths, hospitalizations

over intervals are not possible without aggregate analysis. This is where CoWiz utilizes community and other concepts over MLNs that are inferred from Covid and other relevant data sets for visualization. This demo presents a flexible, interactive dashboard that is capable of visualizing various aspects of Covid-19 data, including the composition of Covid data with demographics (population density, education level, average earning, vehicle movements, and change in purchase patterns) at the granularity of county for the U.S. This paper elaborates on the types of analysis, underlying model, and how a flexible visualization dashboard has been developed using open-source software and data sets. As new data become available, they can be incorporated into the visualization with no manual intervention.

20 – Effects of Photostimulation on Neural Stem Cell Differentiation

Noemi Salgado Cordova
Advisor: Michael Cho
Bioengineering Department

A recently emerging application of photobiomodulation is in neural photobiomodulation. The novelty of use in neural photobiomodulation is in the possible uses for cognitive enhancement and brain trauma healing. Although many studies have investigated various fluences and their effects on stem cell differentiation, this study aims to investigate the effects of power density on cell differentiation. The findings from this study aim to bring up an important questions: how important are exact parameters? And how can thorough consideration yield more beneficial outcomes in clinical settings.

21 – Comparison of Neural and Fuzzy Models for Vowel Recognition

Atul Shrotriya, Shilpa More
Advisor: Frank Lewis
Electrical Engineering Department

Speech recognition has long been used and implemented in controlled environments. It is quickly becoming mainstream with the advancements in deep learning techniques. In this research, different basic neural and fuzzy logic models were compared to determine the best suited techniques for recognizing vowels as they are at the core of speech processing in many methodologies. With conventional equipment used for recording in an uncontrolled environment, this project defines the challenges which can be faced in developing reliable and robust models without using large amounts of pre-recorded data.

22 – Optimal Unmanned Swarm Motion in the Presence of Faulty Nodes

Atul Shrotriya, Saina Namazifard
Advisor: Michael A. Niestroy
Electrical Engineering Department

Controlling robots in swarm motion to achieve set tasks is a highly interesting field garnering a significant amount of research focus. Such robot formations can be of exceptional use during rescue missions where time is a crucial factor and/or human intervention is not possible. During strenuous working

conditions, it is possible for a robot to malfunction. This project implements two basic approaches to control robot swarms and then isolate a faulty robot using the method of trust consensus. It also generates an optimal path for best cost efficiency in terms of time or energy efficiency and dynamically calculates trust values based on individual node behavior.

23 – Above-the-Bin Recyclable Plastic Detector

Niharika Khamkar, Krunal Bhagat
Advisor: Susan Ferreira
Industrial, Manufacturing and Systems Engineering Department

On an average our landfills receive 27 million tons of plastic in a year. Even though the plastic recycling industry has been successful at a few stages of innovation, the alarming rate at which we still see one-time use and recyclable plastic being dumped, is a matter of urgency to fasten this sorting process and save our environment from the hazards of plastic waste. Just as the name suggests, the sensing device will be placed just above the bins, which will indicate whether to throw the material into the recyclable plastic bin or not. It is also true that while some materials are recyclable they must be sorted further (e.g., plastic bags and bottles cannot be recycled together) which will be carried out at the recycling facility. However, the motive of this device will be to sort waste consciously affecting personal as well as packaging industries choice to reduce plastic use, apart from helping the recycling industry speed up the process by skipping one step. The devices installed outdoors will have a solar panel for clean energy use. The compact size of the device will make it easy to install and affordable to be implemented on a large scale.

24 – Leveraging Stream Processing and Complex Event Processing for Situation Monitoring from Extracted Video Contents

Umme Hafsa Billah
Advisor: Sharma Chakravarthy
Computer Science and Engineering Department

There are several Stream Processing (SP) and Complex Event Processing (CEP) frameworks for situation analysis and monitoring for sensor data. These frameworks are not appropriate for analyzing video situations since video data characteristics are quite different from traditional sensor data. This work proposes an approach to situation analysis of videos such as CCTV footage by extracting video contents at the frame level. As video content extraction (e.g., object detection) has achieved tremendous success with neural networks recently, it is possible to perform video situation analysis by leveraging SP and CEP frameworks. This work presents a principled approach for expressing different types of video situations using a non-procedural video query language (termed CQL-VA) based on continuous queries. The data representation, classes of queries to be supported and querying of situations are discussed in this work. We believe the approach presented will help extract meaningful situations flexibly and efficiently from the contents extracted from videos. This is a step to move from customized situation detection to non-procedural query-based situation detection with tremendous advantages.

Research Experiences for Undergraduates

25 – Development and Validation of a Cyclist Behavior Questionnaire for the U.S. Population: Survey and Bike Simulator Research

Abigail Werner, Sarahi Hernandez Valencia
Advisor: Shuchisnigdha Deb
Industrial, Manufacturing and Systems Engineering Department

Safety for cyclists is becoming a critical issue in the United States, especially in urban areas and centralized cities. It is important to understand the behaviors of this vulnerable population so that public officials can improve cyclist safety and cyclists can safely interact with traffic and other road users. Behavioral research for road-users primarily uses self-reporting questionnaires; researchers develop and validate survey tools for their target population. In this project, two undergraduate students, selected from underrepresented populations (female and Hispanic male), have developed a cyclist behavior questionnaire for the U.S. population and collected data using an online survey. The students have also created simulated environments for a bike simulator study in order to validate the questionnaire by comparing survey data with simulated scenario-based study data.

26 – BIA: Body Imaging (Gender, Weight, Height, Body Mass Index) Analyzer

Steven Varghese, Haoyang Song, Jordan Brian Williams, Troy Xavier Philip, David Mendoza
Advisor: Aera LeBoulluec
Industrial, Manufacturing and Systems Engineering Department

Through 10 independent variables, such as gender, age, BMI, marital status and heart disease, we can predict whether a patient is likely to suffer a stroke. The potential techniques used will be logistic regression and classification tree.

27 – Influence of Spatter Generation in SLM Processing on the Properties of Powder Material

Manjunath Hanumantha, Kevin Pelino, Carlos Carmona, Timothy Zwerg, Yukti Shinglot, Ryan Bailey, Bibek Adhikari
Advisor: Amir Ameri
Mechanical and Aerospace Engineering Department

A major drawback of additive manufacturing is the deposition of spatter into the surrounding powder or the solidified layer during fabrication which diminishes the microstructural and mechanical properties of AM parts. Until now, the phase change, impurity content, and powder size distribution changes resulting from the ejection of spatter powders are not well understood. There is an obvious need to characterize the spatter particles and systematically analyze the location of these fallen spatters. This study focuses on the identification of critical zones that are vulnerable to spatter deposition, which in turn enable the prediction of mechanical properties of the neighboring parts located on the build plate. The characterized powder spatter behaviors, together with the

obtained information on the location of these fallen spatter particles, will then be used to aid production planning and optimization towards better print quality and enhanced sustainability performance in AM.

28 – Study on the Microstructural and Surface Roughness Variations of SLM IN718 Overhangs

Bharath Ravichander, Carolina Favela, Manya Singh, Samantha Pacheco, Nischal Maharjan, Nikchey Khatri
Advisor: Narges Shayesteh
Mechanical and Aerospace Engineering Department

Inconel 718 (IN718), a nickel-based superalloy, is commonly used in nozzle turbines. Conventional manufacturing of complex IN718 geometries is difficult due to its high stiffness values. Consequently, additive manufacturing methods like selective laser melting (SLM), offer a viable solution for the fabrication of IN718 high accuracy. One of the limitations of this technique is its need of supports in order to fabricate overhanging structures. These supports need to be designed carefully and tend to consume resources. In this research, we study the angled structures fabricated without supports. The overhangs are fabricated using uniform process parameters for varying overhang angles and thicknesses. Microstructural and surface roughness analyses are carried out in order to determine variations in grain structure, melt pools and surface roughness. The outcome of this study will help us in predicting the need for supports in overhangs and inclined structures used within a part having complex geometry.

29 – Smart Shutter

Shishir Acharya, Nishma Luitel, Dijesh Pradhan, Kashif Hussain, Freddy Aguinaga
Advisor: Chris McMurrough
Computer Science and Engineering Department

Smart Shutter is a solution designed for the control and management of multiple blinds for commercial buildings such as hospitals, elderly homes, plantations, and houses. Effectively eliminating the need for manually adjusting huge numbers of blinds in a building through a mobile application that will be available for both iOS and Android, Smart Shutters will have scheduling capabilities and group functions all controllable through Wi-Fi and Bluetooth, allowing for autonomous operation with a one-time setup.

30 – Remote Sensing of Subsurface Soil Moisture

Toan Nguyen, Susav Shrestha, Beatriz Meadows
Advisor: Saibun Tjuatja
Electrical Engineering Department

Over the past decades, soil property monitoring has become increasingly important due to climate change. It provides essential information about the land. This information can then be used to predict natural disasters such as drought, flooding, or the land's potential for agricultural productivity. This project aims to establish the feasibility of a novel subsurface soil sensing system.

It consists of a backscatter soil sensor, which stays in the ground, and a radar system which captures the reflecting signal. An algorithm is developed to estimate the soil moisture from the received signal.

31 – Topology Optimization and Scaling for 3D Printed Models

Steve Berdote, Bijan Niakan
Advisor: Robert Taylor
Mechanical and Aerospace Engineering Department

3D printing technologies provide enhanced design freedom to scale stiffness through material and geometric configuration. Such design freedom offers enhanced efficiency and effectiveness for applications such as aeroelastic wind tunnel models where scaled structural response is critical and conventional methods are costly. This work aims to enable rapid, low cost scale model design for flight vehicles using optimization methods to leverage design freedom enabled by 3D printing technology to establish similarity between models of different scales. The approach for optimizing the wing will be to reduce the number of members within the wing using topology optimization. Then follow it up with optimization approach developed in previous work to design a high aspect ratio wing model for structural similarity with a large scale model. The goal of this approach is to create improved CAD models that can be adjusted more rapidly and simplify assembly to minimize defects in the final product. A scale model wing will be optimized, implemented in a CAD model, 3D printed, and tested statically for similarity with the large scale structural response. The work will be executed in collaboration with the U.S. Air Force Research Lab Aerospace Systems Directorate.

32 – Unraveling the Kinetics of the Aqueous Precipitation of Magnesium Silicate Hydrate in Cementitious Environments

Dylan Singh
Advisor: Erika La Plante
Materials Science and Engineering Department

Increasing environmental concerns arising from concrete's high energy consumption and carbon dioxide emissions is generating an interest in improvements in concrete durability, partial replacement of ordinary Portland cement, or creation of new binder chemistries. Cements based on bonds between magnesium and silicon, also found in nature, are less explored and their utilization in construction applications is limited, in part because of insufficient data ascertaining the kinetics of precipitation and the structural mechanisms for strengthening. In this study, in situ and ex situ experiments using atomic force microscopy with mineral substrates (mica, periclase) were performed to produce magnesium silicate hydrates (MSH). The environmental conditions including the magnesium/silicon molar concentration ratios, temperatures (25°-50°C), and reaction durations (1-40 hours) were varied to study their influence on morphology and growth rates of MSH. The MSH precipitates were analyzed using Fourier-transform infrared spectroscopy, Raman spectroscopy, and scanning electron microscopy with energy dispersive X-ray spectroscopy to ascertain their chemical composition. The insights gained from this study will

enable the precise chemical synthesis of MSH from abundant magnesium-rich solids and brines, leading to the widespread use of MSH as a binder material for construction purposes and an alternative to ordinary Portland cement.

33 – Holonomic Vehicles and Integral Reinforcement Learning

Evanns Morales-Cuadrado
Advisor: Yan Wan
Electrical Engineering Department

This project involves the utilization of holonomic vehicle simulations to accomplish goals related to path-planning implementation. Holonomic vehicles are those whose controllable degrees of freedom are equal to the total number of degrees of freedom, and in order to achieve path-planning goals through varied environments with obstacles autonomously, concepts related to control as well as machine learning concepts must be applied. The ultimate goal is to use the concepts of integral reinforcement learning to achieve path-planning goals.

34 – Development of Aniline Tetramer Doped Biodegradable Photoluminescent Loaded EpoR Nanoparticles for Treatment of Peripheral Arterial Disease

Na Nguyen, Tuyet Taylor Bui
Advisor: Kytai Nguyen
Bioengineering Department

Peripheral arterial disease (PAD) is the pathological condition when the blood flow to the lower extremities is limited due to the blockage of the blood vessels, which leads to a high rate of morbidity and mortality. Over 8.5 million Americans have been affected with PAD, the majority of whom are elderly. The common approach to treat PAD includes invasive surgical intervention, which can cause discomfort in patients and post-surgical complications, and is not an effective option for elderly patients. Therefore, our goal is developing a less-invasive approach to treat PAD using EpoR loaded nanoparticles made of the imaging enabled BPLPAT.

35 – Computational Model of Porcine Neonatal Heart for Congenital Heart Disease Research

Anura Shrestha, Jessica Lim
Advisor: Jun Liao
Bioengineering Department

Congenital heart disease (CHD) often requires surgical intervention. A lack of thorough understanding of the biomechanical behavior of the neonatal heart causes relatively poor short- and long-term outcomes of the repairing of/implants in the hearts. 3D modeling of the neonatal porcine heart will be pursued in collaboration with the Radiology Department at UT Southwestern Medical Center. We will create a model using computed tomography data scanned from neonatal porcine heart and ScanIP software. We will also obtain tissue properties from the neonatal porcine tissues. The 3D mesh of the neonatal heart and tissue behavior will be used for computational simulations with ANSYS.

36 – Synthesis of Core-Shell Nanostructures for the Transport of Biological Matter in Microfluidic Devices

Mohammadkian Mahroumi, Abisha Pandey, Prashanna Acharya, Andrina Shrestha
Advisor: Michael Bozlar
Mechanical and Aerospace Engineering Department

This project will provide unique opportunities for students across different departments to combine theoretical and experimental skills toward the fabrication of core-shell nanostructures that are expected to be employed as agents/carriers of biological samples, including human blood samples or drugs. We will investigate novel electrospraying synthesis routes to produce polymeric nanostructures and learn diverse analytical techniques to characterize the nanomaterials produced in the lab. Challenges include an effective synthesis of a fully biocompatible and hydrophilic core, combined with a superhydrophobic outer shell with well-defined diffusive properties to allow release and delivery of the biological substance at the target location.

37 – Identifying Dimensions for Vulnerability Analysis and Model Development to Measure the Resilience Level of Transportation Infrastructures in North Texas

Thahomina Jahan Nipa, Bishal Pandit, Sagar Hamal
Advisor: Sharareh Kermanshachi
Civil Engineering Department

Adverse impacts of natural disasters become astounding when infrastructure possesses a poor resiliency level. Hence, multiple studies have been conducted to develop a resilient system that reduces the negative consequences of disruptions and decreases reconstruction time after disasters. However, measuring the resilience of an existing transportation system is yet to be developed. Therefore, this study aimed to develop a categorized set of resilience measuring dimensions for the transportation network. Established dimensions will eventually help to develop a decision-making tool and create a map-based color-coded vulnerability analysis of transportation infrastructures. The decision-making tool and subsequent results will assist decision-makers in preventing damages due to disruptive events and will save millions of dollars of taxpayers' money.

38 – Development of a Smartphone App for Smart Freight Traffic Signal Priority on Urban Freight Corridors

Nishma Luitel, Swastik Khadka
Advisor: Taylor Li
Civil Engineering Department

The research team will develop a multi-purpose smartphone app to augment two traffic research projects: a Private-Public-Partnership traffic data collection system in Arlington and evaluation of an adaptive traffic signal system in Frisco. The smartphone app will be an in-vehicle data logger to collect truck trips synchronized with windshield videos. The truck logs will be combined with real-time traffic data to evaluate both truck and background traffic mobility on a UTA-developed, live arterial traffic management platform deployed in Arlington. It will also be an LTE-based transmitter for freight signal priorities at intersections to explore innovative approaches to multi-modal traffic management in Frisco.

39 – Developing Models for Impacts of Socio-Economic Conditions on Project Cost and Time in Roadway Projects

Allison Fenske, Edgar Gerardo Gonzalez
Advisor: Kyeong Rok Ryu
Civil Engineering Department

Roadway construction projects are prone to frequent cost overruns and schedule delays. Of numerous factors causing changes in projects, socio-economic conditions have been insufficiently investigated despite their possible impacts on project cost and time. To this end, this project aims at developing novel models that can quantify and visualize impacts of socio-economic conditions surrounding roadway construction work zones on project cost and schedule. We successfully collected a comprehensive set of project, socio-economic, transportation, and weather data and will develop GIS-based models using ArcGIS, statistical tools, and machine learning techniques. We took an active role in analyzing underlying relationships and deriving implications.

40 – A Software Fault Localization Approach to Explainable Artificial Intelligence (XAI)

Edrik Aguilera, Jaganmohan Chandrasekaran, Sunny Shree
Advisor: Jeff Lei
Computer Science and Engineering Department

Machine learning models, a core component to artificial intelligence systems, often come as a black box to the user, leading to the problem of interpretability. Explainable artificial intelligence (XAI) is key to providing confidence and trustworthiness for machine learning-based software systems. We observe a fundamental connection between XAI and software fault localization and present a technique that uses BEN, a combinatorial testing-based software fault localization approach to produce explanations for decisions made by ML models.

41 – At-Home Rapid COVID-19 Paper Strip Detection Test

Enrique Villafuerte
Advisor: Kytai Nguyen
Bioengineering Department

Our goal is to develop an at-home COVID-19 testing kit composed of a sample pretreatment and a sandwich ELISA lateral paper flow testing strip that will yield results in 20 minutes. Our design utilizes an ELISA format, using an indication component (quantum dots) that is easily readable, and a detection component (antibodies) that is reliable. To achieve this goal, three specific aims are proposed: (1) Fabrication of a point-of-care lateral flow paper strip detection device, (2) Evaluate the performance of the design with patient samples (3) Adjusting design to add serology testing lines to reveal which stage of COVID-19 infection a patient is in. The main innovative aspects of the design are (1) a user-friendly setup that is affordable and readily available to the public, (2) uses a non-invasive sample source, (3) has detection principles that are easily adaptable to detect many different infections with minimal adjustments. The impact of this research will save the lives of millions as it would serve to alert users if they are infected and/or asymptomatic indicating whether they should quarantine or get early medical attention.

42 – Understanding of Patterns in Electricity Usage and Market Data Towards Facilitating Demand Response with Dynamic Pricing

Devon Stapleton, Anjal Parikh, Syeda Hasan
Advisor: Shouyi Wang
Industrial, Manufacturing and Systems Engineering Department

The renewable energy revolution will substantially alter the future energy. With increasing penetration of stochastic renewable energies, power distributors must respond to an extremely dynamic, complex, and challenging real-time supply-demand balancing problem. A promising solution is demand response (DR) with time-varying electricity price signals. The REU team will work with high-resolution IOT electricity usage data from an actual Arlington, Texas, household, and Texas market price data from the Electric Reliability Council of Texas (ERCOT). Identified patterns in these data will inform the development of state transition modeling within a large-scale DR management optimization funded by NSF Award ECCS-1938895.

43 – Robot Localization and Navigation by Fusing Ultra-Wide Band (UWB) Sensing Data

Binoy George
Advisor: Yan Wan
Electrical Engineering Department

Localization and navigation play crucial roles in the fields such as autonomous driving and robotic applications. This research aims to explore the use of Ultra-Wide Band (UWB) technology in robot localization and navigation to improve the accuracy with low cost. This project will integrate the UWB sensors on a

robot with other localization and mapping sensors, such as cameras, to provide a more accurate position estimate. A robot navigation and control system will be developed on a Turblebot II robot platform using the fused UWB data.

44 – A Proactive and Dynamic Approach for Equitable Police Patrol Deployment

Prabin Lamichhane, Shahab Ghandi
Advisor: Yuan Zhou
Industrial, Manufacturing and Systems Engineering Department

The perceived lack of racial equity in policing has recently received headlines. Policing is complex, involving officers, criminals, politicians, citizens, and stressful, emotional situations. Within the past decade, the predictive policing movement has sought to predict crime, but existing data are highly biased. The proposed project steps away from purely data-driven predictive learning and instead employs stochastic simulation models to overcome bias in representing the dynamic policing system. For this project, the team worked with agent-based modeling and 911 call data to explore how proactive and dynamic police patrol deployment can balance workloads, decrease stress, and reduce crime.

45 – Autonomous Vehicle Meets 3D Printer: Cost-effective Monitoring of Additive Manufacturing using Robots

Travis Major, John Smith, Cindy Cruz
Advisor: Chen Kan
Industrial, Manufacturing and Systems Engineering Department

This project aims to develop a novel robotic monitoring system for additive manufacturing (AM). As opposed to fixed-location monitoring, our system leverages a robotic sensing platform – an autonomous vehicle with sensors, and actively decides when and where to collect quality-pertinent data from the AM process. This will significantly reduce the equipment cost and lift the burden in data transmission, analysis, and storage. For this project, the team will explore hardware design – how to build the robotic sensing platform – and software development – how to control the platform for cost-effective monitoring of the AM process.

46 – An Engineering Approach for COVID-19 Strategies That Balances Reopening and Transmission Interventions at County and Campus Scales

Deependra Thakur, Kara Annis
Advisor: Victoria Chen
Industrial, Manufacturing and Systems Engineering Department

Amid the ongoing pandemic, nations are facing two conflicting objectives: mitigating COVID-19 infections and fatalities, and reopening communities. While politics has clashed with public health science, yielding mixed messaging, the deeper issue is recognizing that engineering may hold the solution to balancing these objectives. Transmission via asymptomatic and pre-symptomatic cases is a new challenge that has worked against existing public health protocols, and, yet, U.S. pandemic decision-makers demonstrate reluctance to change course. This project will employ the C3 AI COVID-19 Data Lake to benchmark and inform engineering-based intervention strategies using multi-objective optimization and agent-based modeling.

47 – Re-Imagining the Use of Mine Tailings into Construction Materials

Balaram Luitel, José Velásquez
Advisor: Kathleen Smits
Civil Engineering Department

Mine tailings are the waste effluent of the mineral processing required to extract the metals that humans use every day. Proper management in the disposal of mine tailings is one of the main problems faced by the mining industry worldwide, especially in artisanal and small-scale gold mining (ASGM). To mitigate mine tailings disposal-related problems, communities have developed initiatives to recycle mine tailings into construction materials without knowing the proper mixtures and ratios between mine tailings and cement to accurately develop physical properties that can stand the anticipated structural forces. This study will examine through different mine tailings – cement ratios and tests – the optimum ratios and mixtures required to generate good structural strength properties by testing cylindrical concrete core samples under the compressive strength test ASTM – C 39.

48 – Using Augmented Reality and Machine Learning to Guide Physical Exercise Routines

Kyle Henry
Advisor: Christoph Csallner
Computer Science and Engineering Department

This project creates prototype solutions for a 2-year Caruth-funded project. The ultimate goal is to leverage ongoing advances in augmented reality (AR) hardware, machine learning, and software to motivate seniors via AR-based smartphone apps to increase their physical activity levels. While there are clear software engineering challenges in developing an app seniors care about and want to interact with, this project focuses on the underlying technical challenges of understanding, comparing, and ultimately selecting recent AR hardware/software combinations that are most promising for achieving the ultimate goal of motivating seniors to increase their physical activity levels. Specifically, this research develops the application and evaluates how well the app runs on different platforms. The evaluation will compare different device features, such as the operating system and CPU architecture, memory usage, and detailed runtime performance measurements. The resulting implementation source code is available on GitHub (https://github.com/SonicHedghog/Senior-Fit) as open-source software.

49 – Digital Twinning Microstructures of Additively Manufactured Materials

Devasri Warrier, Bryan De Santiago, Rejin Adhikari
Advisor: Xin Liu
Industrial, Manufacturing and Systems Engineering Department

The microstructures of materials from additive manufacturing (AM) have a profound effect on the final properties of the materials. To predict the effective properties, finite element (FE) models are often used as digital twins of these microstructures. This project will develop algorithms to reconstruct FE models of the microstructures based on the key features (e.g., micro-voids). The developed models will have the equivalent mechanical properties of the original microstructures. The effective properties of the digital twins will be computed by a novel multiscale model. This project will enable a better understanding of microstructure-property relation for AM processes.

50 – Modeling a Virtual Logistics Community for Texas Farmers

Phyllicia Gitumbi
Advisor: Caroline Krejci
Industrial, Manufacturing and Systems Engineering Department

To ensure the survival of their farms, regional food producers must find ways of extending their market reach. Larger markets are typically located in urban centers that are distant from farms, and most small-scale producers do not have the transportation infrastructure to support efficient distribution. Transportation collaboration is a potential solution, but most producers will not participate due to issues of trust, scheduling complexity, and cost. This project uses data collected from Texas farmers, via interviews and focus groups, to inform the design of a digitally-mediated platform that will facilitate transportation collaboration among farmers and community members.

51 – Increasing Robustness of Deep Learning-based Audio Detection Systems against Adversarial Examples

Ashwitha Kassetty, Subham Pokhrel
Advisor: Shirin Nilizadeh
Computer Science and Engineering Department

Audio event detection systems capture audio from the environment and detect the presence of a specific sound of interest. These systems make extensive use of deep learning classifiers as their primary detection algorithm. We first developed deep learning-based models for detecting physical safety-related audio events in this project, such as gunshot, glass breaking, car alarm, and dog barking. Secondly, we evaluated their robustness against adversarial examples, where the adversary tries to avoid detection, and finally, we proposed new methods for increasing the robustness of these systems against adversarial examples.

Other Undergraduate

52 – Understanding the Behavior of Natural Gas Leaks in the Subsurface Under Varying Environmental Conditions to Better Inform First Responders

Hilton Duong
Advisor: Kathleen Smits
Civil Engineering Department

Over the past 40 years, 50 natural gas pipeline incidents were reported to the National Transportation Safety Board. These incidents led to injuries and fatalities while also causing significant infrastructure damage. The goal of this project was to design testbeds that simulate gas leakages in rural and suburban areas under varying environmental conditions that can be used to better inform first responders and industry partners of the behavior of methane in the subsurface. A literature review was conducted to identify causes of the gas leaks, sizes of natural gas leaks that led to the incident, and the behavior of the natural gas in the subsurface. This information was used to determine patterns in incidents from gas distribution lines and select scenarios most commonly observed to replicate in a test site at Colorado State University's Methane Emissions Technology Evaluations Center. Several common scenarios identified included natural gas movement through preferential pathways (e.g., severed pipes and poorly packed soil) and natural gas movement under impermeable surfaces (e.g., concrete). The data collected from this testbed will be used to inform best practices for first responders and industry partners to aid in the detection and handling of gas leaks.

53 – Automated Process for Cell Expansion

Bilal Alameri
Advisor: Brian Dennis
Mechanical and Aerospace Engineering Department

Human stem cells are special types of cells that have a high ability to develop into different cell types. The stem cells can be developed and used to replace damaged organs and tissues. Stem cells are medically used to treat serious illnesses and diseases. At a high demand, the stem cell production process is done at a low rate because the stem cells are sensitive and easy to differentiate into undesired forms of cells. In a traditional method, stem cells are grown and incubated on solid (sphere) surfaces in a controlled and sterile environment. The cells grown on surfaces require circulation and agitation to maintain a uniform level of oxygen and food in the cell culture media, which can be damaged by a process shear force. This research is focusing on improving the stem cell harvesting method by growing the cells inside hollow microcarriers (HMCs) to avoid cell differential from the shear force, and the automation system will be integrated to enhance the process.

54 – TDIndustries - Truck Based Service

Salvador Camacho
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

TDIndustries is a mechanical construction and facilities management company that builds infrastructures and maintains their building equipment. TDIndustries has a variety of customers that may not align with an ideal customer profile that results in an increase in non-value-added activities, spending sales and money that exceeds gross margin, an increase in service agreement cancellations, and performing work that ends up not being profitable. In this project, we plan to use the DMAIC methodology to determine an ideal customer profile for TDIndustries' Service Department to sell more strategically and have a standardized process to determine the proper customers that have value and are profitable.

55 – Machine Learning Application in Engineering

Isabella Reyna, Philip Adams, Dorian Villegas, Thi Nguyen, Shahab Ghandi
Advisor: Aera LeBoulluec
Industrial, Manufacturing and Systems Engineering Department

We will apply machine learning algorithms, such as regression and neural networks, to a data set that has over 1,000 data points. We will use the Python programming language for this project. Our objective will be to predict a response variable using at least five predictor variables.

56 – ALS Eye Tracking App

Steven Kosts, Anthony Vardaro, Zixiu Su, Kelly Le
Advisor: Chris McMurrough
Computer Science and Engineering Department

This is an application used to help the physically impaired still communicate with others. The application will allow someone who can only move their eyes to communicate with anyone.

57 – An Open Domain Conversation Chatbot

Jacob Valdez, Chance Huddleston, Kennedy Ratemo, Payton Field, Adam Mazen
Advisor: Nadra Guizani
Computer Science and Engineering Department

Open domain conversation represents significant mastery over both the mechanics of language production and the high-level and long-range interactions of social dynamics. Meeting these demands is no trivial task, and forgetting large and general multi-million dollar ML systems, the solution for college students during a resource-constrained pandemic is not as simple as scaling parameters and training data. Additionally, we seek to implement the entire inference training pipeline directly on mobile devices. However, in informal settings and when restricted to one user, open domain conversation may actually be closed. We believe a few well chosen priors can rapidly accelerate convergence such that few shot training can adapt an ML model to individualized user-agent interactions. The result we hope to achieve is a simple, yet powerful open domain chatbot on mobile Android phones.

58 – Pressure/Touch Sensing Glove

Prabin Gautam, Eric Garrett, Alex Gonzalez, Mario Ferreira
Advisor: Robert Magnusson
Electrical Engineering Department

The fully functional model will be a polished touch sensing glove that will have a friendly user interface that prompts the user to select what part of the hand the system should measure the pressure of. There will be multiple pressure sensors that work coherently and accurately to detect the pressure being applied.

59 – A Custom Application to Collect and Display Road Condition Images During Winter Weather Transportation Operations

Pratiksha Acharya, Pooya Darghiasi, Bahram Abediniangerabi
Advisor: Mohsen Shahandashti
Civil Engineering Department

Real-time images of road conditions help transportation operations managers, snowplow operators, and the traveling public make well-informed decisions during snowstorms. The data can be collected through snapshots of road conditions by a mounted camera on transportation agencies' snowplows. The objective of this project is to develop an iOS application installed on tablets to collect geotagged images of road conditions. The custom application was designed to collect and transfer geotagged images of road conditions at predetermined time intervals (i.e., 10 minutes) when a snowplow is operating at a speed of 5 mph or more. The custom iOS application was developed in Swift. To create the application, the team used different application programming interfaces, Swift classes, and methods to execute various tasks, such as retrieving the vehicle speed, capturing the images, determining the vehicle location, constructing metadata, and uploading the data to cloud space.

60 – Versatile Thermal Conductivity Instrument

Ashley Van Ausdale
Advisor: Ankur Jain
Mechanical and Aerospace Engineering Department

Thermal properties are very important for understanding and optimizing the nature of heat flow in engineering systems. As these measurements can be done with commercially available equipment, it is desirable to build an instrument in-house to measure thermal conductivity, to provide design and operational flexibility. We designed an in-house instrument based on heat transfer concepts and what can be understood from the commercially built, FOX 50. The instrument's goal is to find the steady state of a specimen when placed between two temperature regulated plates: one cooled and one heated. When the heat

flux of the material is constant over a specified time the system is considered to have reached steady state. Calculations to solve thermal conductivity can be done with equations resulting from the two-thickness method, which involves measuring the same material twice, but at varying thicknesses. This instrument will have the ability to find the effective thermal conductivity of a specimen without a multitude of restrictions on the specimen's dimensions.

61 – Beneficial Reuse of Fly Ash as a Landfill Liner Material

Tukwa Ahsan
Advisor: Melanie Sattler
Civil Engineering Department

Coal-fired power plants produce a global average of nearly 375 million tons of fly ash each year, contributing to hazardous waste and groundwater pollution. Fly ash, a byproduct of coal combustion, contains toxic metals that increase risk of developing diseases. Meanwhile, the waste discarded in a landfill can break down into toxic leachate before entering and contaminating water sources, unless prevented by a non-permeable landfill liner. The overall goal of this project was to study the potential for recycling fly ash in landfill liners to both reduce the amount of fly ash to be discarded and better contain landfill waste. Due to its high absorbance and strength, fly ash often exhibits cementitious properties and can prevent waste from leaking out of landfills. This research will facilitate the optimal design of landfill liners by examining how five mixtures of different ratios of fly ash, bentonite, and lime contribute to the strength and cracking potential of landfill liners. The research uses multiple experiments, including the determination of shrinkage limit and compressive strength tests, to compare data and optimize the fly ash mixture.

Senior Design

62 – Surgical Drill End-Effector

Sandesh Amgai, Rupak Luitel, Ayush Thapa, Prince Agrawal, Colton Bass, Mukunda Thakali
Advisor: Robert Woods
Mechanical and Aerospace Engineering Department

Medtronic Powered Surgical Solutions has led the race in supplying effective and top-notch medical instruments throughout the country. Their drive to increase the efficiency of the instruments by automating them for point accuracy is evident from the range of equipment they provide to the medical centers in the city. The recent issue in manual handling of surgical drills is imminent to Metro Controls Inc. We propose an end-effector for a robot capable of holding the surgical drill. The ongoing issue of the instability of the human hand and the difficulty for surgeons to perform hour-long operations manually, resulting in hand soreness after holding the drill for a long amount of time is well known. Our end-effector will replicate the stiffness of a human hand and hold the drill as a human hand. The designed end-effector will be a tube packed with an experimental foam material that has the compliance of a human hand which will be attached to a robot. The robot will maneuver in a workspace with our end-effector holding the tool and performing cutting operations on the bone.

63 – Vertically-Enabled Cargo Transfer Robot

Heather Pavlik, Alaina Burge, Brian Crowson, Cole Johnson, Garrett Hadley, Jacobus Mathee
Advisor: Ashley Guy
Mechanical and Aerospace Engineering Department

The Vertically Enabled Cargo Transfer Robot, or VECTR, is a product designed to assist those unable to traverse stairs to do so confidently while bearing a load themselves. It is a user-controlled platform which can transport a significant load (such as groceries, a package or a comparable payload) up a common set of stairs. While the final delivered design will consist of 3D models, full engineering drawings, dynamic simulations, and structural simulations, the team is currently in the process of building a proof-of-concept prototype to illustrate the key aspects of the design.

64 – Rail Gun Autoloader

Andrew Chedid, Paul Cigainero, Lucas Burton, Nethaniel Singh
Advisor: David Wetz
Electrical Engineering Department

A railgun is an electromagnetic accelerator that launches metallic or plasma projectiles using electromagnetic force. This idea is based upon the principles of the autoloader. The autoloader allows for continuous shots of projectiles through the electromagnetic railgun and consists of two components, the projectile storage, and the loading mechanism portion. The projectiles are spring-fed in front of the loading mechanism. The loading mechanism will use a linear actuator to insert the projectile directly into the railgun. The autoloader will have the capability to detect if a projectile is loaded inside of the railgun. This will be done in the form of a continuity check using the gun's rails. An open-loop shown will represent the railgun unloaded, while a close loop will represent the railgun loaded. If there is a projectile already loaded inside the railgun, it will not allow the user to load another projectile. This was implemented for safety to make sure there is no accidental firing, as well as making sure the railgun will not be double-loaded. The autoloader is a quicker, more reliable method of loading when it comes to therefore producing more speed, reliability, and consistency.

65 – Hotspots

Rahat Alam, Luis Najera Ruiz, Paul Patraca Pantoja, Ruben Rodriguez
Advisor: Shawn Gieser
Computer Science and Engineering Department

We are working on an Android application that revolves around giving the user a social media platform to search for and interact with any events going on in the local community. A cross between TikTok and Google Maps is what we are going for.

66 – Electronic Speed Controller Size Reduction

Bradley Hannum, Nazeeha Giotis, Alexis Melesio, Romario Nguyen
Advisor: David Wetz
Electrical Engineering Department

Endurance with new unmanned aircraft system (UAS) platforms is becoming more important than ever. However, large (>10m wingspan) unmanned aerial vehicle (UAV) motor technology has stalled due to demand in miniature UAV systems. A lightweight UAV electronic speed control solution is desired for large multi-rotor UAVs (e.g. quadcopters) that use U15II KV100 motor systems. Lockheed Martin has provided desired parameters to accomplish such a controller, ideally to be similar in function as the existing, on the market FLAME 180A HV ESC, but in half the volume/size/weight. However, with progression of the project, trade-offs for the build arose and a 20% size reduction is the limit of attainability.

67 – Twitch IoT Hub

Justin Erdmann, Alexander Isaula, Seth Jaksik, Dominic Kotzer, Kevin Chawla
Advisor: Shawn Gieser
Computer Science and Engineering Department

The Stream Hopper is a customizable IOT hub device to enhance a viewer's experience and a streamer's interaction with his or her viewers. The IOT hub can be customized to have unique events to the streamer's preference. The IOT hub has three different types of connections to supported devices: USB, GPIO, and WiFi. The IOT hub will support various devices with different connection types from Twitch or StreamLabs. The Stream Hopper will provide "in-real-life" notifications for streamers based on stream events.

68 – Tab Welder

Giovanni Arciniega, Juan Rosas, Saleman Aziz, Michel Guido
Advisor: David Wetz
Electrical Engineering Department

Spot welding is a common method used for assembling battery packs. Unlike soldering, which places large amounts of heat stress on the battery, spot welding uses a short burst of large current which melts the metals at a desired point and creates a strong bond upon cooling. The goal for this tab welder is to utilize the process of capacitive discharge to achieve the welding of nickel tabs to 18650 and 26650 Lithium-Ion batteries as well as be able to create a junction between two dissimilar metals for homemade thermocouples.

69 – UTA ACM Website

Bojil Ivanov, Sanjeet Acharya, Kierra Thompson, Andy Sustaita
Advisor: Shawn Gieser
Computer Science and Engineering Department

This senior design project is a website for UTA's ACM chapter. ACM chapter officers can post events and news relating to the chapter, and ACM members can sign up for the website for special benefits. The website will be laid out with Home, News, and About pages. Each user can upload items to their profile for other users to check out, such as blogs, class notes and lectures, and résumés for companies to download. Officers can update the main pages and send out email and calendar notifications to people signed up for the website.

70 – Allergy Minimizing Mask

Jimmy-Bao Le, Brian Nguyen, Mahad Noor, Nicholas Oribhabor, Aws Kamil, Bader Abu Fayyad
Advisor: Raul Fernandez
Mechanical and Aerospace Engineering Department

Seasonal allergies are a common annoyance for people all around the world. Our Allergy Minimizing Mask is a filtration mask that will protect the user from outdoor allergens and pollen while preventing the recycling of air within the mask. The mask will also be clear so that the user's face can be visible. The mask will achieve efficient filtration with the use of HEPA filters placed in the air purifying respirator, which will be attached to the mask with the use of Teflon tubes and is capable of filtering particulate matter and airborne allergens. This combination of HEPA filters and the air respirator will provide fresh incoming air for inhalation, while the mask's exhalation system effectively removes the exhaled air from the mask preventing re-inhalation of carbon dioxide.

71 – Conceptual Design of an All-Body Aircraft for Space Tourism

Sushrut Kinhekar, Henry Barahona, Pablo Garcia, Thomas Garcia, Richard Godziela, Jarod McCants, Miguel Navarro, Luke Patterson, Jenor Rasmussen, Gabriel Reyes, Benjamin Shipp, Jackie Tran, Josue Vazquez
Advisor: Bernd Chudoba
Mechanical and Aerospace Engineering Department

Despite several decades' worth of progress, access to space is still very limited to civilians in the 21st century. Private sector and start-up companies have recently taken the lead in the space sector and have exhibited an interest in making space accessible to a bigger demographic of the population by creating a market for space tourism. Realizing that space tourism is the next big step in the new space age, our senior design team, Reach Sub-Orbitals, will design a reusable suborbital vehicle specifically for space tourism. "Aspiration" is a single-stage rocket-powered suborbital vehicle with a lifting-body geometry, designed to go beyond the Kármán line with six passengers and two crew onboard, creating new astronauts with each takeoff. It will be designed to operate in and out of commercial airports, employing horizontal takeoff and horizontal landing methods instead of conventional large ballistic launchers and vertical sounding

rockets. Aspiration will utilize an iterating and converging design methodology and will be compared to its competitors within the space tourism market with an overall cost, market and competition assessment.

72 – Linear Transformer Driver

Jesus Arvizu, Nathan David, Pedro Ramirez, Mark Aquino, Ian Busch, Jesse Sanchez
Advisor: David Wetz
Electrical Engineering Department

The Linear Transformer Driver is a pulsed power generator. The LTD is made of multiple modules that use low voltage and current switches to split the total current of a module before it goes to the magnetic core. The modules generate a flux inside their own magnetic core which then generates a current onto a secondary stalk that sits in the interior of the circular module. The modules can be stacked on top of one another multiplying the total output power of the driver. The output pulse is triggered from a transmitted signal going to each of the modules which allows the solid state switches to turn on and carry current from charged capacitors. The pulse transfers over to the secondary stalk via the magnetic core multiplied by the other modules in the stack.

73 – Twitter Hashtag Suggester

Osman Fabela, Jared Gatlin, Ameet Subedi, Lamia Chowdhury
Advisor: Shawn Gieser
Computer Science and Engineering Department

Twitter has become a prolific social media platform where influential people like TV celebrities, politicians, and athletes, as well as ordinary people, can put forward their opinion on various topics in the form of tweet. At the end of every tweet, people use hashtags to index keywords or topics in the platform. In this project, we are developing a web-app named Tweeter, where we suggest hashtags based on the content of the tweet. For this, we are developing a web-interface where users can type a tweet. On the side, the system will suggest relevant hashtags. We will be using Twitter API where we can access Twitter data and gather various trending hashtags. When users type their tweets, the app analyzes the contents of the tweet and after processing them and scanning the data from Twitter API, relevant hashtags are suggested. For such actions, we use algorithms like machine learning and natural language processing to gather relevant hashtags from the tweet itself and other related trending hashtags. We will use cloud technology for all database and back end data processing.

74 – Conceptual Design of a Blended Body SSSO Space Tourism Vehicle

Jayson Seaton, Jose Vasquez, Alejandro Rodriguez, Johnny Nguyen, Osigbeme Akalumhe, Justin Rhine, Kapil Shahi, Prabhasha Wattegedara, True Do, Adedeji Adenuga, Ricardo Rodriguez, Nikechulowu Ebolum
Advisor: Bernd Chudoba
Mechanical and Aerospace Engineering Department

This conceptual design project focuses on designing a single stage suborbital space tourism vehicle that is fully rocket-powered to compete with companies

such as Virgin Galactic and Blue Origin. Helios Aerospace, the team designing the blended body vehicle configuration, utilizes the mission requirements of Virgin Galactic to have a direct comparison to how the conceptual design of this single stage system fairs versus a two stage system. The project goal is to determine the best configuration possible to achieve FAR requirements, safety, and business case to be competitive on the market.

75 – SuperSensor

Cameron Arnold, Logan Martin Betts, Ethan S. Storm
Advisor: David Wetz
Electrical Engineering Department

The SuperSensor senior design project is a collaboration between students of the UTA Electrical Engineering and Computer Science and Engineering Departments. The sensor board consists of non-invasive environmental sensors that record data such as temperature, pressure, reflectivity, and other measurements. These sensors are connected to a microcontroller called the BeagleBone Black that will preprocess the data. Along with the sensor board, a software defined radio (SDR) is also attached to the microcontroller. The SDR intercepts and demodulates AM, FM, and phase-modulated signals. The microcontroller uses Amazon Web Services to apply machine learning to the collected data. This preprocessed data is then used to interpret the sensor board's surroundings and display the information on a graphical interface.

76 – Microfluidic Device to Fabricate Alginate/Gelatin Beads

Ridhi Pradhan, Shreejana Thapaliya
Advisor: Yi Hong
Bioengineering Department

Development of a microfluidic system that can fabricate composite beads in wide range is important and can be of great significance in various drug delivery systems and tissue engineering applications. The current market has various microfluidic systems that can fabricate composite beads, but the sizes are limited and are too costly when varied range beads are required. Therefore, our main objective is to create a microfluidic system emphasizing the wide range of alginate/gelatin composite monodispersed bead (100 μ-1mm) production by changing the flow rate and working within a budget constraint of less than $500. The successful completion of this project will aid in microfluidic system development that would be beneficial in bioengineering and biomedical applications in near future.

77 – Biosensor for Microbial Detection

BK Sangita, Aasma Sapkota, Jorge Sosa Salvador
Advisor: Kytai Nguyen
Bioengineering Department

Creating a biosensor for the detection of nosocomial bacteria.

78 – Autonomous Drone Showcase

Bryce Humphrey, Jeremiah Tate, Alejandro Zapata, Pace Honeycutt, Kevin Truong
Advisor: David Wetz
Electrical Engineering Department

The objective of the Unmanned Aircraft System (UAS) university innovation showcase is to create an autonomous drone to complete a series of trials at the UTA football field. The showcase will consist of three predetermined trials that highlight the drone's autonomy, obstacle avoidance, and image/logo recognition. UTA will compete against two other universities, UT Dallas and UT El Paso. The drone must adhere to FAA rules and regulations, be fully autonomous, be able to maintain a given altitude, and be able to locate and land on the correct university logo. The trials will be evaluated on completion time, ability to maintain correct altitude, accuracy of the landing, obstacle avoidance, and budget. The UTA team consists of three engineering disciplines: Electrical Engineering (EE), Mechanical and Aerospace Engineering (MAE) and Computer Science and Engineering (CSE). The EE team is responsible for power, power distribution, and interfacing with other components. The MAE team is responsible for designing and constructing the chassis, calculating thrust requirements, and selecting the propellers. The CSE team is responsible for image processing, obstacle avoidance, and calculating the flight path.

79 – HashtagIt

Bailey Brown, Christopher Lemieux, Ebrahim Bharmal, Saurab Siwakoti
Advisor: Shawn Gieser
Computer Science and Engineering Department

HashtagIt is an web-application that suggests hashtags based on the tweet you want to post. HashtagIt users will be able to use our product to add relevant and trending hashtags to their tweets to reach a broader audience. A front-end website will be used for the users to enter their tweets. In order to suggest the hashtags, tweets have to be provided to a suggestion engine. The suggestion engine will break tokenize the tweets and sort them. Tweet data will be retrieved from Twitter API.

80 – Sensorium Cloud

David Chau, Andrew Chanthamany, Cuong Phan, Nirakar Nepal, Hersh Mistry, Chesley Cecil
Advisor: Chris McMurrough
Computer Science and Engineering Department

Using a board with numerous sensors, we will characterize a kitchen using machine learning to detect what appliances are in use. Sensor readings will be sent to the AWS cloud and streamed to a machine learning model that will display predictions to users.

81 – Alan Ritchey-Niagara Water Offloading Process Improvement

John Smith, Christina Nguyen, Abigail Werner, William Watt
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

Alan Ritchey truck drivers are experiencing excessively high wait times when unloading tanker trailers of drinking water at the Niagara bottling facility in Dallas. This wait time is causing high detention fees to be paid to the drivers, risk of overrunning federally controlled work times, and negative environmental impact from the trucks idling for extended periods of time. In our senior design project, we will decrease driver wait times at the bottling facility by closely examining the current process and seeking out any causes of the wait times that can be changed and improved.

82 – Siemens Grand Prairie Switchboard Workstation Tool Management

Shahab Ghandi, Evan Iglehart, Isabella Reyna, Mohammad Zamil
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

The use of toolboxes in the switchboard area at the Siemens Grand Prairie plant is resulting in missing tools, incorrect tool uses, excess costs, lower productivity, and potential missed calibrations for ISO purposes. These issues have a significant likelihood of occurring and negatively impacting the plant. Our goal is to reduce tool-related operational expenses within the switchboard area, specifically in the mechanical and wiring workstations. We plan to achieve this goal by improving the current tool management system.

83 – AVRSL Indoor Mapping Robot

Phoebe Light, Travis Major
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

Dollamur Sports Surfaces is a leading global manufacturer and distributor of competitive sports flooring for many physical activities and sports such as wrestling, cheerleading, MMA, yoga, and fitness. They are the official mat used by USA Wrestling and Judo and are the largest tournament mat supplier in the U.S. The Consumer Direct Department, commonly known as CD, does the final processing and shipping of e-commerce orders. The four main items sold in CD are 3'x6' personal mats, 5'x10' home mats, 10'x10' home mats, and 12'x12' home mats. A few other items are sold through CD, such as cleaning supplies and tape. Though the CD Department is a relatively small department at Dollamur, they are swamped by sales increases due to COVID-19. This change in demand led to an increase in late orders and an excess amount of daily non-value-added time spent for employee movement and material transportation. If this continues, CD will not be able to meet demand while ensuring quality. Our goal is to reduce employee movement and material transportation waste within the Consumer Direct Department system to reduce process cycle time while providing room for future growth.

84 – Monkee Management

Dylan Carter, Aamir Mazumdar, Antony Nguyen, Brendan Jacobson, Jacinto Mendoza
Advisor: Shawn Gieser
Computer Science and Engineering Department

Monkee Management is a project management web application used by students to plan, collaborate and keep track of progress in projects. Users can create and maintain projects and tasks, log hours worked on tasks, and generate reports for sprints.

85 – Conceptual Design of Rocket Powered, Horizontal Takeoff, Wing-Body, Suborbital Launch Vehicles

Cody Harris, Samantha Pacheco, David Garcia, Briana Levrie, Brian Nyaberi, Tamanna Garg, Christian Flores, James Walker, Taiwo-Bayonle Olayiwola, Jose Martinez, Daniela Castaneda, Lucia Rodas
Advisor: Bernd Chudoba
Mechanical and Aerospace Engineering Department

A new market in the aerospace industry has matured with space tourism companies taking the final steps toward opening their doors to the public. Space tourism's goal is to have passengers fly above the Karman line and experience microgravity for a respectable amount of time. Albatross Spacelines' goal is to design a vehicle that can complete the mission of space tourism with the requirements of the vehicle taking off and landing horizontally, being rocket propelled, and following a wing-body geometry. The vehicle must also be able to carry 6 passengers and not experience more than 3 gs during ascent and 5 gs during descent. These constraints allow a general solution space to be created that relate the vehicle's takeoff gross weight and planform area. This is then matched to a configured vehicles geometry where the solution space is reduced further by required lengths, areas, and volumes. With this complete, the vehicle is analyzed through the entire flight profile. If the vehicle cannot perform the mission, it is removed from the solution space. If the analysis passes, the design will remain as a feasible vehicle. This solution space of feasible vehicles is the ultimate goal of the project.

86 – Compass Group: Chartwells Front-End Remodel Design of UC Connection Cafe at UTA

Steven Varghese, Daniel Foster, Jesus Salazar
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

Our project group will analyze operational data from the UTA Connection Café and provide recommendations or alternatives on potential process and layout improvements for the front-end remodel design. The goal of these recommendations is to increase the cafeteria's throughput and allow better flow to decide whether it is worth spending $1.5 million to redesign the front end or not.

87 – Advanced Control Actuation Drive System Software

Michael Jezreel Aquitania, Nicholas Nguyen, Bernardo Narez, Steven Adams
Advisor: Chris McMurrough
Computer Science and Engineering Department

A control actuation system controls aerodynamic surfaces such as fins and canards to provide attitude and directional/steering control on aerospace vehicles. The Advanced Control Actuation Drive System is intended to be a motor drive amplifier that will be able to provide guidance for an aerial vehicle. The ACADS is designed to drive a brushless DC motor in forward and reverse directions and provide braking in both directions. When an electrical machine is required to work as both a motor and a generator in both forward and reverse directions, it is called four-quadrant operation. The ACADS will operate in all four quadrants. The ACADS will also have a human-to-machine interface using Ethernet TCP/IP stack communication protocol that can provide real-time data visualization and input controls. The system provides motor controls that operate within -40° to +40° in 1° increments while maintaining a high angular slew rate (1° per 100ms). The ACADS can operate over a wide range of input voltages (18V DC - 60V DC) and temperatures range (up to 65°C). This project is a continuation from last semester's ACADS team.

88 – Custom Box Company Performance Improvements

Brian Marshall
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

The Custom Box Company (CBC) produces cardboard boxes in a wide range of sizes and styles, primarily in low to medium volume orders. Over the past months, CBC has seen significantly increased demand for boxes, resulting in delayed orders and longer lead times. This project considers the development and implementation of improvements to the production process at CBC in order to better meet current and future demand.

89 – Prediction and Validation of Photostimulation to Improve Insulin Secretion in b-cells

Ahmed Gure, Joshua Eller, Anthony Ruiz
Advisor: Michael Cho
Bioengineering Department

Type I diabetes mellitus is defined by the patient's natural β-cells producing little to no insulin. In the absence of a permanent solution, one temporary treatment is islet transplants, containing a collection of healthy β-cells that will produce the required insulin. Our device attempts to increase insulin secretion of β-cells in vitro, in a culture dish. Photostimulation was chosen due to its precision, residual effects, and minimum cellular harm. Photostimulation excites Cytochrome C Oxidase (COO) inside the cell's mitochondria. An excited COO will produce more energy in the form of adenosine triphosphate (ATP), which

increases β-cell insulin production and survivability. Other devices have used photostimulation for the same purpose, utilizing laser lights that operate at a wavelength around 800 nm. The device has been fabricated and characterization was done successfully. The power of the device was 27 mW, while the change in temperature of the device was less than 0.5 ℃. The device is under testing for its efficiency in in-vitro environments with a focus on β-cells. After stimulation, ATP production, cell proliferation, cell viability, and insulin secretion will be measured and compared to unstimulated cells. This will be used to validate the effectiveness of the designed device.

90 – Autonomous Unmanned Aerial Vehicle

Archit Jaiswal, Alvin Poudel Sharma, Michael Rao, Anfal Chaid, Martin Royal
Advisor: Chris McMurrough
Computer Science and Engineering Department

Drone technology has been in increasing demand. It has a wide spectrum of implications ranging from recreational purposes to military purposes. We are developing an autonomous drone to perform several tasks at the Unmanned Aerial System (UAS) Innovation Showcase. Several universities will participate, in partnership with Raytheon Technologies, in the UAS Showcase Event. This competition requires the participating teams to develop a drone from scratch and enable it to perform several autonomous tasks. The drone needs to perform in three phases of the event. The first event requires the drone to take off and land autonomously after flying straight for 30 yards on a football field. The second event requires the drone to find the university's logo placed anywhere on a football field and land on it. The final event requires the drone to search for the randomly placed university logo while avoiding obstacles during the flight. There will be no human controlling the drone in any showcase events.

91 – Luxottica Sponsorship

Esteban Piceno, Danella Herrera, David Mendoza
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

Our project sponsor, Luxottica Dallas, decided to involve us in their frame-to-come (FTC) process for improvements. Per their request, improving the FTC process should be in relation to an associate bonus metric: Quality: breakage; Quality: store rejects; Service: dwell time; and Cost: paid efficiency. The goal for the improvement of the FTC process is to increase the jobs per hour from 28 to 30 or more. Improvements focused on the given task while taking into account the requested changes and feedback that employees provided along the way.

92 – LifeFit

Sergio Paniagua, Alexander Mangum, Mohan KC, Kritan Duwal, Bryan Nguyen
Advisor: Chris McMurrough
Computer Science and Engineering Department

Our team has been working on a continuing project with State Farm. Over the past 9 months, we have gathered and performed machine learning on data from FitBits. We have also created an Android application and a web application with fully dynamic graphs which allow a user to visualize this data and determine how healthy they are. Our primary focus has been to create a classifier that accurately determines how healthy a person is based on their FitBit data.

93 – identiDoc

Roshan Shrestha, Jonathan Marek, Pawan Khadka, Sandesh Koirala, Abhinaw Shahi
Advisor: Chris McMurrough
Computer Science and Engineering Department

identiDoc is a project sponsored by State Farm. It is a document identification solution in which a user can upload a file for classification into different document classes and also detect whether or not a signature is present on the document.

94 – RV Weather App

Alexander Eseyin, Bivek Shrestha, Christine Par, Pramit Bhusal, Sushmita Khadka
Advisor: Chris McMurrough
Computer Science and Engineering Department

We developed a mobile application to alert RV customers about critical weather or weather advisories that arise on their route. It will send push notifications and/or SMS messages to alert the users. We integrated the front-end and back-end using Laravel and React Native.

95 – Educational Games Suite

Jeremy Radford, Matthew Harrison, Jamie Nguyen, Robert Schultz, Christian Teeples
Advisor: Shawn Gieser
Computer Science and Engineering Department

Our project is a suite of educational games that are designed to assist non-profit organizations like the Salvation Army in teaching the children of families in need. Our educational game suite will serve as a supplementary form of instruction in teaching resources provided by these organizations and be accessed on a web application.

96 – Eye-Tracking Keyboard

Kyra Belgica, Callen Wessels, Thuy Pham, Jaehee Seh, Utibaebasi Obot
Advisor: Chris McMurrough
Computer Science and Engineering Department

Individuals with a muscular degenerative disease such as Lou Gehrig's disease, or ALS, often have trouble maintaining their lifestyle as their condition progresses. Assistive devices, such as eye trackers, allow these individuals to stay connected with the world as they always have. These technological aids have historically been expensive and hard to maintain because every patient has a unique condition that requires different services. Fortunately, these technologies are becoming more accessible, but the issue is that they are largely behind in terms of software and support. This lack of maintenance causes individuals with ALS to have slow software that can only run on older versions of their operating systems. Our objective is to create a modern eye-tracking keyboard software that solves many issues current individual with ALS face today. Our software will be portable across operating systems and includes many accessibility features while being easy and intuitive to use. Our software also uses a unique keyboard layout that aims to reduce eye strain and increase typing speed. Paired with low-cost consumer eye trackers, we hope to create an adequate replacement for costly medical devices that is both more user-friendly and more feature-rich.

97 – Virtual Reality

Christopher Socolich, Tam Doan, Jonah Branch, Josue Blanco, Vincent Nguyen
Advisor: Shawn Gieser
Computer Science and Engineering Department

We were approached by the UTA College of Nursing and Health Innovation to design a virtual reality simulator that would require the user to perform several tasks that were not commonly addressed in normal studies. These entailed diagnosing a patient with an untreatable ailment, giving the patient the news of their condition and informing them of their next options, determining the suitability of their household for hospice release, and dealing with the patient's body post mortem. For our section, we were tasked with completing the final task, dealing with the patient's body post mortem.

98 – Transact Estate Management System

Swasti Baral, Rajesh Rayamajhi, Prabishan Shrestha, Bishesh Shrestha,
Pawan Raj Adhikari, Rhea Pottathuparambil
Advisor: Chris McMurrough
Computer Science and Engineering Department

Transact estate management system is an IoT based system. The intended users are institutions like universities, where this system would be handy in tracking and updating the status of various devices like campus access devices, card readers, door locks, contactless cards, etc. The system will be used to alert any device's failure and monitor the general behaviors of the devices. It uses Azure IoT to contact back and forth with the connected IoT devices. The end product would be a dashboard or estate manager where all the hardware devices report into it as a central system/host to monitor the connected IoT devices, receive alerts and store the status history of each device. Each institution has its own central app to view their connected devices, but they are restricted from viewing other institutions' details. The administrator or the Transact team could view the status of the devices of all the associated institutions categorized by their institution ID and perform the administrative actions.

99 – EZpayit eWallet Mobile App

Jeremy Evans, David Miller, Alex Pham, Matthew Do, Bao Cu
Advisor: Chris McMurrough
Computer Science and Engineering Department

EZpayit is an electronic wallet enterprise system. It provides all network end-user consumers and businesses the ability to connect, communicate, procure, shop, buy, sell, pay, conduct business, schedule, ship and manage. The project focused on designing a mobile application involving the implementation of ACH transfer that will allow users to transfer money with each other involving cryptocurrency. The transferred money will go through a provided service to the correspondent bank, to the automated clearing house, to the other user's bank and into the other user's eWallet. Other implementation such as authentication, balance, account details and more will be included.

100 – 3D Reconstruction and Simulation of a Hypertrophic Heart

Shiska Raut, Kristofer Pas, Sudip Thapa
Advisor: Jun Liao
Bioengineering Department

3D reconstruction of anatomical features from imaging modality such as MRI and CT scans has become an important subfield in disease diagnosis within the field of medicine, as well as biomedical engineering. The transformation of 2D images into 3D structures allows physicians and surgeons to view the diseased part from a more practical perspective, understand the level of risk associated with surgery and plan accordingly. A good example of where 3D reconstruction can be greatly beneficial is prior to an open-heart surgical procedure where the surgeon's view during surgery is greatly compromised due to continuous blood flow. Although 3D reconstruction has the potential of becoming highly advantageous in disease diagnosis, it is not yet considered an efficient procedure as a single protocol for rapid 3D reconstruction does not exist. In fact, 3D reconstruction of anatomical parts is a tedious task in most cases. Thus, coming up with a protocol to rapidly create an accurate 3D reconstruction of an anatomical part can greatly reduce risks associated with the surgical procedure and save a significant amount of time.

101 – Tube Cleaning Device

Samuel Law, Morgan Jones, Matthew Depalma, Enoc Maldonado, Collin Bednarz
Advisor: Raul Fernandez
Mechanical and Aerospace Engineering Department

This team was tasked with designing a device to clean test tubes used for conducting experiments pertaining to genetics and fruit flies. The device that we developed will clean 72 test tubes per batch using a row of brushes to agitate the material inside the test tube, and a row of water jets that shoot streams of water to remove the material after it has been brushed. The device will fit inside of a typical lab sink. The primary goal of the device is to save staff in campus labs time cleaning test tubes.

102 – MedTech

Maxwell Pham, Hemantha Govindu, Nisarg Shah, Nikita Menon
Advisor: Shawn Gieser
Computer Science and Engineering Department

MedTech attempts to solve the problem in current Electronic Health Record Systems where medical professionals spend too much time with billing data to the system and not enough time with patients. We aim to cut down this time with an easy-to-use user interface that can process information quickly between the database and the client's UI.

103 – Low-Cost 3D Bioprinter

Morgan Mote, Rajiv Bhandari, Chanh Tran
Advisor: Justyn Jaworski
Bioengineering Department

This device will facilitate the rapid customization of 3D-printed biomaterial scaffolds of collagen fibers and serves as a promising approach to fabricating customizable skin grafts or artificial tissues. The project constraints being set forth are: a printing speed range of 10 um/min to 10mm/min with a resolution of 1.5 um, three-dimensional movement within the volumetric space of 64 cm^3, facilitation of boundary and origin detection with complete control of printing stage movement and position via real-time user input, and the elimination of mechanical vibrations causing capillary displacements along the printing stage larger than 1 um. The printer's performance will be evaluated using a stereo-microscope and photoelectric LED sensors placed on each axis of the printing stage to ensure the movement of the printing stage remains within the volumetric boundary. The parts for the printer assembly will be fabricated in UTA facilities and the expected cost to create this prototype is around $300.

104 – Wearable American Sign Language Translation Device

Anne Alsup, Nosisa Ncube, Aaron Tekleab
Advisor: Oguz Yetkin
Bioengineering Department

We are developing a lightweight wearable American Sign Language translation device consisting of 5 wireless fingernail devices, 5 ring devices, and a wrist device. The ring devices are composed of three infrared (IR) emitter/receiver pairs that are operated by a microcontroller in the wrist device. All of the IR LEDs flash in succession, which will trigger the IR LEDs in the wireless fingernail devices to flash. The intensity of the signal emitted by the LEDs in the ring and fingernail devices is collected by the sensors. A light intensity matrix is then created to determine the position of each finger. The microcomputer in the wrist device uses this matrix to train the neural network developed to predict the gesture. Lastly, an audio output of the translated sign is initiated allowing anyone near the user to understand the gesture. Four buttons will allow the user to reset to a default training, retrain the neural network, translate their sign, or restart the system. The device works without any external monitor or computer making it unencumbering and easy to use.

105 – Advanced Control Actuation Drive System (ACADS)

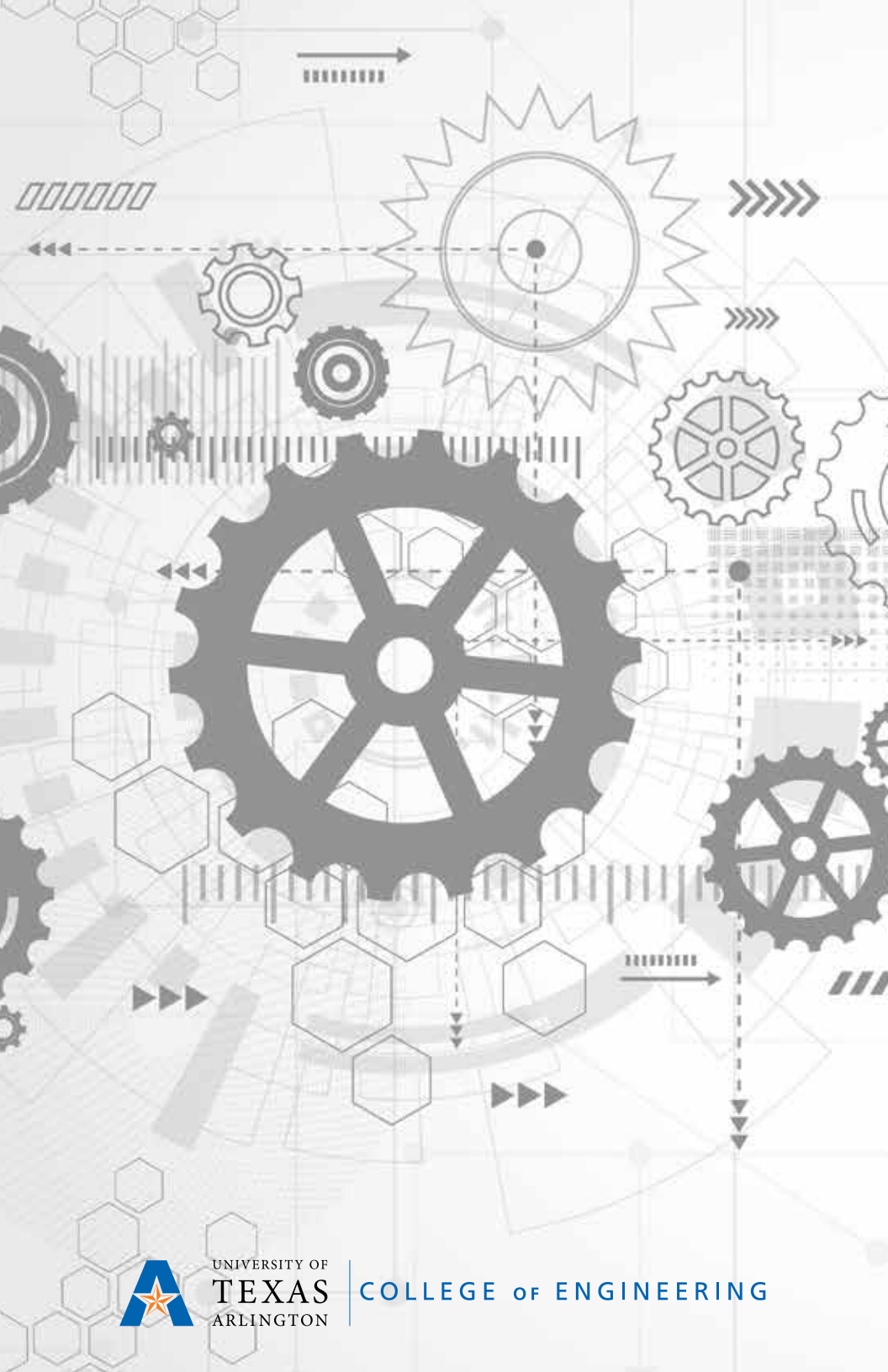
Kyle Creed, Peter Nguyen, Hanna Othmal, Harsh Patel
Advisor: David Wetz
Electrical Engineering Department

The ACADS (Advanced Control Actuation Drive System) employs a four-quadrant controller to drive two Maxon brushless DC motors with the capability of energy harvesting. The system is powered by either a 20V or 60V Lithium-Ion battery. It is to be controlled locally or remotely on a phyCORE SOM with browser interface. As per sponsor requirements setup by Lockheed Martin, two boards will control the complete functionality of the system, the Motor Drive Board and Control Board. Dimensions for the Motor Drive Board must be within 3"x3"x3" and the Control Board within 6"x5"x3". The Control Board houses the power supply converters as well as the connectivity to interface to the phyCORE and the other microcontroller, the Tiva C. The Tiva C will be used for Pulse Width Modulation, current sensing, encoder position tracking. The encoder is used to ensure the motor stays within a -40° to 40° bound, these 80 degrees are the only positions needed for the system and must report position degree to an accuracy of 0.5°. The Motor Driver board will contain the power stage which includes GaN FET's as per requirements. Both motors will interface with this board for hall sensor feedback and power.

106 – Wavelength-Switchable LED Light Source for Applications of Photobiomodulation

Rachel Kerstens, Andrew Chi, Christie Joy Pascua
Advisor: Hanli Liu
Bioengineering Department

Design, build, and test a wavelength-switchable LED light source unit for delivering red, near infrared, or infrared light (620-1050 nm) that can be used for photobiomodulation or low-level light therapy. When it is used, an appropriate wavelength in the range of 620-1050 nm can be selected by a switch and delivered through a fiber-optic bundle with a tunable power density. The system needs to be stable over 1-2 hours, without significant healing problems. Also, the optical power density is expected to be between 20-200 mW/cm2.



UNIVERSITY OF TEXAS ARLINGTON | COLLEGE OF ENGINEERING