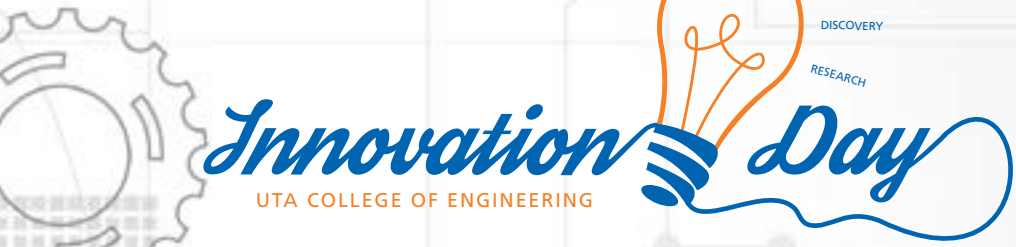

PROJECT ABSTRACTS AND PARTICIPANTS

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1 – PIV Investigation of Flow Field Around Submerged Bridge Geometry

Shah Md Imran Kabir, Qazi Ashique E Mowla
Advisor: Habib Ahmari
Civil Engineering Department

River bridges are susceptible to flooding and are considered the most frequent causes of bridge failure. The hydrodynamic properties of bridge superstructures are of practical importance for many engineering applications. Although the flow interactions with rectangular cylinders have been broadly studied, investigations on the flow around actual bridge decks and interactions with water flow are limited. This study will investigate the flow structures for typical I girder bridges when submerged with flood flow and establish the relationship between the dimensionless kinematics parameters and hydrodynamic force coefficient. In the present study, a Particle Image Velocimetry (PIV) investigation of scale bridge models was performed using the physical modeling technique. The mean velocity field and streamlines were estimated from the PIV data and tested for different hydrodynamic and geometric conditions. Moreover, the kinematics of the flow have been estimated from the PIV data which is used to develop a relationship with the flow hydrodynamics for different bridge geometry. Results of this study indicated that the hydrodynamic force coefficients and flow kinematics are correlated. These findings supported the long-standing belief expressed by much prominent research that the formation of the wake region is directly related to the hydrodynamic forces.

2 – Compound Coastal, Fluvial, and Pluvial Modeling: Comparison of Hurricanes Rita, Ike and Harvey Forcing Effect in Beaumont-Port Arthur, Texas

Nahal Maymandi
Advisor: Michelle Hummel
Civil Engineering Department

Over the past decades, compound flooding driven by the superposition of storm surge, sea-level rise, and extreme rainfall has been increasing. In traditional modeling approaches, the driving processes are simulated separately, leading to discrepancies between simulated and observed data, which necessitates coupled modeling frameworks to improve model hindcasts and forecasts. Here, we utilize Delft3D to simulate flood extent and depth in the Beaumont-Port Arthur (BPA) region of Texas during Hurricanes Rita (2005; moderate rainfall/storm surge), Ike (2008; extreme storm surge/minor rainfall), and Harvey (2017; extreme rainfall/minor storm surge). The model is run for each hurricane period with various forcing combinations to determine the relative contribution of coastal, riverine, and pluvial processes to maximum flood depths across the study domain. The results show that the maximum flood extents and depths cannot be predicted based on a simple superposition of water levels from individual models. Furthermore, the relative dominance of coastal, fluvial, and pluvial processes can vary substantially across historical storm events, with

implications for the flood control and risk reduction efforts. Results from this research can inform local planning efforts aimed at reducing the vulnerability of residents and critical infrastructure to future flood events in the BPA region.

3 – Numerical Simulation of Hydrodynamic Forces on Riverine and Coastal Bridges Subjected to Extreme Weather Events

Fahad Pervaiz
Advisor: Michelle Hummel
Civil Engineering Department

This research applies hydrologic and hydraulic modeling to identify flow parameters affecting riverine bridges in Texas under current and future conditions. The developed set of flow parameters is then used as boundary conditions in computational fluid dynamics modeling to calculate hydrodynamic forces on scaled and full-scale riverine bridge decks. Finally, a probabilistic analysis of hydrodynamic loading and structural response is conducted for bridges in coastal Texas subjected to storm surge and wave loading to evaluate bridge vulnerability and performance. Together, these analyses provide critical information about the flow conditions affecting bridges, the resulting hydrodynamic forces experienced by bridge structures, and the implications for bridge reliability in riverine and coastal systems. Results from this research can aid in the prioritization of maintenance and retrofitting activities for bridges across Texas and can be used to determine whether the current design standards for bridges and countermeasures (e.g., shear keys and ear walls) are sufficient or if improved standards are required to resist adverse hydrodynamic forces and overturning moments that may result from partial or complete inundation.

4 – Development of a Bayesian Copula-based Nonstationary Framework for Compound Flood Risk Assessment

Kasra Naseri
Advisor: Michelle Hummel
Civil Engineering Department

Flooding is one of the most important natural hazards that threaten social stability and economic growth in flood-prone regions. Over the last decades, a significant shift in the frequency and intensity of climate extremes has amplified the flood hazard. This study develops a non-stationary and copula-based Bayesian framework that incorporates the impact of dependence between flooding drivers. The framework will allow investigating how the individual and combined effects of dependence and non-stationarity will influence the frequency and magnitude of extreme events. Furthermore, the Bayesian framework will allow for the incorporation of uncertainty, which may arise from the shortage of data, model selection, and parameter estimation. Results show that the interplay between dependence and trends can reduce the joint return period by more than five times in locations with high positive trends in sea level and precipitation and strong dependence while increasing the joint return period in locations with a negative trend in precipitation. In addition,

preliminary results reveal that uncertainty is highly dependent on the length of joint data. This study highlights the importance of hydrological dependence and trends in the quantification of return periods and emphasizes the necessity of accounting for uncertainty to permit reliable estimation of flood hazards.

5 – Development of Automated Algorithm Utilizing Deep Learning to Predict Insulin Secretion

Anne Alsup and Kelli Fowlds
Advisors: Michael Cho and Jacob Luber
Biongineering Department

Our automated algorithm is expected to empower researchers to batch analyze multiple calcium spiking image stacks within in a fraction of the time that would otherwise be required with current methods. Insulin secretion from pancreatic β-cells is integral in maintaining the delicate equilibrium of blood glucose levels. Calcium is known to be a key regulator and triggers the release of insulin. This sub-cellular process can be monitored and tracked through cell imaging and subsequent cell segmentation, registration, tracking, and analysis of the calcium level in each cell. Current methods of analysis require researchers to outline β-cells manually and involve multiple software packages that tend to introduce biases. Utilizing deep learning algorithms to automatically segment and track thousands of cells will greatly reduce the time required to gather biologically significant data. Tracking cells over a time-series image stack will also allow researchers to isolate specific calcium spiking patterns and spatially identify these cells, creating an efficient and user-friendly analysis tool.

6 – Surface Flashover Under Varying Surface Pollutions

Brad Hannum
Advisor: David Wetz
Electrical Engineering Department

Electrical insulators are critical components in every high voltage application, whether it is operated continuously or in a pulsed mode. Bulk dielectric breakdown and surface flashover must be prevented in all cases, including those that occur in polluted environments. Though electrical standards have been written as a guide to prevent insulator surface flashover, such as Underwriters Laboratories (UL) 840 [1], they are not directly applicable to pulsed power applications where size and weight are critical. The design of experiments within UL 840 is vague; it does not consider a harsh sea environment, and it is written with electric power utilities in mind rather than shipboard pulsed power systems. These shortfalls call for research to be performed to compare UL 840's limited recommendations to measurements made at more representative conditions. The results can be used to develop a more accurate reference manual for those in the pulsed power community. In the work presented here, five different material samples have been subjected to a few different pollution levels and the dielectric flashover strength has been studied across samples of five different widths. The experimental rationale, design, and results will be presented.

7 – A Capacitive-Inductive-Capacitive (CLC) Testbed for Studying the Rapid Discharge and Recharge of High Voltage Capacitors

Alex Johnston
Advisor: David Wetz
Electrical Engineering Department

In many high-voltage pulsed power systems, polypropylene metallized film capacitors are used as primary or intermediate energy storage devices. In repetitive rate systems, the need arises to discharge, recharge, and discharge again and depending on the rate and duration of operation, this type of operation can occur rapidly many times. The stress of high-rate discharge and recharge following each other quickly can push capacitors to their limits electrically, mechanically, and thermally causing pre-mature failure. Understanding what causes a failure in a capacitor, and what alterations can lengthen lifetime are of interest. To study the lifetime of high-voltage capacitors, a testbed has been assembled in which a single high-rate discharge, recharge, discharge experimental procedure can be performed on capacitive unit under test. The testbed is assembled using a capacitive-inductive-capacitive (CLC) architecture and capacitors as high as 80 kV can be studied. The testbed will be discussed along with some commissioning data collected.

8 – Power Hardware in the Loop (PHIL) Emulation of Electrochemical Energy Storage Systems with Operating Voltages As High As 1 kVDC

Cole Tschritter
Advisor: David Wetz
Electrical Engineering Department

The U.S. Department of Defense has considered employing lithium-ion energy storage as either a prime power source, backup power source, or buffering source in a few of its future mobile electrical power systems. Battery open circuit potentials as high as 1 kVDC have been considered and while batteries with this high a potential are starting to emerge in industrial solar applications and even in automobiles, their deployment to date is limited. This means that there is a great deal still to understand about how to assemble batteries with this high a voltage and how to ensure they are safely operated and maintained. Devices such as battery management systems are being improved every day and they must be studied and characterized before they are deployed on fully operational batteries. Evaluation of the short- and long-term performance of batteries and their safety equipment is expensive, difficult, and can introduce safety concerns. In the work presented here, a battery emulator has been assembled and validated using a power-hardware-in-the-loop (PHIL) system. Using this method, any type of battery can be emulated so long as a validated MATLAB simulation model at the cell level is available. Though the eventual plan is to emulate a 264 cell battery using the PHIL hardware, only a few have been emulated to date. The options considered for emulation of the real-time battery model will be discussed along with some experimental results obtained to date.

9 – DC and Pulsed Evaluation of Altered Dielectric Insulation Materials

Tyler Scoggin and Hayden Atchison
Advisor: David Wetz
Electrical Engineering Department

In high-voltage pulsed power systems, transformer oil, de-ionized water, or some type of gas are often used as insulating materials. Regardless of the material used, dielectric breakdown is always a concern. All those materials are conforming and self-healing making them attractive, but they introduce significant engineering challenges and restrictions when it comes to sealing and/or pressurizing them. Liquid dielectrics are heavy so they may reduce a system's power and energy density and their dielectric properties are unable to be functionally graded so that can lead to boundary conditions that create high electric-field enhancements. Solid dielectrics can be more attractive from a maintenance, power density, and energy density point of view but they are not self-healing and they can be difficult to manufacture, especially around complex geometries. Epoxies have been studied to some extent but much more work is needed to fully understand their future uses. The rapid rise of additive manufacturing has also opened new avenues that need to be better explored. Epoxy, thermoset plastics, and additively manufactured materials can be functionally graded using nano-particle additives introducing the ability to potentially minimize electric-field enhancements across boundaries. In the work presented here, epoxy, thermoset plastics, and additively manufactured dielectric samples, that are both raw and dielectrically altered will be experimentally studied in both DC and pulsed experimental conditions to evaluate their dielectric strength.

10 – Leveraging AI and Supply Chain Technologies for Early Detection and Prevention of COVID-19 and Respiratory Infections in URM Communities

Gohar Azeem
Advisor: Erick Jones Sr.
Industrial, Manufacturing and Systems Engineering Department

The COVID-19 pandemic was a crisis of different proportion, creating a different type of burden on government agencies. Vulnerable communities including the elderly and communities of color have been especially hard hit by this pandemic. This research is based on a NSF-funded grant (2028612) to help federal agencies by investigating supply chain strategies that could minimize the impact on underserved populations during pandemics and by integrating artificial intelligence and social determinants of health to make optimized supply chain models more robust. This research investigated a healthcare supply chain model that leverages AI and telemedicine to provide timely delivery of vaccines to COVID-19 patients that are most at risk for severe illness or death. The optimized supply chain model maximizes social goods by sending drugs or vaccines to the communities that need it the most regardless of ability to pay. The outcome of this study helped us prioritize the communities that need the vaccines the most. This information can be used in our healthcare supply chain model to ensure timely delivery of vaccines to patients that are the most vulnerable and hence the overall impact of COVID-19 can be minimized.

11 – Development of Automated Fiber Placement Manufacturing Cell

Sandesh Amgai
Advisor: Paul Davidson
Mechanical and Aerospace Engineering Department

Automated Fiber Placement (AFP) has revolutionized the manufacturing process for aerospace applications with its reliable layup for complex geometries, shorter production times, increased material yield, automation and flexibility with intelligent designs. UTA's Laboratory for Advanced Material Manufacturing and Analysis has developed a compact and versatile AFP system capable of laying two tows simultaneously and independently, mounted on a KUKA robotic arm ready to meet research and industrial needs. The system has the versatility of laying down thermoplastic, thermoset, and dry fiber tapes, in 2D and 3D curvilinear paths as planned by the user. Tested with a maximum speed of 350 mm/s, we can go up to 500mm/s for straight tow orientations. We intend to extend our computational expertise by utilizing the in-house manufacturing system to develop and optimize design and manufacturing processes for aerospace and automotive applications.

12 – Experimental Demonstration of Band Flips and Band Closure in Resonant Optical Lattices

Nasrin Razmjooei
Advisor: Robert Magnusson
Electrical Engineering Department

We demonstrate band flips in one-dimensional dielectric photonic lattices presenting numerical and experimental results. In periodic lattices, there exists a second stop band where one band edge experiences radiation loss resulting in guided-mode resonance, while the other band edge becomes a non-leaky bound-state in the continuum. To illustrate the band flip, band structures for two different lattices are provided by calculating zero-order reflectance with respect to wavelength and incident angle. We then provide three photonic lattices, each with a different fill factor, consisting of photoresist gratings on Si3N4 sublayers with glass substrates. The designs are fabricated using laser interferometric lithography. The lattice parameters are characterized and verified with an atomic force microscope. The band transition under fill-factor variation is accomplished experimentally. The measured data is compared to simulation results showing good agreement.

13 – Bioadhesive for Glenoid Labrum Tear Repair Through Induced Host Progenitor Cell Responses

Cynthia Co, Samira Izuagbe, Bhavya Vaish
Advisor: Liping Tang
Bioengineering Department

Glenoid labrum injuries occur because of repetitive movements or traumatic dislocation events. While arthroscopic repair of the torn labrum can restore the anatomy of the shoulder, current surgical procedures are not always able to

restore normal function of the torn labrum. Failure of surgical repair has been attributed to, at least partially, the poor healing capability of the fibrocartilage labrum. Here, we report the creation of a PDGF-releasing chitosan (CS) adhesive for reattaching torn labrums and promoting labral tissue regeneration through recruitment of nearby progenitor cells and inspiring ECM production. A small laceration in the anterior labrum at the level of the glenoid rim was created to simulate a Bankart lesion in rats. Adhesive with or without PDGF was applied to close the tear site. At 0, 3 and 6-weeks, analyses of cell/tissue responses were performed to assess the integrity of the repaired tissue, inflammatory response, ECM regeneration, and progenitor cell recruitment. Our proof-of-concept in vivo studies indicate the application of the CS adhesive reduced labral tissue inflammation following injury, mitigating the degeneration process. Subsequently, local delivery of PDGF enhanced tissue repair through recruitment of nearby progenitor cells and promoting cell proliferation and differentiation at the injury site.

14 – Upgrading Wastewater for Irrigation Use: A sustainable Solution

Mithila Chakraborty
Advisors: Melanie Sattler
Civil Engineering Department

Many irrigation projects are now considering the use of non-traditional water sources, including treated wastewater, to augment supplies. Treated wastewater, however, may still contain many organic pollutants of emerging concern, because traditional wastewater treatment plants are unable to remove them. Adsorbents have been demonstrated to effectively remove recalcitrant organics from wastewater more effectively, at a lower cost, and using fewer chemicals and energy than many competing techniques. A single adsorbent with one pre-treatment, however, is not effective for simultaneously removing different types of water pollutants. This work proposes a novel solution: waste materials – rice husk and sewage sludge – modified with different physical/chemical pre-treatments to create a multi-sorbent mixture, Multisorb, which will be able to simultaneously remove different organics. The overall goal of the proposed project is to increase the sustainability of agricultural/food production systems by facilitating the use of treated wastewater for irrigation. By using waste materials as adsorbents, the project will provide a low-cost, sustainable method of removing recalcitrant organics from treated wastewater. So far, the batch test with synthetic wastewater has been shown a promising result of absorption for PFAS and PPCPs. Few waste-made adsorbents have shown similar and/or higher adsorption than Commercial Activated Carbon (CAC). Examples include rice husk modified with ZnCl2 at 800 deg. Celsius, sewage sludge modified with ZnCl2 at 800 deg. Celsius and rice husk ash modified with H3PO4 at 650 deg. Celsius.

15 – Prioritizing Organic Waste to Energy-Renewable: Development and Application of the POWER Framework

Doreen Ntiamoah-Asare, Opeyemi Adelegan, Mithila Chakraborty, Mehrdad Arabi, Bahareh Nasirian
Advisor: Melanie Sattler
Civil Engineering Department

Many regions are currently aiming to divert food waste and other organics from landfills to preserve landfill capacity and increase regional renewable energy opportunities. Many regions already have anaerobic digesters (AD) that convert sewage sludge at water resource recovery facilities (WRRFs) to biogas. Using this existing infrastructure, organic wastes like food, yard, and fats/oils/grease can be co-digested to increase biogas production. The newly-developed "Prioritizing Organic Waste to Energy-Renewable (POWER) Framework" can help cities/regions assess the feasibility of co-digesting organic wastes at existing or new WRRF digesters, on-farm digesters, or stand-alone digesters. The POWER Framework consists of 4 components: a GIS toolbox, a basic POWER tool, an optimization GUI, and a city guidebook. The GIS toolbox estimates quantities of organic wastes that can be collected for digestion and assist in visualizing the spatial distribution of different waste components at different geographic levels. The POWER tool is a user-friendly Excel spreadsheet which estimates fuel produced (electricity, or CNG), costs/benefits, emission reductions, renewable energy credits earned, and net energy balance. The optimization GUI allows the user to determine the overall least-cost system for transporting and digesting waste for conversion to energy, and the optimum region(s) of waste to send to each.

16 – ILGAM Model for Predicting Generation and Emission of Methane From Landfills in Semi-Arid Regions of Iran

Sayyed Hossein Khazaei, Reza Rafiee, Mazaher Moeinaddini, Nematollah Khorasani
Advisor: Melanie Sattler
Civil Engineering Department

Due to the high cost of measuring methane generation in landfills, models are commonly used for greenhouse gas emission inventories and for designing systems for landfill gas collection and utilization for energy. However, common landfill gas models estimate methane with high error for Iranian landfills. In this study, the Iranian Landfill Gas Model (ILGAM), a first-order decay model, was developed for methane generation from landfills in semi-arid regions of Iran. The main parameters of the model include methane generation potential (Lo) and decomposition coefficient (k). Methane potential is modeled as a function of waste composition and landfill type, and the decomposition coefficient is estimated as a function of temperature and rainfall in the study area. To evaluate model performance, field measurements of methane emissions were collected from the Karaj City landfill in central Iran using a static chamber between September 2020 and January 2021. The measured average methane emission rate of Karaj landfill was 283.96 g / day/m2; the ILGAM model estimated this rate with an error of 5.8%. By comparison, the landfill gas models

LandGEM-Inventory, IPCC and CLEEN had errors of 74.4%, 40.2% and 27.1%, respectively, compared to the measured value. Although ILGAM simulated the emission rate for Karaj City landfill with good accuracy, future work will evaluate its performance with additional landfills.

17 – Women in Construction Industry: Occupational Health and Safety Challenges

Apurva Pamidimukkala
Advisors: Sharareh Kermanshachi
Civil Engineering Department

The construction industry has traditionally been a male-dominant sector. Since 2000, women have accounted for approximately 10% of construction employees, indicating that they have been continuously underrepresented. However, the culture and environment of the sector present various challenges to female participation. As a result, the purpose of this study was to identify and categorize the challenges faced by women in construction fields and offices and develop strategies to overcome these occupational challenges. First, thorough research of prior related studies was performed. To collect data, ten interviews with women active in the construction industry were conducted. Twenty-two occupational barriers to women's health and safety were identified. Next, 26 strategies were identified from a thorough review of previous literature. The Delphi method was then employed to rank and weigh the effectiveness of the identified strategies. Ten women with construction-related positions participated in a two-round Delphi method to rank and weight the developed strategies. Results revealed that the top two strategies were determined as providing adequate sanitary facilities at job sites and offering challenging roles and opportunities for women's progress. The findings of this study will guide employers and policymakers to implement strategies and policies to help women advance in the construction industry, and benefit from a more diverse working environment.

18 – Additive Manufacturing of Novel Ti-Ti Metal Matrix Composite

Oscar Valdez, Aditya Ganesh, Ahmet Tanrikulu, Sandesh Amgai
Advisors: Paul Davidson, Amir Ameri
Mechanical and Aerospace Engineering Department

The introduction of additive manufacturing has allowed the fabrication of intricate structures with ease compared to previous machining and casting methods. A growing area of research focuses on creating materials with customizable properties using additive manufacturing approaches. These approaches rely on combining different materials to obtain composite-like material behavior. This study investigates the possibility of creating a Ti-Ti Metal Matrix Composite (T-MMC) material using a feedstock with only one type of metal powder by altering the printing parameters in direct metal laser sintering. Dogbone specimens of T-MMC were printed using Ti-64 feedstock with print patterns representing [0/90]xs and [+45/-45]xs composite configurations. Samples were tested in tensile loading up to failure to characterize mechanical performance and failure. Analysis using Digital Image Correlation and SEM show variation in microstructure, mechanical properties, and failure behavior, corresponding to the designed print pattern. On this basis, it is possible to create an additively manufactured part that shows a response similar to that of a composite, therefore allowing for the fabrication of parts with tailored material properties while using a single material feedstock.

19 – Automated Inspection and Material Supply in the Construction of Highways and Bridges

Karthik Subramanya, Apurva Pamidimukkala
Advisor: Sharareh Kermanshachi
Civil Engineering Department

Highway construction has been challenged by issues such as a skilled workforce shortage, cost overruns, quality disputes, and schedule delays. The incorporation of technologies in highway construction has always proven to be advantageous in improving the efficiency and safety of projects. The research focuses on simplifying, semi-automating, or fully automating the day-to-day operations of engineers, inspectors, material suppliers, truck operators, backend office workers, inspection/testing agencies, and Department of Transportation (DOT) representatives. The Automated Inspection and Material Supply (AIMS) platform will be deployed using a combination of e-Ticketing, fleet management, advanced sensors, digital inspection checklists and drones. The study has laid out the benefits of using AIMS depending on different stakeholders' responsibilities in day-to-day operations using a combination of extensive literature review and a survey of DOT representatives. The findings of the paper imply that AIMS technology can render minimal cost overruns/schedule delays, safer operations, and higher construction quality in highway and bridge projects. The contribution of the study is to examine the efficacy of integrating technologies and to assess the integrated AIMS platform in terms of tangible costs and benefits. Further research will assist in providing database platforms for integration and guidelines for the implementation of the technology.

20 – Influence of Graphene in Twisted High-Density Polyethylene Fibers

Ashish Lal Sivadas Anilal, Sehee Jeong, Rochelle Spencer, Stephanie S. Lee
Advisor: Michael Bozlar
Materials Science and Engineering Department

High-density polyethylene (HDPE) has a unique capability to induce banded spherulite structures as it crystallizes from its melting temperature. In this research, we intend to study the twisting of HDPE fibers reinforced with carbonaceous nanoparticles such as graphene. The use of graphene as a multifunctional reinforcement in polymer matrices is a topic of great interest due to simultaneous improvements in mechanical, electrical, and thermal properties of the composites at very low weight fractions. We synthesized graphene by the chemical oxidation of natural graphite and further looked into the extent of influence of graphene in the twisting of HDPE fibers. The graphene-HDPE nanocomposites are prepared by the principles of melt extrusion in the form of microfibers, using a twin-screw extruder. The influence of graphene was studied under various parameters such as the extent of

graphene reductions, cooling rate, etc. The graphene-HDPE composites are also examined at the macroscale and microscale levels using in-situ pico-indentation combined with scanning electron microscopy imaging and polarimetry. The graphene-HDPE composite microfibers are expected to stand superior to conventional fibers, overcoming shortcomings such as flammability, low sensitivity to stress cracking, poor creep resistance, etc.

21 – Long Wave Infrared Filters

Fairooz Simlan
Advisor: Robert Magnusson
Electrical Engineering Department

Design, fabrication, and characterization of robust guided-mode resonance (GMR) infrared filters operating in the 8 to 13um infrared region are presented. Germanium is used as the waveguide layer for its IR transparency and high refractive index. Both TE and TM polarizations are taken into account for the fabricated GMR filters. Preliminary experimental spectra agree qualitatively with the theory.

22 – Healthcare Costs of Construction Workers in Unfavorable Weather Conditions

Sanjgna Karthick, Apurva Pamidimukkala
Advisor: Sharareh Kermanshachi
Civil Engineering Department

Unfavorable weather conditions that include extreme hot and cold weather conditions lead to various health challenges for workers. Health challenges in hot weather conditions include musculoskeletal disorders, hypertension, and heat stress, and workers may experience frostbite, hypothermia, cold stress, and other illnesses in cold weather. Increased mortality rates and accidents in construction sites also lead to increased health care costs for workers and higher insurance premiums. Therefore, a questionnaire survey was developed and distributed to understand the health challenges of workers, which yielded 111 responses. The responses were used to descriptively study the relation between the healthcare costs incurred by the workers and their unfavorable working conditions based on various factors like gender, age, ethnicity, job position and type of construction sector. The results revealed that field workers had higher healthcare costs than workers in managerial positions. Based on gender, male workers and workers above 51 years of age had higher health care costs. Based on the construction sector, workers from the heavy industrial sector incurred higher costs. The results identified in this study can help professionals in the construction industry to understand and plan the health care costs and claims of workers performing in extreme weather conditions.

23 – Rechargeable Zinc Air Batteries Using Graphene

Mrinal Chatterjee, Maruf Bhombal
Advisor: Michael Bozlar
Electrical Engineering Department

Rechargeable zinc air batteries are environmental friendly energy storage devices with high energy density and low cost. In this research, we intend to make highly conventional and rechargeable zinc air batteries for better performance and more storage. Hence, by including the application of graphene we can attain such battery for more practical use.

24 – An In Vitro 3D Model for Studying the Effect of IOL and Posterior Capsule Interactions on Cell Responses as a Precursor to PCO formation

Samira Izuagbe, Joyita Roy, Le Hoang
Advisor: Liping Tang
Bioengineering Department

Posterior Capsule Opacification (PCO) is the major cause of post-operative complication of cataract surgery. PCO is characterized by the migration of lens epithelial cells (LEC) from the anterior eye capsule to the posterior eye capsule and ultimately into the junction between the implanted IOL and capsule. Here, the LEC differentiate into myofibroblasts or lens fiber cells and deposit extracellular matrix which cause opacification of the lens and poor vision. Although LECs are known to be responsible for PCO, the interaction of the IOL-capsule system as an instigator for PCO formation is still unclear. Various in vivo and in vitro methods have been employed to study the progression of PCO to device suitable treatments or preventive techniques. Although these methods have been reliable thus far, their inability to mimic the interaction between the IOL and capsule present as limitations. Thus, we introduce a novel 3D gelatin-based posterior capsule model capable of mimicking the interactions between the IOL and posterior capsule. Here, the effect of this interaction on LEC responses can be studied, and the implication of the adhesive strength of the IOL to the capsule as a factor of PCO formation assessed.

25 – Improving Urban Mobility Through Innovative AV Technology – Arlington, TX, as a Case Study

Mohammed Arif Khan
Advisor: Sharareh Kermanshachi
Civil Engineering Department

Recent technological advancements have revolutionized the transportation sector. As a result, new players in urban mobility are entering the market at a high rate and are experimenting with innovative means to solve urban transportation problems. Arlington, TX, is the largest city in the United States without a mass transit system, but it has been a pioneer in introducing several new mobility services to its residents. Currently, the city is piloting a federally funded automated service named Rideshare, Automation, and Payment Integration Demonstration (RAPID), which uses innovative technologies to

improve public transportation through integration with existing services. As one of the country's first on-demand autonomous vehicle (AV) services, RAPID offers shared rides in the UTA and downtown area using a fleet of AVs. Over the first year of service demonstration, RAPID service has offered over 58,000 trips. Using real-time ridership data, this research aims to explore how Arlington residents and especially UTA students use the AV service and how the service meets their mobility needs. Employing data analysis, we will provide meaningful insights into the AV service acceptance by people after its implementation. The study findings could be used by decision-makers and service providers to improve the shared autonomous vehicle performance and exploit the innovative technology to optimize urban mobility efficiency and equity.

Other Undergraduate

26 – Computatrum: A Computer Program That Uses the Computer Like a Human and Uses It to Program Itself

Jacob Valdez
Advisor: Deokgun Park
Computer Science and Engineering Department

I propose developing a fully autonomous, open-ended machine learning system trained with the objective of researching and developing state-of-the-art ML systems, including improvements of itself. I am not just reformulating autoML, unsupervised learning, intrinsically-motivated reinforcement learning, or some evolutionary AI-generating formal algorithm. I propose developing a system that genuinely propagates feedback from 'end-to-end', that pursues its own cultivated intrinsic motivations, is its own economic entity, is subject to the same financial and technological constraints as a human engineer, and uses standard peripherals connected to a virtual machine running Ubuntu with Internet access to interact with robots, research sites, and its own software and computer resources.

27 – 1 Wamp Amplifier

Ricardo Perez, Nam Hoang, Vince Mai, Lenoardo Fernandez
Advisor: David Wetz
Electrical Engineering Department

In EE 2240-002 (Sophomore Project Laboratory), each of five student groups have researched, designed, and experimentally evaluated one of four different guitar pedals or a guitar amplifier. In the work discussed here, a guitar amplifier has been designed, simulated, experimentally built, tested, and documented. The amplifier is an electronic device or circuit that increases the amplitude of the input signal such that it can be better heard on a speaker. A key requirement of an amplifier is that it must not increase the amplitude of any noise on the signal as that will distort sound quality. Amplifiers are commonly used by bassists, keyboard players, and guitarists who want to produce clean sounding music. The team has researched amplifier designs, simulated the design using

Matlab Simulink and LT Spice. Once simulated, the circuit was implemented on a breadboard and experimentally studied. Next the circuit was studied on a milled circuit board and finally a professionally manufactured printed circuit board. Along the way the design is validated against the imposed requirements and constraints. At the end, a working amplifier is available to be used in series with the guitar pedals implemented by the other four groups.

28 – Creating a Distortion Pedal

Andrew Kozelsky, Jason Bradford, Zaid Osama Del Meqbel
Advisor: David Wetz
Electrical Engineering Department

An electric guitar produces a sinusoidal AC signal that can be manipulated using analog electronics. Circuits used to manipulate the sound of an electric guitar are usually housed in an assembly known as a guitar pedal. Distortion pedals use operational amplifiers and diodes, along with other components, to clip a sinusoidal waveform such that a near square wave is created. These pedals produce the gritty, heavy sound that is foundational to hard rock, punk rock, heavy metal, and many other music genres. In the work presented here, a distortion guitar pedal circuit that is based off of those commercially available, has been designed and simulated using LTSpice and Simulink. Once the simulations demonstrated the expected electrical performance, the circuit was constructed on a breadboard and experimentally studied. Next, the breadboard circuit design was replicated on a milled protoboard and validated. Finally a milled single-sided PCB was designed using EAGLE and it was housed in a robust guitar pedal case to create a fully functional distortion pedal. The design along with the process undertaken will be presented here.

29 – Fuzz Face Guitar Pedal

Hamza Khan, Halil Tulek
Advisor: David Wetz
Electrical Engineering Department

In modern music, the audio signal produced by an electric guitar is modified using an electric circuit, housed in the form of a foot pedal, to produce a unique sound effect. One of these is known as the fuzz pedal that uses extreme clipping to turn the signal into what's essentially a square wave creating a large harmonic saturation. The pedal is either stand-alone or housed in a larger 'stompbox' and it is connected between the guitar and the final amplifier stage. A fuzz pedal often includes rotary dials that are used to adjust parameters such as volume and gain and a main foot switch that activates or deactivates the effect. In the work documented here, a fuzz pedal has been electrically designed, simulated, built, and tested experimentally. Simulation tools including LTSpice and SIMULINK have been used. The circuit design was first studied on a breadboard and then on a milled printed circuit board and finally a professionally manufactured printed circuit board was procured and studied. The design process along with the simulation and experimental results will be discussed.

30 – Wah Pedal

Pedro Villafranca, Ben Schmitz, Loc Nguyen
Advisor: David Wetz
Electrical Engineering Department

Electric guitars have taken over the music industry, replacing the acoustic guitars traditionally used by so many famous artists. The audio signal produced by electric guitars can be distorted using an electric circuit connected in series with the guitar output and the amplifier. There are over fifteen different types of guitar pedals that each have their own unique effect. In the work described here, a classic Wah distortion pedal has been simulated, fabricated, and experimentally studied. This type of pedal has been used by musicians including Jimi Hendrix, The Red Hot Chili Peppers, and many others. Distortion occurs when the Wah pedal alters the tone and frequencies of the audio signal. Simulation tools including LTSpice and Simulink have been used to understand and demonstrate the pedal's operation. The electrical circuit has been studied on a breadboard, milled circuit board, and a professional printed circuit board has been fabricated. The design, simulation, and experimental study of the Wah pedal will be presented.

31 – Electioneering

Karun Dawadi, Shishir Bishwokarma, Dirk Anthony Clark, Brenda Martinez, Prajwal Rana
Advisor: Chris McMurrough
Computer Science and Engineering Department

Help grass root elections campaigners manage elections and analyze election data

32 – Gamifying Local Government

Elias Baez, Imani Matthews, Lorena Hernandez, Paisley Morrison, Kaliuntai Mason
Advisor: Jaime Cantu
Computer Science and Engineering Department

Due to COVID-19, there is an increase of polarization in politics. Policy makers and communicators must find a way to reduce partisan prejudice and often spiteful malevolent ill will. The solution to pollution is dilution. In order to increase participation in local government, we propose applying game mechanics, elements, and principles to better engage the community. By swiping left or right on our app, Arlington residents will be kept informed on local legislation and sentiment in a fun way. Seeking more information will funnel users to become active participants in their community.

Research Experiences for Undergraduates

33 – Cost-Aware Polyamide 12 Recycling in Selective Laser Sintering

Esequiel Aguilar Villareal, Cynthia Marie Dominquez, Kristen Marie Leiker
Advisor: Yiran "Emma" Yang
Industrial, Manufacturing and Systems Engineering Department

Additive manufacturing, owing to its layer-by-layer production method, can provide enhanced manufacturing complexity, increased customization level, and reduced production time and cost. The selective laser sintering (SLS) technique uses a laser as the power source to sinter powdered material, aiming the laser automatically at points in space defined by a 3D model and binding the material together to create a solid structure. In practice, more than 50% of the virgin powder is usually wasted. Motivated by the high cost of virgin material, polyamide 12 (PA12) powder recycling in SLS will be investigated in this REU project. Mechanical sieving will be used as the primary recycling method. Comparative studies will be performed to evaluate the particle size and distribution, material properties, and mechanical properties of virgin powder and recycled powder, along with cost estimation. Approaches to potentially enhancing the quality of recycled powder will also be explored.

34 – Non-Intrusive Queen Bee Activity Monitoring System

Yahya Yanouri, Po En Su, Md Safkat Rahman
Advisor: Wei-Jen Lee
Electrical Engineering Department

In a beehive, the queen is the most important individual. If the queen bee dies, the hive dies as well, so monitoring her health is essential. The purpose of this research project is to create a non-invasive sensor circuit that can sense the queen bee's behavior patterns, to determine if the queen bee is in good health.

35 – An Immersive Teleoperation System for Robot Navigation

Noah Wood
Advisor: William Beksi
Computer Science and Engineering Department

The goal of this project is to add immersive teleoperation capability to our Clearpath Husky unmanned ground vehicle. We will use commercial-off-the-shelf 3D cameras to capture an augmented reality view from the perspective of the robot. The robot's onboard cameras will be paired with a compatible virtual reality (VR) headset. Custom developed software will provide higher degree views of the surrounding environment. These views will be displayed within the VR headset for the purpose of providing descriptive visual feedback for long-distance operation of the robot. The setup will ensure a wider capture of the terrain and the ability to see potential collisions/obstacles from the side of the robot during navigation. This project will provide a unique undergraduate research experience and support PI William Beksi's work on automating infield high-throughput plant phenotyping in collaboration with Texas Tech University.

36 – AbuseGuard: Guarding Social Media Users Against Toxic Behavior

Unique Karanjit, Sayak Saha Roy, Mohit Singhal, Michael Edward Brady
Advisor: Shirin Nilizadeh
Computer Science and Engineering Department

Hate speech and toxic behavior toward individuals on social media platforms have been linked to negative emotional, psychological and behavioral consequences among both youth and adults. Prevalent user-based approaches towards curbing offensive content, such as 'blocking' are reactive in nature, i.e., they only take place after the attack has occurred, and can also become cumbersome with a large amount of abusive content. Also, hate speech detection on these platforms mostly focuses on explicit phrases and simple lexical features, while such toxic behaviors leverage the context of conversations and personal (dis)taste of victims. Thus, we propose to develop AbuseGuard, a context-aware and personalized machine learning-based system that proactively detects hate speech and blocks hate speech instigators before they can interact with users. We will evaluate the performance of our system by conducting both qualitative and quantitative user studies.

37 – Design and Manufacturing of Ultralight Lattice Metamaterials Inspired by Nature

Noor Alyasiri, Clay Gifford, Abhimanyu P Patel
Advisor: Xin Liu
Industrial, Manufacturing and Systems Engineering Department

Innovative materials with a high stiffness/strength-weight ratio are highly sought-after in many engineering applications. Beam lattice metamaterials are highly tailorable man-made materials which have shown great potential to improve the stiffness/strength-weight ratio with light weight. In this project, we propose a new approach to power the beam lattice metamaterials by the innovative beam cross-sectional design. Inspired by dragonfly wing structures, a bio-inspired, hollow cross-section will be developed for the body-centered cubic (BCC) lattice metamaterial. A novel multiscale structural modeling approach called mechanics of structure genome (MSG) will be employed to compute the beam cross-sectional properties with different cross-sectional shapes. A deep learning neural network model will be developed to connect the cross-sectional design parameters to the cross-sectional properties. To reduce the stress concertation at the beam connections, a varying hollow cross-section will be employed to enhance the connection region. The multiscale modeling will be performed using the MSG model to compute the effective material properties and the strengths of the BCC metamaterials. The BCC metamaterials will be fabricated by selective laser sintering. The standard compressive tests will be carried out to investigate the mechanical behaviors of the developed metamaterials and validate the proposed design.

38 – Artisanal and Small-Scale Gold Mining National Mercury Emissions Estimates using Hg:Au Ratios

Ashley Nguyenminh, Michelle Schwartz, Nathaniel Steadman
Advisor: Kathleen Smits
Civil Engineering Department

Artisanal and small-scale gold mining (ASGM) has become a global concern due to the health and environmental impacts caused by mercury emissions during processing. However, there are few studies conducted to estimate emissions, resulting in inconsistent estimation methods. This lack of data arises, in part, due to the logistic challenges caused by spatial distribution of ASGM operations, poor access to ASGM sites for testing and observation, and limited techniques for observing emissions from systems used by the ASGM sector. Therefore, consistent methods to estimate emissions across scales are warranted. Different methods for determining Hg:Au values, or the emission factor used for calculating mercury emissions, were compared for Ghana and Nigeria. Three common methods for determining Hg:Au ratio were analyzed to compare the resulting mercury emission estimates: a regional average, a processing-specific average, and an operation size-specific average. Data was selected from Global Mercury Assessments, peer-reviewed literature, and National Action Plans. Data analytics tools in Excel were used to compare variations in Hg:Au values and Hg emissions based on processing type and scale of operation. Results of this study may be used by national governments to evaluate whether bias is introduced to mercury emission estimates based on calculation methods utilized.

39 – High Resolution of Whole-Mount Mouse Organs with Axially Swept Light Sheet Microscopy

Toluwani Ijaseun, Cynthia Marie Dominguez, Diya Mahesh Ramchandani
Advisor: Juhyun Lee
Bioengineering Department

Medical imaging plays an integral role in clinical diagnosis and the pursuit of basic research. With the use of light-sheet fluorescence microscope (LSFM) technology, in combination with tissue clearing and labeling techniques, researchers have been able to view high-resolution images of tissues on the subcellular level. Current LSFM technology has many advantages since it has two different objective lenses for detection and illumination. Therefore, unlike other microscopy systems, field-of-view does not depend on detection objective lens magnification, which allows large field-of-view. However, due to the tradeoff of lateral resolution and Rayleigh length (depth of focus), there is a certain limitation of mesoscale to macroscale sample imaging. We seek to customize and produce quantifiable improvements to LSFM technology and current tissue clearing and staining techniques. This will include optimization of the Rayleigh length and enhancement of nanometer spatial resolution by using Axially Sweeping Sub Voxel Light Sheet Microscopy. Also, we will study dyes and antibodies to identify optimal labeling and visualization of the vasculature of the heart and lungs. Finally, we will explore improvements to organic solvent-based tissue clearing protocols to homogenize the optical properties of the tissues.

40 – Research on Academic E-Portfolios

Batul Ali, Yanini Zamarripa Carrete, Alexander Rue
Advisor: Bonnie Boardman
Industrial, Manufacturing and Systems Engineering Department

Electronic portfolios are a system where work is collected, organized, and evaluated. The focus of this research project is to show how E-portfolios could allow students to highlight their work and reflections on their work, to other students, professors, and potential employers. Research questions include the following: Do E-portfolios help students see how one class connects to another in their field of study? Do E-portfolios help students reflect on their own learning? And can E-portfolios help assess attainment of longitudinal learning outcomes? The goals are to research past implementations in STEM environments, demonstrate how undergraduate engineering students at UTA could access E-portfolio software, and discuss the ways an implementation could aid those students. We will present our research on this topic and demo E-portfolio software to show how it could be accessed and used by a student.

41 – Simulating a Monitoring System for Police Patrol Officer Wellness

Prabin Lamichhane, Deependra Thakur
Advisor: Yuan Zhou
Computer Science and Engineering Department

The job of a police officer is highly stressful with constant potential for threats to their health and mental and physical well-being. These stressors can lead to adverse psychological and physical health consequences and negative behaviors, including alcoholism and suicide. Further, recent events criticizing police departments have placed even more pressure on law enforcement. This proposed project seeks to improve policing by creating a simulation framework to monitor the stress level and wellness of officers. The REU team will work with agent-based modeling, 911 call data, and wellness survey instruments to create simulated streams of hypothetical officer workloads, stressful encounters, and wellness scenarios. Statistical process monitoring approaches will be applied to these data streams to study potential approaches for monitoring officer wellness, so as to detect critical cases of officer stress early.

42 – Structural Scaling for 3D Printed Models with Frequency and Modal Similarity Constraints

Logan Hutton
Advisor: Robert Taylor
Mechanical and Aerospace Engineering Department

3D printing technologies provide enhanced design freedom to scale stiffness through material and geometric configuration that 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. An optimization approach developed in previous work will be enhanced by adding natural frequency constraints and vibration mode shape matching to the similarity conditions applied in the model. If time allows, point mass distribution and aeroelastic constraints will also be investigated. These constraints and conditions will be applied to a previous topologically optimized internal structural configuration in a scaled high-aspect ratio wing model for structural similarity with a larger scale model. Internal structural configuration and sizing of a scale model will be optimized, implemented in a CAD model, 3D printed using MultiJet Fusion technology, and tested for similarity with the large scale structural response.

43 – Development of Injectable Nanocomposite Hydrogels for Stimuli-Responsive Pain Medicine Delivery

Nicholas Singleton, Uday Chintapula, Ankitha Srinivasa, Luis Soto Garcia
Advisor: Kytai Nguyen
Bioengineering Department

In 2019, opioids caused nearly 71% of all drug overdose deaths. Opioid addictions and overdoses occur for two reasons. Opioids trigger the release of endorphins that inhibit the perception of pain and amplify feelings of pleasure. This pleasurable feeling can cause an addition and dependency on opioids. To provide long-term pain relief, increased doses of the pain medication would also be administered to the body, which could culminate in long-term drug abuse. As an alternative to conventional treatment, enhancing the bioavailability of a drug at the site of pain can combat opioid abuse by reducing high dose requirements to help solve the opioid epidemic. Hydrogels are excellent biomaterials that exhibit a versatile chemical structure. Their biocompatibility enables them to serve as an effective product for providing controlled release of pain medicine. Injectable hydrogels embedded with stimuli-responsive nanoparticles can serve as an on-demand drug delivery system for pain management and reduce the use of pain medicine. In this research, we will synthesize a drug delivery system composed of a hydrogel embedded with light-responsive nanoparticles loaded with pain medication for controlled drug release using an external near infrared (NIR) light source whenever a patient experiences pain, for better pain management. We will also design the NIR device. The release of drugs from this system under our knee customized NIR device will be further investigated.

44 – Physiological and Psychological Improvements by Light Stimulation

Guarav Thapa, Caroline Carter
Advisor: Hanli Liu
Bioengineering Department

Light stimulation has shown to improve cognition; however the underlying processes are unclear. Our study focuses on the quantification of physiological and psychological effects due to transcranial photobiomodulation. For our initial investigation 10 subjects were used. Two-channel optical fibers were connected to their forehead using BBB Nirs software. Wavelengths used were 800nm

and 1064nm on their forehead for eight minutes, pre- and post-stimulation, while the subjects were taking the CANTAB cognitive tests simultaneously. Physiological effects, which include the study of chromophore change Hbo, Hb and cco, were quantified using bbnirs and psychological effects were quantified using CANTAB software. Our results are expected to show an increase in cognitive scores which indicates psychological improvement and changes in neuro-physical parameters through the alternation of power spectrums at lower frequencies. Overall, we can combine these results to see how light stimulation can improve the human cognition.

45 – High-Throughput Cancer-Normal Cell Interface Platform for Discovering New Molecules for Cancer Treatment

Giles Fitzwilliams, Samia Shuchi, Anajani Chavali, Adam Germain
Advisor: Young-tae Kim
Bioengineering Department

A cancer statistics study published in the early part of 2021 stated that amongst the projected 1,898,160 cases in the United States a total of 608,570 deaths by cancer were projected to occur by the end of that year. According to the statistics, the most common cancers diagnosed in males and females were prostate (34,130 cases) and breast cancers (43,600 cases) respectively. Prostate cancer is usually caused by LNCaPs (Tai, et al., 2011) which is a hormone-independent cell line extracted from a metastatic lesion of prostate cancer. Breast cancer has 92 different cell lines among which the MDA-MB-231 is a highly invasive one (Chavez, Garimella, & Lipkowitz, 2010). The common feature of both cancers is that they have extremely limited treatment options. According to the statistics, the past decade (2008-2017) noticed a slowing in the reduction of breast cancer along with a complete halt on the reduction of prostate cancer. Comprehension of the cancer cells' mechanism for metastasizing throughout surrounding cells can be a significant step in understanding how to neutralize the metastases. Numerous methods and assays are being conducted by scientists today to investigate the numerous interactions that take place between various cancer cell lines and the healthy normal stromal cells that surround them. In our research, we will use an island cell-seeding method and differing drug dosages from multiple drugs to explore the changes in interactions that occur between the interfaces of both breast and prostate cancer cell lines when seeded with human dermal fibroblasts.

46 – Develop a Prototype of a High-Speed 3D Printer

Huy Phan, Phat Nguyen, Thong Tran, An Nguyen, Huy Nguyen
Advisor: Cheng Luo
Mechanical and Aerospace Engineering Department

In this REU project, we will develop a prototype of an innovative high-speed 3D printer for efficiently printing 3D plastic structures. As different feedstock is used, the proposed 3D printer will not have the clogging issues that existing printers have. Consequently, it can print at least 100 times faster than existing printers, as validated in our preliminary tests. UTA has recently filed an international patent for the proposed printer, which justifies its novelty. The

PI is its inventor. Previously, through preliminary tests, the PI's group has demonstrated the feasibility of developing the proposed printer. In this project, six undergraduate students will further develop their prototypes. The PI will aid them in theoretical modeling, and two Ph.D. students will guide their experimental work. Expected outcomes of this project are the prototype of the proposed printer, modified 3D printing software for controlling the proposed printer, and new theoretical models to determine temperature profile and pressure distribution of the high-speed melt flow. If successful, due to its much-improved production rate, the proposed printer will be an important tool for efficiently printing 3D parts, with unique applications in fabricating large-scale structures, such as aerospace, automotive, and infrastructure components.

47 – Beyond a Barrier-Free Campus: A Human-Centric Framework to Analyze the Personal Environment of Wheelchair Users

Steven McCullough, Hilton Duong, Krishna Patel
Advisor: June Young Park, Jessica Eisma
Civil Engineering Department

One of the largest minority groups in the U.S. is people with disabilities. While the establishment of the Americans with Disabilities Act had a significant impact on the accessibility of the built environment, it does not consider the perceptions of wheelchair users. Specifically, ADA guidelines provide detailed procedures for design and construction of the built environment for wheelchair users. However, evaluation and maintenance are less emphasized in practice. In this research, we propose a human-centric framework to analyze the personal environment of wheelchair users. For the proposed framework, we will develop a low-cost hardware which continuously acquires data to identify the seat comfort level as well as personal environmental conditions (thermal comfort and air quality) of wheelchair users. Then, the developed toolkit combines data collection with actual human responses to comprehensively evaluate their comfort levels. Ultimately, this will enhance the active role of wheelchair users to evaluate their environmental conditions with minimal privacy intrusion and further report their issues to the campus facility management group.

48 – A Novel Bistatic Radar Reflectometry System For Real-Time Pavement Surface Condition monitoring

Brent Oksanen, Stephanie Clairmont, Khang Pham, Raad Abusaad
Advisor: Saibun Tjuatja
Electrical Engineering Department

Pavement surface condition monitoring is an important part of structural health monitoring of our critical infrastructures and an enabler in ensuring safe operations. State-of-the-art, real-time pavement surface monitoring approaches involve embedding sensors into or on the structures. While embedded sensor systems provide site-specific measurements, they are costly to deploy and operate, less robust, and have limited coverage/monitoring area. This project proposes to develop a novel bistatic radar reflectometry system for real-time

pavement surface condition monitoring that can be scaled in space and time, can operate in harsh environments, and can be deployed on-site or on UAS platforms. The system consists of a novel bistatic radar reflectometry system, which has non-co-located transmitter and receiver arranged on an incident plane, and a physics-based parametric retrieval algorithm for pavement surface roughness and condition estimation.

49 – Extending CoWiz++ Visual Dashboard for Understanding Covid Data

David Rademacher, Jacob Valdez
Advisor: Sharma Chakravarthy
Computer Science and Engineering Department

We have a visualization dashboard for COVID with two panels. They are available to the public at https://itlab.uta.edu/cowiz-test and we are getting quite a lot of hits. We use data from multiple sources, such as The New York Times, Centers for Disease Control and Johns Hopkins University, and use real-time data from the World Health Organization and relevant news items on COVID for the period of interest. The focus and goal of this project is to extend the dashboard in one or two ways. We can add a new panel to show a new aspect of COVID, such as temporal analysis of COVID-related parameters like mobility in public areas or vaccination rates across different regions (like U.S. states or countries of the world). We can also add another map to contrast two periods, which will be easier to understand. We plan to add one or at most two extensions as part of this effort.

50 – Morphing Structures Using Bio-Mimetic Soft Actuators

Devang Tavkari
Advisor: Paul Davidson
Mechanical and Aerospace Engineering Department

Scientists are exploring elastic and soft forms of materials for robots, electronic skin and energy harvesters in an attempt to mimic nature and to enable novel applications in wide fields. In this project we aim to study the kinematics of soft structures made using embedded twist-coil soft actuators. Twisted-coiled actuators (TCA), use high-strength fibers, stretched along their fiber direction to align the constituent macromolecules. Highly overtwisted fibers spontaneously form coils to minimize strain energy. These coiled structures provide remarkable tensile actuation (>20%) when heated. The challenge, however, is to be able to predict the actuation and soft structure coupled interaction, as this dictates the kinematics of the structure. In this project, empirical and analytical formulations were developed to characterize the relationship between joule heating current, voltage, temperature and actuation, for a TCA made using nylon thread and silver-coated nylon cable. Experiments with TCA under varying input conditions were conducted with optical and thermal imaging. Optical imaging was used to quantify actuation lengths and thermal imaging was used to measure temperature variations. Furthermore, TCAs were embedded in structures made of soft silicon to demonstrate shape change or morphing using TCAs.

51 – Development of αICAM1- EpoR- PLGA Nanoparticles for Treatment of Peripheral Arterial Disease

Vy Tran, Xi Tan
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 blood vessels, leading to a high rate of morbidity and mortality. Over 8.5 million Americans have been affected with PAD, a 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 it is not an effective option for elderly patients. Therefore, our goal is developing a less invasive approach to treat PAD by using ICAM-1 PLGA NPs to deliver the EpoR gene to the ischemic tissue.

52 – Development and Implementation of Virtual Reality (VR) Training to Prevent Powered Haulage Accidents in Small Mines

Le Huang
Advisor: Sharareh Kermanshachi
Civil Engineering Department

Powered haulage accidents are the leading cause of fatalities in the mining industry. Powered haulage covers accidents caused by the motion of a haulage unit, which can include motors and rail cars, conveyors, belt feeders, bucket elevators, self-loading scrapers and shuttle cars, and can include accidents that are caused by an energized or moving unit or failure of component parts. A common problem for high-risk industries such as mining is how to provide effective safety-related training. Therefore, the objective of this study is to analyze the root causes of these accidents and train miners to adopt intervention strategies to eliminate such accidents. To achieve this purpose, two powered haulage accident virtual reality (VR) scenarios were developed. Then, the potential learning outcomes of the developed scenarios were evaluated and the effectiveness of these scenarios for the small mine workforce was assessed. The results revealed a significant improvement in the trainees' level of knowledge, and the majority of the trainees agreed that VR is a practical and effective training method. Therefore, incorporating VR technology would benefit several entities while filling the need for improved training.

53 – Additive Manufacturing of Composite Structures: Design, Fabrication, and Testing

Emily Tran, Whitney Hall, Yukti Shinglot, Manya Singh, Gavin Humphrey, Behzad Farhang
Advisor: Narges Shayesteh
Mechanical and Aerospace Engineering Department

The aim of this proposal is to study the effect of reinforced structures in Laser Powder Bed Fused (LPBF)-IN718. This study is designed to fabricate composite structures using different reinforced rods of different geometries. The rods will

be fabricated with different manufacturing process parameters compared to that of the main part. The bonding and mechanical properties of the built part will be studied. The group will utilize UTA's Innovative Additive Manufacturing Lab for conducting this proposed research.

54 – Weld Strength and Microstructure Analysis for Laser Welding of Shape Memory Alloys

Brandon Ayala, Tony Le, Bhawika Kandel, Sravya Nadella, An Khang Nguyen, Quoc Bao Duong
Advisor: Amir Ameri
Mechanical and Aerospace Engineering Department

Laser welding of nitinol shape memory alloy (SMA) wires and finding the right combination of weld parameters for better mechanical properties is the focus of the study. Different welding process parameters will be implemented to find the optimized values that result in desired properties. Microstructural analysis at the weld zone will be used to find the precipitation of potential phases at the weld and fusion zone. Tensile testing of the wires, along with hardness analysis, will be conducted to find optimum weld parameters for a good weld strength. Different field environments will also be set up during the welding process to see how it affects the precipitation of different phases in the weld zone and thus the strength of the weld.

Senior Design

55 – Microfluidic System for Cell Culture Beads

Mohammad Abu Khoder, Giles Fitzwilliams, Izabella Solorzano
Advisor: Yi Hong
Bioengineering Department

The microfluidic device we are fabricating will have the ability to produce beads with a size ranging from 100-1000 microns with a uniform shape. The system will be made of PDMS, and the beads will be made of sodium alginate and gelatin for providing a non-toxic environment for the cells.

56 – Raytheon Drone Competition

Beatriz Meadows, Gasan Abdellatif, Kyle Breidenthal, Suzanne Nassar
Advisor: David Wetz
Electrical Engineering Department

The purpose of this project is to build an autonomous unmanned aerial vehicle (UAV), commonly known as a drone. Over the past few years, drone popularity has increase in military operations, as well as other industry sectors, because of their size, versatility and ability to be controlled from a separate location. The UTA team will create an autonomous UAV that will successfully complete a set of tasks that relate to existing real-world challenges. The Electrical Engineering students will study the power requirements, map the connections for components and assist computer science with sensor selection. The drone must execute four tasks given by the sponsor to prove its functionality: autonomous flight and landing, autonomous flight and landing on school logo (image processing), outdoor obstacle avoidance and indoor obstacle avoidance (GPS disabled). The EE team has successfully selected a source of power based on research and experimentation. The team has mapped all the connections needed for proper functionality and established reliable electrical connections. The drone has been built and performed its first autonomous flight. The next steps are integrating the image recognition and obstacle avoidance capabilities.

57 – Three-Wheeled Electric Scooter

Alexa Juele, Dalton Zarko, Litzia De La Cruz, Gabriel Cisneros, Fernando Hernandez, Phuc Dinh
Advisor: Bob Woods
Mechanical and Aerospace Engineering Department

Green Wheel's design for a three-wheeled electric golf scooter was modeled to be faster than similar products on the market, allow for additional riders and display digital readings of both battery life and speed. This scooter was designed to decrease stresses experienced while in use, prevent the possibility of rollover and increase maneuverability at higher speeds. The team is currently in the process of manufacturing and assembling the vehicle in order to have a fully functional scooter by the conclusion of the 2022 spring semester.

58 – Linear Transformer Driver

David Martinez, Lucas Contreras, Austin Davis
Advisor: David Wetz
Electrical Engineering Department

The Linear Transformer Driver is a pulsed power generator comparable to the Marx Generator. Where the Marx Generator is a collection of high-rated capacitors charged in parallel which are rapidly connected in series to deliver a current pulse, the LTD uses multiple low current switches to share the current load of the generator and uses magnetic induction to generate a pulse on the secondary side. This induced current increases additively with the number of stages in the module stack of the LTD. The LTD topology allows for multiple stages to be added to increase the output power of the combined stack. Our project involves the design of a 10kV stack which can output a pulse at 100kHz repetition rate. This paper will focus on the design and construction of a single 1kV module and will cover the project's theory, background, and progress which will be discussed as well as our goals and budget objectives.

59 – Raytheon Supersensor

Evanns Morales, Nathan Ihle, Mario Ferreira, Jameson Schletewitz
Advisor: David Wetz
Electrical Engineering Department

The Raytheon SuperSensor project is a senior design project which aims to utilize the concept of sensor fusion to collect data and contextualize an environment. The project has been in the works since 2017 as a cooperative effort between Electrical Engineering teams and Computer Science teams. Since last

semester, the Electrical Engineering team has been tasked with redesigning the SuperSensor board with new, updated sensors in addition to a new design with an integrated microcontroller - the BeagleBone Black Wireless. This semester, the Electrical Engineering team will test PCB testboard designs for each sensor individually before integrating them together with machine learning and achieve sensor fusion.

60 – Design and Fabrication of an Automated Tubular Perfusion System Bioreactor for Endothelialization of Surface-Modified Silicone Tubes in the In-Vitro Percutaneous Transluminal Angioplasty Model

Enrique Villafuerte, Safia Baset, Austin Armentrout
Advisor: Kytai Nguyen
Bioengineering Department

Commercially available perfusion bioreactors are expensive to fabricate, have no automation, and do not closely replicate physiologic human conditions. Therefore, the objective of this project is to design and fabricate an affordable, automated tubular perfusion bioreactor system (TPBS) to endothelialize surface-modified silicone tubes to model in-vitro percutaneous transluminal angioplasty (PCTA) using drug-eluting balloons (DEBs). Our bioreactor will grow a monolayer of endothelial cells (ECs) onto the lumen of a surface-modified polymer tube that resembles some of the physiologic conditions of blood vessels. Then we will use a DEB to perform a PTCA to test delivery efficacy, EC responses, and TPBS performance. Our goal is to fabricate an automated TPBS able to function 24/7 and connected to the internet of things (IOT) to remotely provide monitoring, feedback, and control. Our project also features a user-friendly design and the ability to be customizable to various applications, including for use in efficacy testing of DEBs.

62 – Photonic RF Distribution

Connor Hernandez, Nicolaus Jennings, Nicholas Chin
Advisor: David Wetz
Electrical Engineering Department

The work to expand the distribution of wide spectrum reference signals through fiber optics while maintaining spectral purity is presented. Applications for distribution of reference signals, in the range of 1-30 GHz, are focused towards large scale Multiple Input Multiple Output (MIMO) schemes brought forward with the rise of 5G. Large scale distribution consists near thousands of outputs, these outputs can be used to synchronize a wide array of antennas or, in general, distribute a synchronizing clock signal to many receivers. Experimental and theoretical results support over 1500 splits meeting phase noise requirements, less than -165 dBc/Hz, across the wide spectrum with sufficient output power.

63 – Phase Shifted Full Bridge Power Supply

Luke Wilkerson, Thomas Nguyen, Lija John
Advisor: David Wetz
Electrical Engineering Department

We are tasked with making a Phase Shifted Full Bridge (PSFB) DC-DC power supply. PSFBs are ideal in high power conversion where isolation between line and load is desired. This topology uses a transformer which reduces efficiency due to losses in the core of the transformer; however, the undesirable effect of the transformer is then used to reduce switching losses this method is called zero voltage switching. Typical applications for this topology include telecommunication and aerospace where a high voltage bus is converted to lower voltage intermediate distribution buses. Our project consists of modifying an existing PSFB power supply to convert a high voltage DC input to a low voltage DC output while maintaining 95% efficiency. It must also be capable of delivering power in the range of 600 watts. The next steps are further lab testing where we will achieve our final prototype with an output of 48V DC. This PSFB will be presented to our sponsor along with our documentation.

64 – Soundproofing Design for Electric Vehicle

Manya Singh, Matthew Koithan, Melissa Hislop, Thao Ngo, Dixan Shrestha, Nitesh Shrestha
Advisor: Yawen Wang
Mechanical and Aerospace Engineering Department

The senior design team under the name of Robust Electric Solutions has been working with external client May Mobility to reduce the noise coming out from the computer fan that is in the trunk of the vehicle while the vehicle is in operation. After several on-site testing procedures, the average noise is measured to be around 65 decibels while the vehicle is in operation. Specifically, RES has been working on Hybrid Electric Lexus RX-450 fleet. The major problem associated with this vehicle is the loud noise from the computer fan and overheating of the computer system. From the first half of the senior design project, our team has successfully accomplished the noise reduction by 10 decibels from the average noise without an increase in temperature of the system. RES has also performed multiple acoustic and thermal analysis on multiple insulation materials to select the best material for the job. RES has proposed a two-part solution to this problem, where the second fold will be focused on reducing the overall noise levels by additional 10 decibels, design morphology of the soundproof chamber, thermal analysis and management and vibro-acoustic simulation.

65 – Development of a Biosensor for the Detection of Bacterial Pathogens

Samuel Fuentes, Reginald Conley, Babin Khadka
Advisor: Kytai Nguyen
Bioengineering Department

Nosocomial infections are a massive healthcare burden. In the U.S. alone, over $28 billion are spent annually. The current prevalent method for detection is the standard two-day bacteria culture. Faster detection using biosensors often requires specialized equipment that is costly. In addition, these methods are often limited to detecting a single type of bacteria. The goal of this project is to build a cost-effective point of care device capable of producing an accurate colorimetric diagnosis of bacteria in liquid samples within 15 minutes. Our device will focus on detecting Staphylococcus aureus and Escherichia coli, two common causes of nosocomial infections, individually and combined on a single device with an ideal 10^3 CFU (colony formation units) LOD (level of detections). The device is based on lateral flow assay (LFA) platform. The mechanism of detection is the use of specialized label-free iron oxide nanoparticles capped with copper sulfide. These particles will allow the visualization of the bacteria to the naked eye via the use of specific antibody test lines. Because the particles use a label-free detection method, they have shown promise for binding both gram-negative and gram-positive bacteria. This opens the market to customizable pre-built bacterial LFA strips that can be easily modified to detect any bacteria that the user desires.

66 – Deep Learning Neural Network for Light Field Microscope

Nicholas Laudermilk, Murtaza Khokhar, Xi Hau Tan, Nowshin Faiza
Advisor: Juhyun Lee
Bioengineering Department

Light field microscopy (LFM) is a 3D-imaging technique requiring only a single photograph. By placing a microlens array into the optical train of a standard microscope, light fields of a subject may be captured. This allows us to capture angular information at the expense of some spatial resolution, resulting in a low-resolution image. Our project aims to address this problem by implementing a deep learning neural network to enhance the output resolution of the LFM System trained on high-resolution light-sheet images.

68 – LM Wearable

George Scott, Henry Aguirre, Easton Bryan, Eric Henderson, Jacob Rendon, Robert Ringo
Advisor: David Wetz
Electrical Engineering Department

Many wireless authentication systems have become obsolete and create vulnerabilities for the homes and businesses that rely on them. For example, traditional Radio Frequency Identification cards have become notoriously easy to clone since they have no on-board security measures. This issue is addressed with Near Field Communication, a subset of RFID where the transponder can authenticate the reader before giving up its ID. Now NFC has been successfully adapted for several applications requiring extensive security, such as credit cards and Disney's "Magic Bands". Magic Bands are wrist-worn devices that serve as highly secure wireless park tickets. The biggest known vulnerability of NFC is the case when the transponder falls into the hands of an unauthorized user. As a result of this vulnerability, Disney is required to check either the biometrics or photo ID of the park goer after their ticket is scanned. Unfortunately, this takes away from the autonomous and seamless nature of a wireless authentication system. The purpose of this project is to employ current technology and design a highly secure wireless lock and wearable key pair, where the devices will communicate using NFC, and the key features an additional on-board authentication method capable of verifying its user.

69 – Pellet Extruder

Christian Tindula, Logan Hutton, Elliott Andress, Khang Tran
Advisor: Paul Davidson
Mechanical and Aerospace Engineering Department

The Laboratory of Advanced Materials Manufacturing and Analysis has recently purchased a Kuka KR70 2100 robotic arm along with a pellet extruder system to create a large scale FDM 3D printer. This pellet system will be used to extrude a variety of materials. This has made it necessary to invest in a new system to weigh and dispense different pellet materials in batches to allow for a multi-material part to be printed. To do this 3D Distribution Systems will be developing a new system that will be able to take two different materials in bulk pellets, weigh the materials separately, and dispense them to the pellet extruder system printer head in predetermined batches in a fully automated system.

70 – Fixed Wing 3D Printed Aircraft: Fire Flies Corp.

Adrian Ly, Jorge Vaca, Faisal Zainal, Mojave Gomez, Guadalupe (Lupita) Cancino
Advisor: Robert Taylor
Mechanical and Aerospace Engineering Department

Fire Flies Corporation will compete at the 6th annual 3D Printed Aircraft Competition. The team will be one of three groups from UTA competing in the Fixed Wing Category. The goal as a team is to design, build, and fly a modified 3D printed aircraft for a minimum of 15 seconds at the annual competition. A team of five engineers at F.F. Corp. will work together to improve the model finished by AeroFusion in May 2021 while still meeting all requirements of the competition. The 3D aircraft model from the previous year is inspired by the Army UAV Raven. For this competition, all airframe components, including all aerodynamic surfaces, must be printed using purely 3D printing technology. It is important to consider that there are no size, configuration, weight, or material restrictions. Fire Flies Corp. has been selected to use the HP MultiJet Fusion 3D printer at UTA, where the team will use nylon powder to print their components. Fire Flies Corp. will primarily focus on test printing and performing stress analysis. Sufficient time will be spent analyzing and bettering our prototype to improve our design accordingly as analysis suggests.

71 – Underwater Propulsion Device

Jordan McCool
Advisor: Raul Fernandez
Mechanical and Aerospace Engineering Department

Creation of an underwater propulsion device capable of propelling a scuba diver up to 3 miles per hour. The device must be safe for use up to 130 feet of depth and run for one full hour between charges.

72 – Mars Rover Proof of Life Module

Nikchey Khatri, Bibek Adhikari, Sandesh Dhakal, Rishab Rijal, Rakesh Yadav
Advisor: Alan Bowling
Mechanical and Aerospace Engineering Department

A proof of life module is a sample collection module assembled into a built-in Mars rover. Our project aims to compete in an annual University Rover Challenge competition, which requires building a module that can drill soil samples from multiple sites, collect and test the sample on-site, and provide feedback for the presence or absence of life. The sample module contains a drilling system that can drill the soil sample and a vacuum system to collect the soil sample and deposit it into a transparent beaker. The beaker is installed with lipids and proteins that can change color if life is on the soil. A camera records and sends the result from the science test to a site located about a mile away. These systems are controlled using Arduino programming. Although there has been substantial improvement in space exploration recently, we have yet to detect life in the extraterrestrial universe. The research involved in building a rover can play a significant part in the future Mars expedition and us winning the URC competition is one of the first steps in this long journey of space research.

73 – Portable Speed Measurement Device

Tolulope Ogunsola, Prabin Gautam, Huy Thien, Nishan Shrestha
Advisor: George Kondraske
Electrical Engineering Department

Despite speed limit signs, driving over the speed limit has been an alarming issue in project sponsor Jesse Lee's neighborhood. Reckless driving in the area has made the neighborhood unsafe. The client has contacted the city council about this, but the city council does not think that this is a problem in the neighborhood. To solve the issue, the team is working with the sponsor to make a portable vehicle speed measurement system that would alert drivers to stay within the speed limit which will ultimately help reduce the number of speeding vehicles through the area. The system will utilize radar to measure vehicles' speed accurately and be able to collect and store data, which encompasses pictures of the violator cars tagged with their respective speeds. The data will serve our client as concrete evidence to draw the attention of the city council to address the issue and provide a solution. The portable speed measurement device will be able to run autonomously with little to no human interaction. It will harness solar power to charge the secondary battery used to power the circuit which makes it a self-sustainable system. Data is sent through a wireless connection to the client's network which can be viewed easily by logging onto a website. The system will be designed to be truly portable in the sense that it can be carried easily to any other location while achieving its purpose just by connecting it to a new location's connection.

74 – Autonomous Drone Structure and Propulsion

Alejandro Araujo, Ashley Van Ausdale, Alejandro Ortega Garcia, Andy Ho, Sean Larson, Rogelio Castillo
Advisor: Bob Woods
Mechanical and Aerospace Engineering Department

This project is a collaboration between engineering disciplines, including mechanical, electrical, and computer science and engineering. This project covers the mechanical engineering team's work which includes selecting the propulsion system and designing and manufacturing the frame, motor mounts, landing gear and electronics housing. The propulsion selection was finalized in the fall semester and saw multiple iterations until the team's size, thrust-to-weight ratio, and flight time requirements were satisfied. The frame and motor mounts were designed to be as lightweight as possible and compliant during landing. The electronics housing holds all the sensors and electronic components in a compact, yet easy to service configuration, with major design consideration given to weight reduction, structural stiffness, and stability in flight. The landing gear has been iterated and tested multiple times to ensure that it can protect the drone from a fall from 20 feet up. The complete drone will compete in a competition on April 23, 2022, where it will be judged based on four autonomous tasks. The first task is to lift off, fly thirty yards, and then land. The second task is to lift off, search for our UTA logo, and then land on the logo. The third and fourth tasks, respectively, are to lift off and navigate through an obstacle course with and without GPS.

75 – Mars Rover-1 Gripper Team

Mahin Maharjan, Taylor Trower, Miguel Arreguin, Ujjwal Khadka, Aditya Jha
Advisor: Alan Bowling
Mechanical and Aerospace Engineering Department

Our senior design project is to develop a fully functional gripper for the UTA Mars Rover team. The Gripper is designed to perform tasks in the University Robotics Competition (URC). The task involves gripping and lifting various objects, typing on a keyboard, flipping switches, inserting a USB drive, and tightening a bolt. It is under 2.5 pounds and has two subsystems, claw and yaw, allowing two degrees of freedom for precise movement and control using a joystick. The claw subsystem opens and closes the claw to perform necessary tasks in the URC, while the yaw subsystem controls the swing of the hand to correct the alignment of the Rover arm. It is designed for easy removal from the rover arm with a quick disconnect through the rotation connection for any onsite repairs that may occur during the competition.

76 – PLATH Corporation: 3D Printed Aircraft

Damilola Arowosafe, Shiliang Li, Regmi Pramishan, Rebekah Hardee, Thao Ngoc Tran
Advisor: Robert Taylor
Mechanical and Aerospace Engineering Department

Our senior design project objective is to design and manufacture a 3D printed aircraft for the fixed-winged category of the upcoming 6th annual 3D Printed Aircraft Competition. In accordance with the competition rules, all airframe components will be 3D printed while the propellers and other electronic components will be commercial off-the-shelf hardware. After a maximum initial propulsion of 8 seconds, the aircraft will operate safely within a 300 ft. by 160 ft. by 30 ft. area during the competition. Weighing under two lbs., this lightweight aircraft will have a wingspan of 34 inches and an overall length of 36 inches. The aircraft will have an electrical system with a transmitter, two servos, a brushless motor, receiver, ESC, and a battery that can last 15 minutes of flight time. The fuselage and wings will be printed into five sections each to minimize print time. The airplane will have two control surfaces consisting of two elevators and a rudder, connected to the horizontal and vertical stabilizers respectively. This fully working aircraft will be delivered to our client.

77 – 3DPAC Aircraft Competition Fixed Wing: Minute Made

Ryan Bailey, Emanuil Borisov, Jorge Mendoza, David Jones, Isaac Willis, Connor Duncan
Advisor: Raul Fernandez
Mechanical and Aerospace Engineering Department

Minute Made will be competing with a lightweight aircraft which incorporates modern RC electronics that allows for extended gliding time once it is no longer under propulsion. Electronic propulsion, flight control, and the ability to glide will allow for the plane to be thrown to a peak altitude, propelled for 8 seconds, and glide down – allowing for the longest possible controlled flight and time.

78 – ASHRAE Design Challenge

Jonathan Yamashita, Zachary Pennington, Nischal Maharjan, Min Karki
Advisor: Raul Fernandez
Mechanical and Aerospace Engineering Department

Dino Flo United is selecting a heating, ventilation, and air conditioning (HVAC) system based on the building's cooling and heating loads calculated for a performing arts building being built in Sydney, Australia. The building has a total area of 23,300 square meters and will feature multiple facilities including offices, classrooms, studios, an auditorium, food services, parking, and performance halls. Three HVAC systems will be selected and compared to meet the owner's budget and requirements based on the use of life-cycle cost process for the applicable climate, sustainability process in ASHRAE Standard 189.1 and environmental impact. The selected system will then be ranked based on the pros and cons of each system and compared to fit the requirements and budget of the owner. The load analysis and life-cycle cost analysis for the model building will be done using TRACE 3D Plus. Schematics for each system are designed to optimize efficiency and space utilization.

79 – Golf Alignment Corrector

Daniel Merworth, Jason Combrink, Martareis McGuire
Advisor: Raul Fernandez
Mechanical and Aerospace Engineering Department

Golf is a multibillion-dollar industry with thousands of products on the market that claim to improve a player's game. None of these products (with the exception of alignment sticks) focus on improving the shoulder alignment, which our client believes is the key to an effective swing. Fox Inc. wants to make a device that lets the user know if the shoulders are in proper alignment, in order to make the golf ball go in the intended direction. The client has a device developed, but they would like it to be improved. The current version of the device utilizes infrared sensors to measure the distance between the golfer and the device. The two points on the golfer and the sensor are located and the device tells the player if the shoulders are aligned. The device, however, is not as accurate as the client would like, especially for taller golfers.

80 – Autonomous Wheelchair Transportation System

Joseph Tyer, Javier Garcia, Gregory Myrick, Michael Murphy
Advisor: Brian Huff
Mechanical and Aerospace Engineering Department

Using an Omron LD-90 in conjunction with a wheelchair, a system will be established to autonomously transport airport travelers with reduced mobility between security checkpoints and their corresponding flight terminal. The unique wheelchair will be constructed from 8020 extruded aluminum to support the passenger and luggage. The Omron LD-90 will be capable of identifying the wheelchair and properly attaching itself to it through the use of its onboard lidar system and external sensors. The interface between the wheelchair and the Omron will be an alignment mechanism which allows for proper alignment and a secure connection between the two. The lidar system on the Omron will be utilized to maneuver itself around the airport, avoid human traffic, and establish its position relative to its onboard map. Individuals that use this system will be able to enter their boarding information onto a Human-Machine Interface (HMI) which will also have an emergency shut off button in case anything goes wrong.

81 – Operational Space Control

Luis Nieves, Ravi Gyawali, Prakriti Pandey, Sanjeev Tamang
Advisor: Alan Bowling
Mechanical and Aerospace Engineering Department

We will develop and implement the controllers used for the UTA Mars Rover arm. We will use a type of controller that is called operational space control. This controller is one of the most sophisticated because it leverages forward kinematics making paths that are more direct.

83 – A Strategy for CFD Simulation of Flow in Nozzles

Emily Tran, Andrew Acosta, Hao Luu, Aaron Peart
Advisor: Bob Woods
Mechanical and Aerospace Engineering Department

Conventional fluid flow in Venturi nozzles and orifices have long been related to the Reynolds number for its dependable characterization of fluid systems. However, while a fluid's viscosity is a significant factor in the Reynolds number, it is not a significant factor in nozzle flow simulations when determining the discharge coefficient of the nozzle. Using the Reynolds number would present a very tedious and iterative process to calculate a discharge coefficient through computational fluid dynamics modeling. The FloWood team was founded in 2021 by four senior mechanical engineering students whose mission is to provide nozzle analysis for verification that the customer's new non-dimensional number can be used instead of the Reynolds number to derive a discharge coefficient. This new number accounts for all non-ideal losses and factors such as the consideration for the Reynolds and Mach numbers by using the pressure differential. The work displayed will showcase and summarize FloWood's solution products that the client has received for air and water of several nozzle configurations, as well as simulation data for the client's physical 142.5 nozzle for various other fluids.

84 – Development of a Formula SAE Electric Drivetrain

Gabriel Nava
Advisor: David Wetz
Electrical Engineering Department

An electric drivetrain is being developed for the 2017 UTA Racing Formula SAE car. A proof of concept and a test mule will be delivered to the FSAE team for the development of the 2023 car; therefore, the system will be constrained to the 80 kW and 600 V limits of the current FSAE rules. The IC engine will be replaced by a single electric motor. The chosen motor has a peak power of 68 kW and peak torque of 140 Nm at 200 ARMS. The torque will be transmitted to the rear wheels of the car through a chain from the motor to the differential as it normally is in an IC car. The motor will be controlled with an inverter rated for 800 VDC and 200 ARMS. The battery will be built using 120 off-the-shelf Li-ion building blocks to achieve the required voltage of 500 VDC and range of 22 km. A drivable car will be delivered to the FSAE team capable of withstanding the typical testing procedures of a Formula SAE car such as skid-pad, acceleration, autocross, and endurance.

85 – A Vascular Stent Delivery System with Hands-On Experience for Children's Science and Technology Museum

Kevin Cao, Amie Kieu, Ryan Pham
Advisor: Charles Chuong
Bioengineering Department

Atherosclerotic plaque forms due to the buildup of cholesterol and fat in coronary vascular wall (luminal diameter < 2 mm), causes restricted blood flow and likely ischemia or stroke. Balloon angioplasty and vascular stenting procedures, performed nearly 1 million times each year in the U.S. alone, have saved lives for patients who otherwise face the consequences of cardiac arrest, including death. The procedure restores blood flow and oxygen to cardiac muscles to help restore heart function. This project aims to educate young children through hands-on experience and visualization of the step-by-step procedure, to understand the basic working principles of the system and how the system helps patients, and to appreciate the significant role engineering plays in the well-being of our society through health care delivery. We will develop a scale model of the vascular stent delivery system with a clear, plaqued luminal wall (diameter at 60 mm or larger) that allows visualization of the step-by-step procedure for children visiting the Children's Museum of Science & Technology to perform a vascular stenting procedure with their hands. The experience includes the insertion of the catheter, navigation, positioning and deployment of the stent through balloon inflation and withdrawal and retrieval of the balloon/catheter. Finally, they witness the differences in blood flow near the lesion site before and after the procedure to appreciate the effect of the treatment. Through their interactive hands-on experience, we hope to incite children's curiosity, interest in engineering, and the application of engineering to solve problems in health care delivery.

86 – Electric FSAE Race Car

Braulio Becerra, Umanga Baral, Himal Bista, Prajwol Acharya
Advisor: Bob Woods
Mechanical and Aerospace Engineering Department

With the car market moving from combustion engine vehicles to a full electric vehicles, one could say that the future for transportation will be electrified. Therefore, team Retro-E is designing an electric race car with the use of an already built and designed space frame chassis from the UTA FSAE '17 car. With F17's chassis, modifications were made so that both accumulators, better known as battery packs, and a single chain-drive system that connects the electric motor to the differential can be mounted in the car. The container for the accumulator and the chain drive are put through finite element analysis to ensure that a minimum factor of safety is met. Furthermore, it is essential to cool the accumulators. With the use of computational fluid dynamics, a fan can be selected to ensure the accumulators will not exceed a critical temperature and provide sufficient air flow to the container. Finally, the last portion of the car would be to select a radiator, pump, and fan to cool the electric motor and provide the correct amount of coolant to the radiator and motor and make sure that the fan will keep the coolant at a certain temperature. In designing the packing components and other modifications to the car, each component and change must comply with the FSAE 2022 rulebook to make sure that the designs can later be used on an updated chassis to compete in FSAE E-car competition.

87 – Lightweight Wearable American Sign Language Translation Device

Ruqaya Abdulzahraa, Savannah Chiweshe, Mahri Kadyrova, Ridhaa Shariff
Advisor: Oguz Yetkin
Bioengineering Department

The main goal of this project is to create a lightweight, wearable American Sign Language (ASL) translation device. Our device features a gloveless design with no necessity for it to be connected to any external computers, monitors, or network. It is composed of five wireless fingernails and five wired rings that are connected via thin wires to a wrist-worn central processing unit. The CPU is composed of an Arduino Mega, a Raspberry Pi 3, and a 9V battery and is encased in a box-like enclosure that features an LCD screen mounted on top for visual output as well as a speaker mounted on the side for audio output. The device will achieve hand gesture recognition using 850 nm infrared (IR) light-emitting diode (LED) emitters in the fingernails and rings. The IR LEDs in the rings will trigger the IR LEDs in the fingernails and thus turn them on. Each ring will have IR receivers that will be able to measure the intensity of the signals produced by the IR emitters in the fingernails. They will then send this information to the wrist-bound Raspberry Pi to translate it through a trained neural network and produce the corresponding letter to be displayed.

88 – DFW Airport Catalyst Center

Leo Rodriguez, Jordan Williams, Jason Chen
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

The Dallas Fort Worth International Airport is located in the Metroplex area, which is home to 24 Fortune 500 companies and 33 local colleges and universities. Due to DFW Airport being in the fastest growing region in the United States, they are in need of a new community-based lab where subject matter experts, contractors and local university researchers/students can access an on-site laboratory. Our team will design the initial lab to have open work areas with quick prototyping tools for product innovation and design.

89 – Calyan Wax Co.

Troy Philip, Silvanus Saju
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

Calyan Wax Co. is candle company based in North Texas where they make candles from scratch using natural, soy-based wax and various fragrances infused. Due to their rapidly growing business and increased success and demand, they are in the brainstorming process of possible ways to improve their production to satisfy the demand and needs of the customer. This project aims to increase production to meet customer demand and increase revenue. To do so there are various aspects of the production facility that are limiting the rate of production, such as but not limited to: The layout itself, as there are many big moving machines and inefficient use of space; reduce manual labor and possibly increase automation for menial tasks specifically; and proper and efficient storage space for candles going through the process of cooling. The current capacity with the floor plan produces around 2000 units and with some additional fixtures and efficient rearrangement and automations, the planned capacity is around 3000 units by the end of the year.

90 – Waste Reduction and Inventory Control at National Door Industries

Cameron Klein, Blessed Emurese, Adrian Estoga, Phyllicia Gitumbi
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

One of the many garage door parts produced by National Door Industries (NDI) are garage door window frames, which improve the aesthetic and functionality of garage doors. NDI's manufacturing process involves cutting a significant amount of raw material to make these frames, which produces a large amount of waste. Our Capstone project focuses on analyzing their raw material sizes and minimizing them to reduce waste, while also implementing an inventory control system to better match production with demand.

91 – Siemens Switchgear Missing Parts

Arafaa Khan, Fady Girgis, Mohammed AlJameel, Aries Ivy
Advisor: Jamie Rogers
Industrial, Manufacturing and Systems Engineering Department

Siemens' switchgear production process begins from the fabrication department to the assembly department. Fifty percent of the jobs in the process reported missing parts as per the 2020 NCR (Non-Conforming Report). These missing parts affect the mechanics in charge of assembling, resulting in increased downtime as they wait for reordered parts. The focus of our work will be in the front-end and back-end workstations in the switchgear assembly department, where we plan to reduce missing parts and downtime for mechanics waiting on replacement parts needed. The report goes into further detail about the initial data we are received and expected impact after reducing downtime, in addition to the customer and stakeholder needs and requirements.

92 – Raytheon Drone Competition

Hayden Lotspeich, Mohamed Mohamed, Tyler Westbrook, Cameron Brown, Victor Tovar
Advisor: Chris McMurrough
Computer Science and Engineering Department

A competition/project that will have a drone complete multiple tasks autonomously. Examples of tasks include flying to a certain location, searching a field for a school logo, and obstacle avoidance.

93 – Aerial Penetration Tester

Benjamin Knight, Michael Bonnet, Michaela Hay, Jorge Estrada, Jose Ibarra, Kartikey Sharma
Advisor: Chris McMurrough
Computer Science and Engineering Department

This project is sponsored by Elbit Systems, who wanted to prove the concept that hacking can be done through a drone. Our basic system requirements are to gain access to a target system on an open wifi network via drone. In short our drone carries a payload with hacking capabilities that are executed remotely through LoRa radios.

94 – Positron Rover

Daniel Marks, Deborah Jahaj, Kamal Karkidholi, Oscar Mariscal, Nathan Fusselman
Advisor: Chris McMurrough
Computer Science and Engineering Department

The Positron "Post Driving" Rover is a robotic solution to moving to a given GPS point, marking that point and then assisting in driving an object into the ground. This solution would be particularly helpful on construction sites where driving rebar into concrete is tedious and expensive. There are many other useful applications for a robot with these capabilities, including constructing fencing and guardrails.

95 – ERB Postal Service

Jonah Bui, Connor Dominguez, Anh Tran, Ian Klobe, Burhanuddin Chinwala
Advisor: Chris McMurrough
Computer Science and Engineering Department

The Engineering Research Building (ERB) is crucially missing visible technology that can be seen by incoming students, potential applicants, and other UTA personnel. As an engineering building, one would expect highly innovative tech seen around the building, but there is nothing. There is nothing to inspire these people and to reaffirm to them that they are studying engineering here at UTA. At the same time, students need help carrying large packages across the ERB. To remediate this, we are implementing a robot that will navigate in the ERB to deliver packages through user requests.

96 – Desktop Assist for the Blind

Kushal Lamsal, Jacob Wilbur, Jason Shamayev, Amanda Whisenand, Jackcheal Dang
Advisor: Chris McMurrough
Computer Science and Engineering Department

We are looking to create a cheap headset to help the blind population in impoverished areas around the world. There are some on the market but none that are economical. More of the blind population would be able to read and have more agency in the things they are able to accomplish. We are going to build two key components. The first is going to be a human wearable device that can either fit on glasses or use some type of headband. The device will consist of a camera to scan documents, a microphone and a hearing piece so that the individual can listen to what was being scanned in. The second part is going to be an app that will facilitate the translation and the scanning.

97 – CableBot

Josh Burkey, Tia Benson, Samson Nguyen, Bryan Rodriguez, Chandler Black
Advisor: Chris McMurrough
Computer Science and Engineering Department

The Parallel Cable Drive Robot is a robot driven by flexible cables attached to the end effector rather than rigid links. Motors with attached spindles will draw and extend those cables to move the end effector as controlled by a Raspberry Pi. The purpose of the robot is to act as an eye-catcher for the UTA College of Engineering. The Raspberry Pi will be accessible through the bottom of the frame or through SSH. The Raspberry Pi will accept commands through SSH and then execute corresponding Python scripts to control the motors and cables, allowing precise control over the motion of the end effector and a payload of 2.27 kg.

98 – RV Travel Data Analysis App

Jackelyn Macias-Brijil, Mohammed James Shihabeddin, Angelica Magnussen, Minh Hoang Tran, Haroon Isse
Advisor: Chris McMurrough
Computer Science and Engineering Department

Recreational Vehicles are large motorhome vehicles that people use for road trips across the country. Generally, RVs are much larger and heavier than regular cars and cannot use typical GPS services such as Google Maps or Apple Maps because these services do not account for the dimensions and weight of a vehicle. Social Knowledge has created an RV trip planning service called RV Trip Wizard that allows users to get a safe and suitable route for their RV. This project will analyze historical data from RV Trip Wizard to identify RV traffic trends that can help new and existing users plan their trips better and provide safe conditions for users. Our team, RVago, will create a travel data analysis web app that will show map visualizations that reflect the travel habits of the RV community. These map visualizations include a heat map of intersection segments of most traveled roads RVers take, a heat map of the elevations of those traveled segments, and an animated heat map that shows through time where the RVers tend to travel.

99 – Night Walls

Sweekar Shrestha, Mohammad Abusalah, Eric Nwagwu, Showvik Das, Sunil Pandey
Advisor: Chris McMurrough
Computer Science and Engineering Department

Our project involves a series of projection mapping and interactive projections using computer vision technology and various design tools. We were presented with a need to improve the night life of downtown Arlington, and our project allows for a unique art projection to display and attract tourists and locals alike

in Arlington. We have used OpenCV, Mediapipe, MadMapper, and various other Python libraries to create an interactive projection environment for users to interact with.

100 – Human Assistance For Robot Arm (HAFRA)

Katia Lopez, Resha Adhikari, Nishan Pathak, Cesar Rea, Richard Tran
Advisor: Chris McMurrough
Computer Science and Engineering Department

The Human Assistance For Robot Arm (HAFRA) project is a Universal Robot, specifically the UR5 robot, that will be picking up envelopes from a conveyor belt and placing them into a bin. The robot will use human assistance to have a success rate of close to 100%. Industries will be able to use this robot in product lines to perform packaging or other tasks. HAFRA should be helpful with tasks such as bin-picking and grabbing items from a conveyor belt. This project will include human assistance that will oversee and fix any mistakes the robot has made remotely. Once implemented, the solution will increase overall productivity and ultimately reduce any errors or mistakes. The project has three major architectural layers which are the program, the UR5 robot, and the user interface. The program will send instructions to the robot to perform its task, which will be picking up envelopes with a QR code label off a conveyor belt and placing them into a bin. A RealSense camera will be used to detect the QR codes. In addition, the user interface will have human assistance for the robot to send a message to, if it detects something unique or a problem it does not have a solution to. A person will then be able to access the robot remotely and help the robot to fix the problem.

101 – AI-Enabled Multirotor UAV

Michelle Duong, Benjamin Barani, Mohid Saeed, Anh Nguyen
Advisor: VP Nguyen
Computer Science and Engineering Department

The scope of this project entails the creation of an AI-enabled multirotor unmanned aerial vehicle (UAV). The UAV will be a quadcopter and will have autonomous capabilities, provided by the use of a Jetson Nano and Pixhawk. A course, set by the stakeholder will consist of waypoints and obstacles. The main objective for the vehicle will be to navigate through the course autonomously from one waypoint to another while avoiding said obstacles.

102 – Multimodal Breast Tumor Localization Seed

Mayur Bhakta, Neaz Almir, Liban Gullied
Advisor: Baohong Yuan
Bioengineering Department

Needle/wire localization is a common procedure performed before a breast biopsy or breast surgery to locate a non-palpable breast tumor. However, this procedure poses several problems for patients as they experience a lot of pain and discomfort from the wire implantation and any slight movement of the body can shift the wire away from the tumor site. Our design aims to eliminate patient discomfort and provide a precise tumor localization mechanism for surgeons to excise tumors using various imaging modalities: X-ray, Ultrasound, and Ultrasound Switchable Fluorescence (USF). Our fabricated device is a biocompatible silicone seed containing fluorescent indocyanine green (ICG)-encapsulated nanoparticles that is imageable under the three imaging modalities. The silicone allows imaging under X-ray and ultrasound technologies, while the loading of fluorescent nanoparticles enables optical imaging using USF. Clinically, the device is designed to be inserted by a medical professional into the breast tumor via a medical probe which will then be removed along with the tumor during the excision procedure. The seed can be placed weeks prior to the scheduled surgery; therefore, serving as a temporary, secure, less invasive, more affordable, and comfortable method for patients preparing for breast tumor excision.

103 – Computational Modeling and Simulation of Hypertrophic Heart for Surgical Planning

Mustafa Aliasgar Khokar, Sudhir Pandit, Sydney Schmoeger
Advisor: Jun Liao
Bioengineering Department

Hypertrophic cardiomyopathy (HCM) is a condition in which the interventricular septal wall becomes abnormally larger and makes it difficult for the heart to pump blood, as the left ventricular outflow tract (LVOT) is obstructed. It is inherited and is found in one in 500 people and is caused due to more than 1400 mutations in more than 14 genes. There is usually a wall thickness of ≥15mm visible by computed tomography, echocardiogram, or cardiac magnetic resonance without presence of any underlying secondary conditions. Septal myectomy is a surgical solution to remove hypertrophy and normalize the blood flow by widening LVOT. Septal myectomy requires highly experienced surgeons who often have to deal with unexpected anatomy during surgery. We propose the use of 3D reconstruction of the images of the hypertrophic heart, providing surgeons with physical models with accurate dimensions during preoperative surgical planning. With this approach, we aim to increase the success rate of the surgeries and decrease complications. With the help of accurate 3D models, the length of the septal wall thickness can be accessed and the volume of the tissues needed to be removed be calculated pre-surgery.

104 – Portable Car Sterilizer

Tuyet Taylor Bui, Anthony Bui, Gunjan Gurung
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The purpose of this project is to design a portable car sterilizer that can homogeneously disinfect target areas using commonly obtained household items within four hours without damaging the interior upholstery of the car; it was also important that our device be safe for the users and the environment as well. With a given budget of $200, we have designed, fabricated, and tested a device that uses an ultrasonic vibrating disc to atomize our disinfectant

solution, 200 ppm hypochlorous acid, because it does not require an external outlet and is quiet to use, allowing for greater portability of the device. The device is fabricated via 3D printing ABS thermoplastic and assembled using epoxy glue. Simulation testing was performed using SolidWorks, and physical and functional testing measured and determined its efficiency in disinfection in vitro, optimal performance distance, and homogeneity of coverage.

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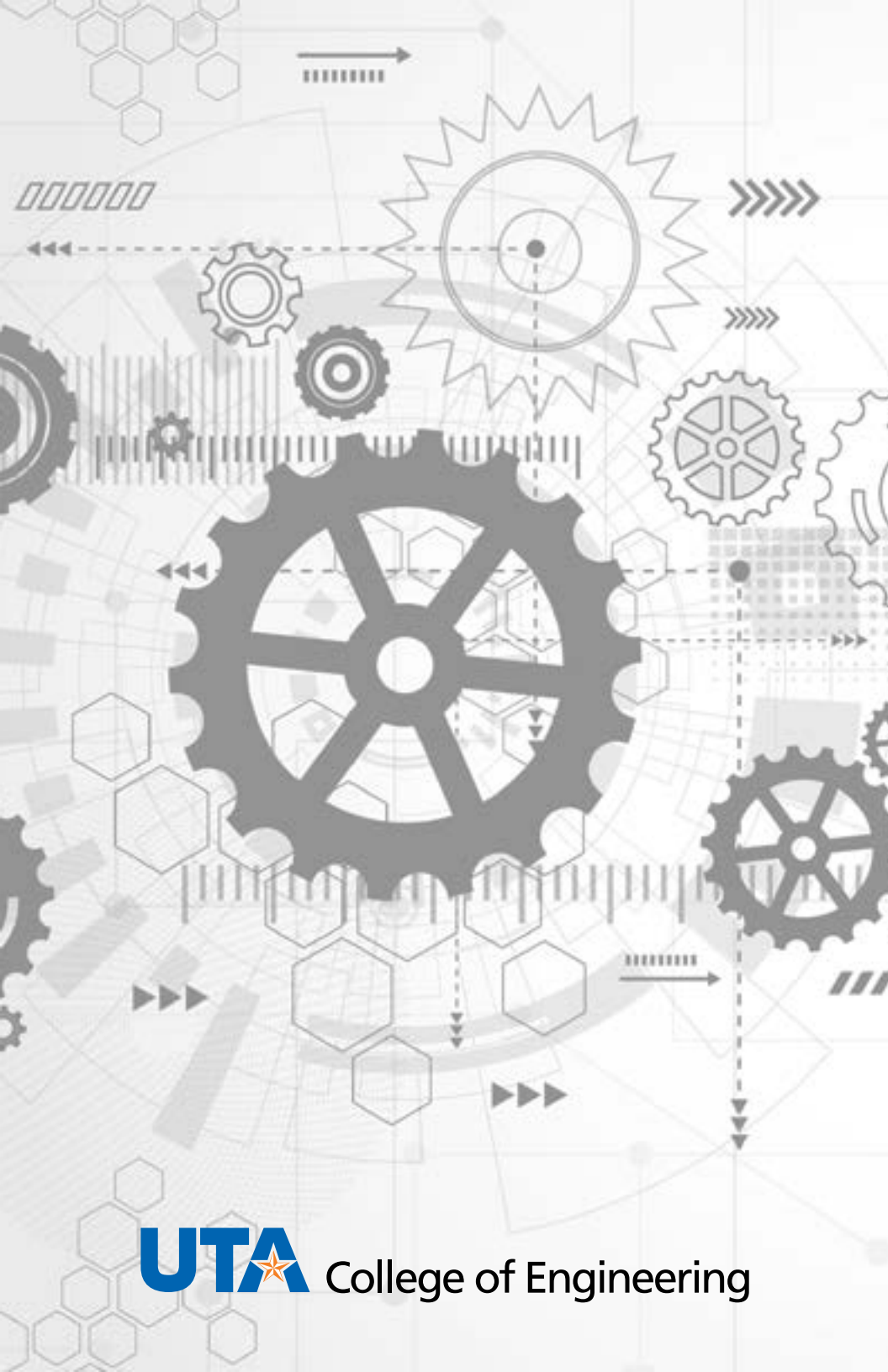
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