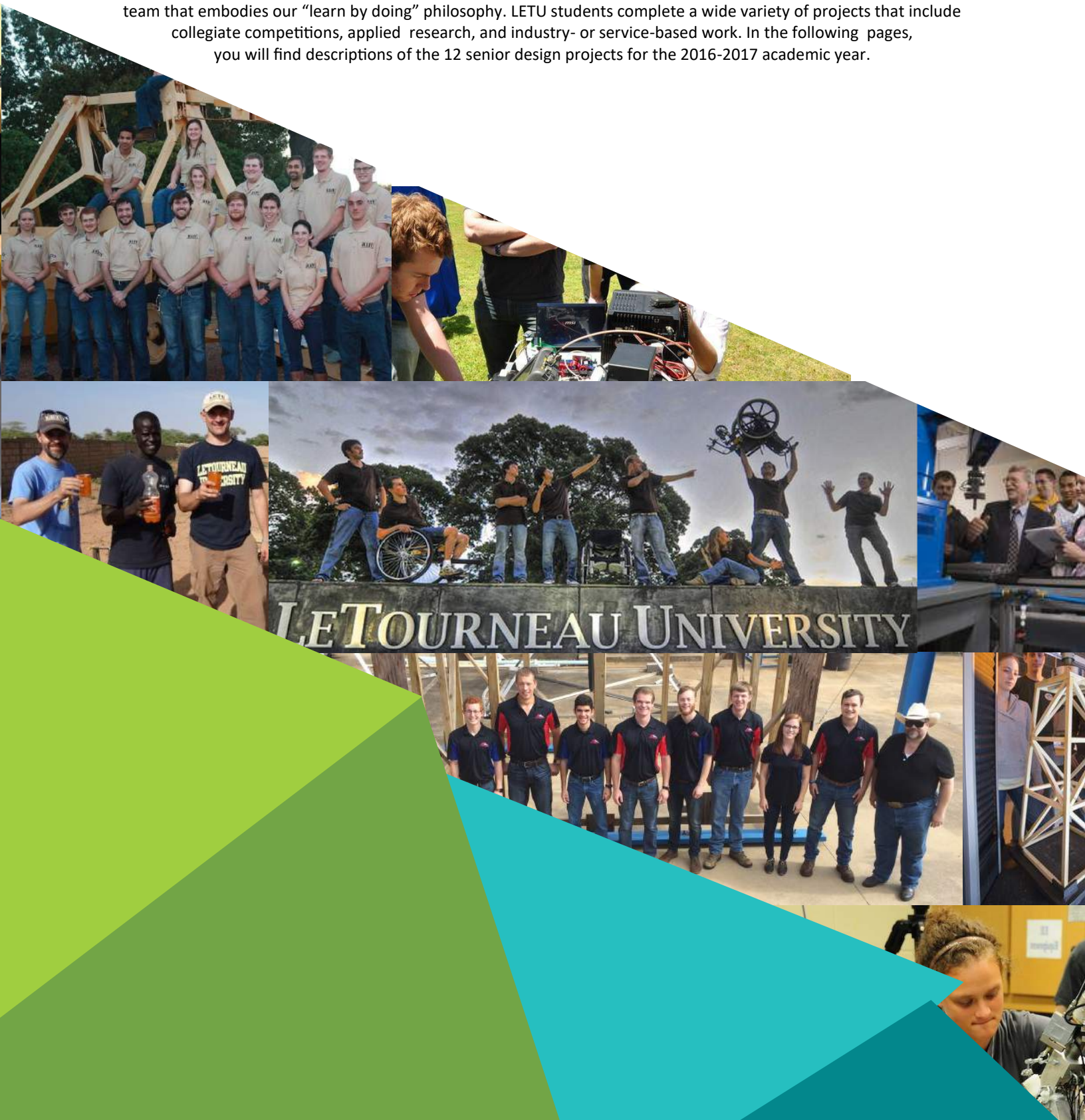
LeTOURNEAU UNIVERSITY

Engineering & Engineering Technology

— 2016-2017 Senior Design Projects —

At LeTourneau University, we implement engineering design and project-based learning throughout our entire curriculum. LETU engineering students participate during their senior year in a year-long capstone project as part of a multi-disciplinary team that embodies our “learn by doing” philosophy. LETU students complete a wide variety of projects that include collegiate competitions, applied research, and industry- or service-based work. In the following pages, you will find descriptions of the 12 senior design projects for the 2016-2017 academic year.



VACS

The goal of this year's VACS (Versatile ADS-B Communication System) team is to design and prototype a card or system of cards small and lightweight enough to be mounted on an unmanned aerial vehicle (UAV) and capable of generating and transmitting ADS-B data compliant with the RTCA DO-282B Performance Standard. The results of this project will greatly improve the ability of commercial aircraft and other ADS-B equipped vehicles to "see" UAVs, significantly decreasing the likelihood of mid-air collisions.

Faculty Director: Dr. Joonwan Kim

Typical Majors Concentrations: Electrical, Computer and Electrical Technology Engineering

The vision of the SafeHome engineering project is to provide the safety, security and dignity associated with a home to people in the wake of disasters. The goal is providing hope and a physical and spiritual foundation for rebuilding. The SafeHome project is working to develop disaster relief shelter technologies as a way of sharing the hope found in Christ with those in need. SafeHome shelters are engineered to be safe, sustainable, and culturally appropriate, providing devastated communities with a secure foundation for recovery and rebuilding. In this inaugural year of the SafeHome project, a team of 10 seniors are working to develop two concurrent shelter designs to be entered in the John Brown University Shelter Competition, which is sponsored and judged by Samaritan's Purse. The specifications for these shelters are targeted at responding to the Syrian refugee crisis in Greece. The competition requires designing and constructing transitional shelters that can accommodate a family of four while considering structural performance and durability, as well as environmental, cultural, and economic conditions. In April 2017, the team will travel to JBU to participate in the competition and subject their shelter designs to rigorous earthquake, wind, rain, heat retention, and habitability testing.

Faculty Director: Dr. David Dittenber

Typical Majors/Concentrations: Civil, Mechanical, Mechanical Technology

WAEVS

Water Automation and Electronically Valved Systems

The WAEVS team is a new project this year sponsored by Tripaga Inc., a Longview-area business that provides data acquisition and monitoring solutions for natural resource industries. Tripaga designs hardware and software solutions for monitoring and accessing remote sites such as oil well sites and water plants. Tripaga requested the WAEVS team to design and build a water plant control module to replace a currently used Turner Control System that was designed in the 1960s and has been a dependable, well-working device. The WAEVS team wants to develop a cost efficient, smaller, and more configurable controller that can be used to control water pumps and electrically operated valves for various small rural water supply systems. The goal of this project is to design and prototype a controller module with analog inputs received from level and pressure sensors and discrete outputs that will be controlled by user-programmable thresholds. The module will be able to serve as a retrofit upgrade to a currently used water plant controller.

Faculty Director: Dr. Joonwan Kim

Typical Majors/Concentrations: Electrical and Computer

STEPS

Specialized Transfemoral External Prosthetic Support (STEPS) aims to develop a prototype assistive device for transfemoral (above-knee) amputees. Transfemoral amputation significantly decreases the quality of daily activities due to the loss of musculature controlling the knee and ankle joints. The assistive device is to be cost-effective and attachable to users' prosthetic legs to stabilize the knee joints during daily motor activities, including stair climbing. One of the goals is to help those transfemoral amputees in under-resourced settings who cannot afford expensive micro-processor controlled knee joints.

Faculty Director: Dr. Ko Sasaki

Typical Majors/Concentrations: Biomedical and Mechanical Engineering

LeTourneau Structural Composites (LSC) is developing new structural product systems based on polymer composites. These systems will offer improved durability and performance compared with traditional options such as concrete, steel or wood. For several years, the team has worked on the bridge deck systems using fiber reinforced polymer (FRP) composites and polymer concrete. As a result of this work, last year's LSC team developed an improved polymer concrete formulation which significantly reduces material costs compared to earlier versions. This year's team will investigate the application of this new formulation on structural beam systems and will evaluate resulting system performance (long and short-term), fabrication methodologies and cost. Work will include structural design, fabrication, short-term static testing, creep testing and materials characterization for both conventional concrete and the new FRP/polymer concrete systems.

Faculty Director: Dr. Steve Ayers

Typical Majors/Concentrations: Civil and Mechanical

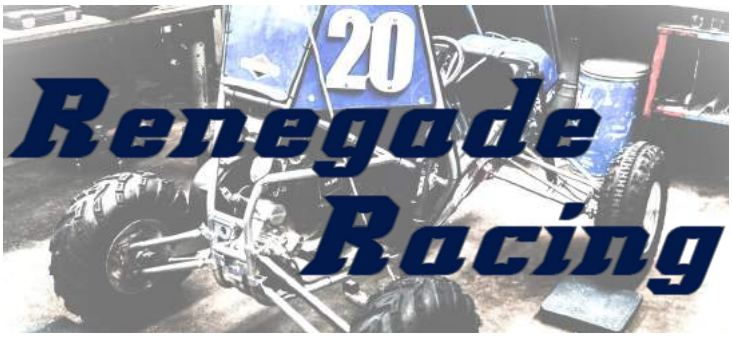
L A R C

LeTourneau Autonomous Robotics Competition

The primary goal of the LeTourneau Autonomous Robotics Competition (LARC) senior design team is to design and build a robot to compete in the 2017 IEEE Region 5 Robotics Competition. This year's competition challenges the sensing, navigating, learning and reading capabilities of an autonomous robot. The field comprises a top surface with obstacles, and the robot must detect an "underground" tunnel system to find and read an information cache. Scoring emphasizes rational search patterns, innovative sensing, computer vision, and accurate environment mapping. The LARC team will compete in IEEE Region 5 against other schools including the University of New Orleans, Texas A&M, and others.

Faculty Director: Dr. Joonwan Kim

Typical Majors/Concentrations: Electrical, Computer and Mechanical



SAE International® sponsors a Baja competition that requires designing and building a Baja vehicle that university teams take to at least one of three competitions. The Renegade Racing Baja team will design the entire Baja vehicle with complete documentation in the fall semester. The team will build the vehicle in the spring semester and take it to one of the three SAE competitions.

Faculty Director: Mr. Wes Downing

Typical Majors/Concentrations: Electrical, Materials Joining, and Mechanical

SULFIDE CONTAMINATION SOLUTIONS
2016-2017

Hydrogen sulfide (H_2S) is a contaminant frequently found in the flowback water that comes to the surface during the production phase of an oil or gas well. H_2S is a particular challenging contaminant due to the difficulty of measuring it in the water phase and its potential to volatilize to the gas phase where it can be lethal. Flowback water containing H_2S is typically disposed of by deep well injection via a disposal well rather than treating for reuse, resulting in significant water loss. This senior design project is the continuation of two previous years of work in which a small scale treatment reactor was built that successfully reduced H_2S concentration of synthetic flowback water by >80% as well as retrofitting an H_2S gas sensor to measure H_2S in the water phase. This year's team is tasked with completing the project with construction of a laboratory scale system that utilizes the H_2S sensor to optimize the treatment reactor performance and monitor outgoing water quality. This initial sensor-reactor system will be tested in the laboratory by treating a large quantity of synthetic flowback water at a known H_2S concentration. Dependent upon successful trials, the sensor-reactor system will then be taken to a functioning disposal well for testing for treatment efficiency of flowback water containing H_2S.

Faculty Director: Dr. Darryl Low

Typical Majors/Concentrations: Civil and Mechanical

DRS
DISASTER RELIEF SOLUTIONS

Disaster Relief Solutions seeks to provide for basic human needs in disaster areas and in the developing world. Rocket stoves are high efficiency stoves used for cooking, sanitizing water and heating. There is little fundamental understanding about what makes a stove "rocket" (draft in air so efficiently that the smoke combusts leading to less fuel use and lower emissions with less adverse health effects). Through heuristic research, we will determine the geometry requirements to allow others to build their own rocket stoves in both disaster areas and developing world scenarios. A complete design, build, test cycle is used. In addition, we are researching how to convert some of the waste heat to electricity to charge cell phones to facilitate essential communication. Additional research is going into options for field expedient stove construction techniques. We will not sell/ship stoves, but rather disseminate knowledge for adaptation by others for use in disaster areas and the developing world.

Faculty Contact: Dr. Scott Anson, P.E.

Typical Majors/Concentrations: Mechanical Engineering, Electrical Engineering and Materials Joining Engineering

ENGINEERED WATER SOLUTIONS

EWS is an ongoing project focused on the development of sustainable water technologies for remote villages in sub-Saharan Africa. Previous teams have successfully developed a low-cost, minimal-equipment drilling method for borehole-style water wells to depths of 80 ft. This year's team will focus on two areas. One focus is on well-commissioning and pumping after the initial borehole has been constructed. This work is essential for the establishment and long-term operation of wells. The second focus is on water purification using a simple distillation system. This work will enable EWS to expand its operations in the area of drinking water supplies. Technology developed during the year will be evaluated during field tests in Senegal in May or June 2017.

Faculty Director: Dr. Stephen Ayers

Typical Majors/Concentrations: Civil and Mechanical

RAIV
REMOTE AIRFIELD INSERTION VEHICLE

For those who intend to take the good news of the Gospel "to the ends of the earth," an estimated additional 1,500 remote airfields worldwide will be required. Existing airfield machines do well on trees and brush, but cannot do anything with rocks greater than 1 inch. Thus, several different machines must be used in concert, and purchased at a cost exceeding a half million U.S. dollars, at minimum, or the task must be done by hand, which is VERY slow. Some 1000' runway projects take years to complete or are never completed due to these difficulties. The RAIV project intends to conceptualize the specifics of a machine and a process to significantly aid in this task. Over several years, the project will design, fabricate, test, and deliver a functional machine and guidebook for remote runway emplacement.

Faculty Director: Dr. Jesse French

Typical Majors/Concentrations: Mechanical Engineering, Materials Joining, Mechanical Tech, Civil, MTAS

FRONTIER WHEELCHAIRS

Frontier Wheelchairs seeks to improve wheelchair design. With the goal of making wheelchairs strong and inexpensive, ease of use has, in some cases, been compromised in developing countries. One part of making chairs easier to use is using components that roll easier. Last year's team built a rolling resistance measuring machine for measuring rolling resistance of wheelchair large wheels. This year, the project will use that machine to characterize wheels for manufacturers from around the world. The design goal is to adapt the machine to also measure rolling resistance of small wheels and casters and use multiple measuring instruments. The team will be expected to publish results in a nationally recognized journal or conference.

Faculty Director: Norman Reese

Typical Majors/Concentrations: Mechanical and Mechanical Technology Engineering

LETU LeTourneau University

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