LeTourneau University

ENGINEERING & ENGINEERING TECHNOLOGY

2022 - 2023 Senior Design Projects

ACME: Additive Construction Materials Experimentation

3D printed concrete technology is a new and expanding field in the construction industry. Currently, there are no existing standards officially recognized for 3D printed concrete by industry, the standards being based on empirical material behavior. The purpose of ACME, the Senior Design team under Dr. Kraig Warnemuende, is to contribute towards the establishment of such standards by characterizing and predicting the material properties of 3D printed concrete and the scalability of 3D printed concrete structures. The ACME 2022-2023 team is in the process of implementing improvements to operational reliability and effectiveness of the printer in order to efficiently implement their proposed experimentation program.

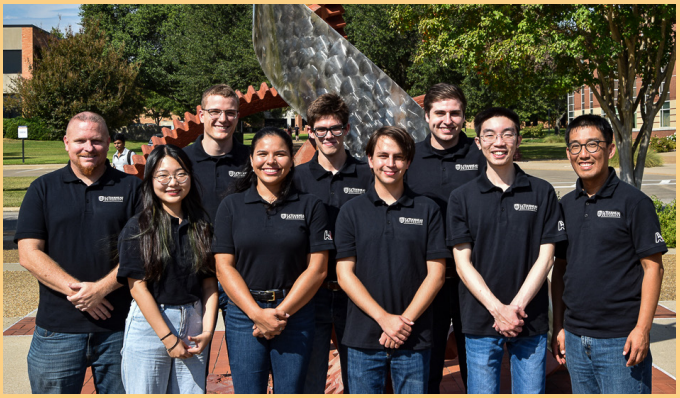
FACULTY ADVISOR: Dr. Kraig Warnemuende

FLOW: Evaluating Drainage Efficiency of LETU Campus

Picture a large dam used for flood control & irrigation. For flood control, the reservoir must receive then safely release rainwater to prevent flooding, while irrigation requires high water storage. LeTourneau University's retention pond performs this dual but conflicting functions and provides a good example to study. Previous teams designed hydraulic structures and performed hydrologic analyses to evaluate sustainability, drainage rates, and effects of reservoir inflow.

This year, improvements were made in hydrologic analyses, hydraulic design, electronic monitoring sensors, and their computer codes so that reservoir accumulation and potential overland inundation can be accurately estimated. This project helps students learn to efficiently perform the same design and mitigation decisions that engineers make in large dams and watersheds and involves application of upper-level courses like Hydraulic Analysis, Hydraulic Design, and Hydrology.

FACULTY ADVISOR: Dr. Yunus Salami



FACULTY ADVISOR: Dr. Hoo Kim

BADGER Creative: Big Autonomous Durable Goose Eviction Robot

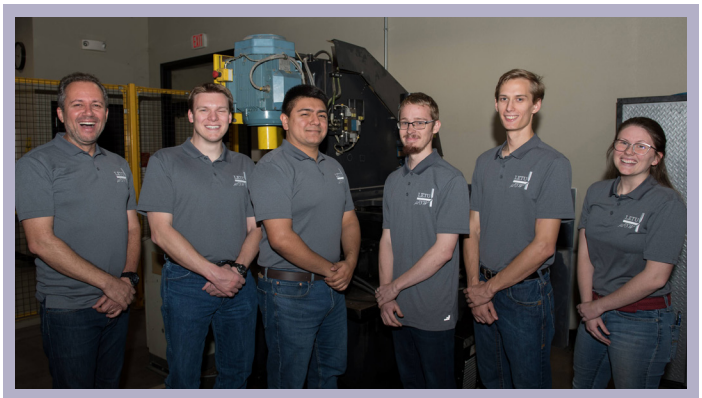
BADGER is an autonomous robot designed for installation on golf courses to autonomously chase Canadian Geese away. This year's team builds upon the work of three previous years' work on the project. The focus is primarily improving GPS path following and computer vision.

FRONTIER ROBOTICS

Frontier Robotics

The Frontier Robotics team will design and build two 15 pound combat robots and a combat arena, host a regional competition, and compete in the national robotics league competition in Kansas City. To enhance performance of the robots, a motor tester will be constructed and various motors will be tested for efficiency and stall characteristics. Various polymeric materials and configurations will also be tested to ensure safe containment of robot fragments within the fifteen foot arena.

FACULTY ADVISOR: Prof. Norman Reese



LETU μFSW

FSW: Friction Stir Welding

The microFriction Stir Welding (μFSW) senior design team, overseen by Dr. Pessoa aims to develop a corner joint for FSW for thin (1.5 to 3 mm) 6061 aluminum plates through a nine-month Senior Design project utilizing a Kielhorn lab equipment and performing literature review, concepting and building welding joints, fixtures and FSW tools, running experiments and characterizing the welded joints.

FACULTY ADVISOR: Dr. Ezequiel Pessoa

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TFRS: Triple Frequency Reference Station

TFRS is a GPS-focused project supported by a generous donation from Coherent Technical Services, Inc. (www.goctsi.com). TFRS will develop a calibration module integrated with a high-performance triple-frequency GPS receiver. GPS operates at three unique frequencies that can experience non-uniform delay during the signal processing the introduce biases among the signals. By identifying the timing bias between the three GPS frequency bands positional accuracy can be improved down the millimeter. Our team works with RF and high-speed digital circuit design, circuit board manufacturing, signal processing and analysis, filter design, and VHDL synthesis.

FACULTY ADVISOR: Dr. Nathan Green

LETREP23: LeTourneau Rehabilitation Engineering Project 2023

LETREP23 aims to design and develop a medical-grade rehabilitation device for individuals with motor impairment due to neurological disorders (e.g., stroke and spinal-cord injured patients). The device uses operant conditioning of the stretch reflex in the soleus muscle to reduce muscle spasticity. This is applying the concept of neuroplasticity to reduce the foot drop commonly seen in neurologically impaired patients. We are also collaborating with a team in the business department to develop a business model for the device, along with a team from the computer science department to create a video-game like interface to improve user engagement during the rehabilitation process.

FACULTY ADVISOR: Dr. Ko Sasaki

Q.E.D.: Quantification of Engineering Dynamics

Machine learning and other mathematical modeling methods can be used to predict the performance of engineered systems including new applications in potable water treatment. The proposed research is to predict operation and maintenance requirements of a rapid sand filter based on experimental measurements and mathematical modeling with machine learning.

FACULTY ADVISORS:
Dr. Andrew Davis & Dr. Darryl Low

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LEVIS: LeTourneau Engineering Vital Imaging System

LEVIS team aims to design and fabricate a portable device for the telehealth market that measures respiratory rate non-invasively using facial recognition and thermal imaging. Additionally, the LEVIS team is creating a cellular app to display the breathing rate measurement and publishing a research conference paper. The medical device builds on the prototypes developed in the previous years by Breathe and LEVI to improve the user interface, portability, and measurement accuracy.

FACULTY ADVISOR: Dr. Joonwan Kim

LUNAR: LeTourneau University Nexus for Amateur Rocketry

The LUNAR team is competing in the Argonia Cup Collegiate Rocketry Competition, in which the challenge is to design and build a high-powered rocket and also a payload vehicle to be ejected from the rocket to deliver a payload to a designated target on the ground. The rocket must be a two-stage design (have two individual motors that fire sequentially), reach a minimum altitude of 9,000' above ground level, and descend at a safe velocity. The payload vehicle is a quadcopter drone that must fit inside the rocket, withstand the forces of rocket flight, and be able to autonomously deliver a golf ball payload from wherever the rocket ejects it to the specified target— a journey of potentially multiple miles and 20 mph wind conditions! This project will need to consider such fields as structural and fluid mechanics, aerodynamics, rotor flight, and wireless communications in order to create a competitive rocket and payload system.

FACULTY ADVISOR: Dr. Chad File

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BAJA: Renegade Racing

Renegade Racing is LeTourneau University's SAE Baja Team. We are a multi-disciplinary team of students fabricating baja-style off-road vehicles to compete in national competitions.

Our objective is to design and build a small, fully functioning, one-passenger car able to take on rough terrain and meet the many specifications put forth by SAE.

The job of the team is not only to build this car, but to engineer, document, and create it in the most cost-effective way possible. The car is tested with high-stakes events including the 4-hour endurance race, hill climb, and maneuverability tests. LeTourneau's Renegade Racing has a history of success, with several Top-20 finishes in the last decade.

The goal this year is to successfully compete in the Oregon SAE competition held in Washougal, Washington in May 2023. This will be the first 4WD vehicle the team has attempted and the first competition in 4 years.

FACULTY ADVISOR: Prof. Jeff Johnson

FACULTY ADVISOR: Dr. Gitogo Churu

TATO: Vehicle Mobility Assist Device

People with physical disabilities often find difficulty entering and exiting vehicles. The main goal of the Transition and Transfer Objective (TATO) is to design and build a device that can safely transport a non-ambulatory person into and out of a vehicle. This will be achieved by creating a hydraulic wheelchair lift that can be operated by the user with as much independence as possible.