2020-2021
Senior Design Projects
LeTourneau University
Engineering & Engineering Technology

ACME

The purpose of the Additive Construction Materials Experimentation project is to develop a 3D tool carrier as the central module of an additive construction platform. The platform is designed to be a test bed for advancement in additive construction techniques and materials. This is a multi-year project. This year the tool carrier module is being designed and constructed to be adaptable in both load and path to meet multiple needs and objectives. This project will facilitate future research and development in materials and processes adaptable to additive construction for the Civil Engineering Department at LeTourneau University.

Faculty Advisor: Dr. Kraig Warnemuende

LETU Breathe

Wouldn't it be nice if our vitals could be measured while social distancing?

The purpose of the Breathe project is to design and produce a medical device that will allow medical professionals the ability to safely monitor patients' respiratory rate without intrusive equipment or direct contact with the patient. The plan includes use of a thermal camera to measure the patients' respiratory rate integrated into a user-friendly environment.

Faculty Advisor: Dr. Joonwan Kim

Flow
LeTourneau University
Engineering Senior Design Team

Gauging devices for water discharge measurement are used to estimate the amount of water flowing per unit time (or discharge) in engineered and natural channels. The information gathered is used by engineers and policymakers for flood control, water supply and irrigation planning, estimating runoff coefficients, and design of related hydraulic structures. The accuracy and precision of these devices is important to be able to make informed decisions. The purpose of the Flow project is to apply these civil engineering principles to the unique characteristics of the LeTourneau University retention pond and campus watershed. The project involves the design, construction, and field testing of various flow measurement devices. Laboratory and field testing will be conducted and optimum designs will be adopted for use in educational labs, including rainfall-runoff monitoring in the LETU retention pond and runoff coefficient computation for the LETU campus watershed.

Faculty Advisor: Dr. Yunus Salami

FRONTIER WHEELCHAIRS

In the developing world, powered wheelchairs are too expensive for most people who need them. Meanwhile, battery-powered wheels are decreasing in cost due to their prevalence in powered scooters and bicycles. The purpose of the Frontier Wheelchairs project is to design, build and test an electric wheel attachment that can be easily attached to existing wheelchair models used in developing countries. This addition will facilitate travel up to 12 miles over semi-rugged roads at up to 10 mph. In this application the device needs to require little maintenance and cost less than $300. This is a multi-year project conducted in partnership with Beeline Wheelchairs, a wheelchair factory in Guatemala.

Faculty Advisor: Professor Norman Reese

LEGRange

The purpose of the LeTourneau Emulated GPS Range project is to develop a wireless, license-free, robust GPS testing system along with an out-of-band attacker board and analysis software. The project will create a GPS Range and place it on campus for the purpose of running over-the-air testing and evaluation of adversarial signals. LEGRange is currently in year two of a three-year project in partnership with Sandia National Laboratories. In year one the focus was on research of the GPS range, designing and fabricating the receiver board, and beginning software development and modification.

In the 2020-21 school year, the technical scope is to develop the GPS range and the attacker, and to provide metrics of success as an output to the client. In year three the team will continue working to further mature the attacker, as well as implementing localization of the attacker based on client input. The GPS range/ constellation will consist of six transmitters and two receivers. The transmitters will receive authentic GPS signals and use it to discipline a fabricated signal over the Industrial Scientific and Medical (ISM) band. The receivers will take in both the authentic GPS signals and the emulated signals to compare their position solutions. Each device will leverage mature code provided through UT Austin's Radionavigation Lab in order to process signals.

Faculty Advisor: Dr. Nathan Green

The purpose of the LeTourneau Rehabilitation Engineering Project is to research and develop a robotic system to assist gait rehabilitation for individuals with motor impairment. The focus will be on a system that potentially enhances neuroplasticity in the central nervous system. Specific objectives are 1) to research and study the latest rehabilitation methods with sensorimotor integration, and 2) to develop a system, using both software and hardware, to implement neuroplasticity-enhancing methods to collect data. This work will become the foundation of the system to be used in clinical settings in the future.

Faculty Advisor: Dr. Ko Sasaki

The goal of LeTourneau University Nexus for Amateur Rocketry project is to participate in the Argonia Cup competition. In order to successfully participate, the project is to create a payload-bearing seven-foot rocket designed to reach a height of 8000 feet and deploy a payload for target acquisition. Once at apogee (maximum height), the rocket will deploy both the parachute and payload simultaneously and autonomously. The payload will be designed to autonomously seek the designated target through GPS and land as close as possible. The project will need to consider structural and fluid mechanics, aerodynamics, and the culmination of these fields pertaining to a launch vehicle system and a payload delivery system. For more information visit lunarletu.squarespace.com.

Faculty Advisor: Dr. Chad File

The Tandem Submerged Arc Welding Productivity Optimization project is the fruit of a partnership between LeTourneau University and Trinity Industries of Longview. In 2019-20 the project completed an initial effort using 9/16-inch plate, demonstrating routes to increase AAC SAW productivity, flexibility, repeatability, while decreasing the required operator welding skill level. The increase in productivity was demonstrated by application of parameters in a specific wire combination at increased speeds that produced welds acceptable in the current Trinity qualified welding procedure. The possibility of increasing repeatability and reducing operator skill level was demonstrated through application of a robot to perform the tack pass that precedes the two SAW passes. This year the goal of the project is to optimize SAW variables for welding 1-inch-thick steel plate in tandem wire feed SAW through welding experiments and process optimization. Specific objectives include: 1) Extend findings to one-inch plate; 2) Quantify the impact of root opening variability on weld quality; and 3) Investigate impact of heat input on weld heat affected zone toughness. The results of this work may enable further productivity improvements in the AAC SAW process and will identify the impact of SAW process variables on weld quality.

Faculty Advisor: Dr. Ezequiel Pessoa

SHEP

The purpose of the Specialized Herding Engineering Project is to develop a smart gate system to attract and guide herds to designated pastures while monitoring ambient conditions. The project sponsor is HerdX, a leading company providing innovative solutions in the global agriculture technology sector. This project implements HerdX's patented pastural rotation system to monitor herds (cattle and sheep) and manage herd behavior, reflecting environmental factors for optimal care of the animals (feeding, watering, etc.). This project includes developing a smart gate system to attract and guide herds to designated pastures. This involves applying renewable energy, autonomous gate control, wireless networking, and robust design to withstand weather forces and the livestock themselves.

Faculty Advisor: Dr. Hoo Kim

Sweet Shop USA, in nearby Mount Pleasant TX, is a leading manufacturer of handmade and specialty chocolates. In a process for packaging mint sticks for a certain client, the packaging was failing for an unacceptable number of chocolates. While they have been able to improve the process so as to minimize losses, there is still a large and growing inventory of failed packages containing usable chocolate. The Sweet Shop is sponsoring this project with the purpose of developing a system for recovering this chocolate. The project will involve research and experimentation with process equipment and solid/fluid properties of chocolate, with applications in process engineering and instrumentation and controls. The outcome will be a working solution to be deployed at the Sweet Shop that will recover the product from the inventory and be implemented into the current real time process.

SWEET SHOP USA®
HANDMADE CHOCOLATES

Faculty Advisor: Professor John Tixier

Persons with physical disabilities often find it difficult to get in and out of vehicles.

The main objective of the Transfer and Transition Objective project is to design, build and test a device that can effectively aid a person with a disability to get in and out of a vehicle safely and with ease. The device must be safe to operate and inexpensive to mass produce.

Faculty Advisor: Dr. Gitogo Churu

TAT