Not sure what a Biosystems Engineer is or what they do? This CI will encourage you to think about the world around you a little differently. You will see how your actions affect the ecosystem in which you live and the biosphere at large. Our world is more than just chemical and physical interactions. Get a glimpse into the possibilities of engineering in the realm of biological systems. May enroll in course directly. Wednesday 10:10 am - 12:05 pm. 424 Brackett

Sponsored by Civil Engineering

Project 2: Clemson ENGAGE ENGR 1900-060 Dr. Jennifer Ogle
ENGAGE was founded as an objective of the Clemson Office of Global Engagement to support the many communities impacted by Tropical Storm Erika that hit Dominica in 2015, and more recently the massive destruction that occurred from Hurricane Maria in September 2017. ENGAGE students come from many colleges on Clemson’s campus, with majors ranging from Civil and Biomedical Engineering to Economics, Education, and Health Sciences.

This CI project brings industry professionals, faculty, staff and students together to improve the living conditions of community partners in developing countries. Students work with faculty and industry team members on the technical aspects of the projects simultaneously networking and learning real-world skills that apply to their future careers. Students tackle developing world problems in a diverse setting, learn to communicate their research to a wide array of audiences, as well as improve their own resumes and online presence throughout the semester. Students have opportunities to travel to Dominica for break trips and work on projects related to clean water, health improvement, elementary education, agriculture, redevelopment and ecotourism, among others. TBA.

Project 3: Martian Soil Simulants ENGR 1900-223 Dr. Q. Chen
This project aims to explore various potentially Mars-compatible processes that synchronize novel composite materials from simulated in-situ Martian materials for the creation of functional building blocks. Examples of the processes the team has been or will be exploring include bio-cementation and thermoset polymeric materials. The created composites will be tested and characterized for their mechanical and physical properties. TBA.

Project 4: The Clemson Concrete Canoe Team (3CT) CE 1990-020 Dr. B. Putman
3CT is a student lead team (under the direction of a faculty advisor) that designs, builds, markets, and races a concrete canoe each year at regional and national competitions. This is a year-long project where the students learn and apply classroom knowledge and concepts to a real-world project. This knowledge includes: project management (organization, scheduling, finances, etc.); concrete mix design and materials; structural analysis and design; naval architecture; public relations; product performance and evaluation; sustainability; mentoring and education; communication skills (oral and written). May enroll directly in course.

Project 5: Emagine-A STEM/STEAM Outreach Program for K-12 Students & Teachers CE 1990-120 Dr. B. Putman
There is a critical need to extend engineering education beyond higher education and to expose younger students (K-12) to the engineering process and careers, especially with the recent national restructuring of the K-12 math and science curricula. This CI team will work with Clemson’s EMAGINE program to create activities designed to engage students and teachers in the engineering process and connect the dots between the concepts they are learning in their classes with the practical applications of this content. Student members of this team will also help deliver the content to K-12 students across South Carolina. This is a great service-learning opportunity where students will build communication and mentoring skills. May enroll directly in course.

Project 6: The Steel Bridge Team CE 1990-002 Dr. W. Pang
The Clemson University Student Steel Bridge Team challenges students to design, fabricate, and construct a model steel bridge. At regional and national competitions, teams are judged on construction speed, weight, and deflection for a prescribed loading scenario. The quality of fabrication and the aesthetics of the bridge are also considered in the final score. TBA. May enroll directly in course.
Project 7: Robotics with Lego Mindstorms NXT
ENGR 1900-010  Mr. Michael Wooten
This project teaches students some fundamentals of robotics, along with some programming. Each student will learn how to use and program the robotic pieces of a LEGO MINDSTORMS NXT kit, and will have to work as a group to complete a creative project for the end of the semester. All student backgrounds welcome, no experience is required. TBA.

GE students who are interested in Projects 8 -17 as their first choice should:

(1) Complete the ECE CI Approval Form, http://www.clemson.edu/cecas/departments/ece/document_resource/undergrad/CI_Approval_Form.pdf
(2) Interview with the instructor
(3) If approved, return the signed form to Ms. Patty McNulty, ECE course coordinator, 102B Riggs Hall.
(4) Do NOT enroll in ENGR 1900-999!

Project 8: Robotic System Design
ECE 1990-001  Dr. W. Reid
Design and build a robot to compete in the IEEE Southeastcon hardware competition. New students are accepted in fall terms only. Competition is held each spring. TBA.

Project 9: Machine Learning Applications
ECE 1990-002  M. Crawley Smith
Undergraduate students in the Future Computing Technology Facial Recognition Team are investigating distributed algorithms for biometrics and the use of accelerator architectures such as FPGAs, GPUs, and MIC processors to accelerate and improve the performance of these algorithms. The field of biometrics, specifically facial recognition, relies heavily on repetitive image processing but has yet to fully take advantage of the efficiency and parallelism offered by accelerator architectures.

Facial recognition is desirable over other available biometric techniques due to its ease of collectability and acceptability, and thus has the potential for use in a wide range of applications. However, due to the lower uniqueness of facial features and typical variations in image samples obtained because of environmental changes like illumination, temporal changes, and occlusion, the robustness of the facial recognition process suffers severely. Several facial recognition algorithms, including principal component analysis (PCA), independent component analysis (ICA), and linear discriminant analysis (LDA), have been researched extensively in comparative and independent studies.

Such studies have revealed that while each algorithm has advantages, none are accurate for all variations of input data, making robust identification difficult. Real-time recognition has also been hindered by the complex calculations and large memory requirements involved in this process. Our research exploits the inherent parallelism available in accelerators by implementing multiple algorithms concurrently to increase accuracy via fusion of results while improving decision time by exploiting the available parallelism. The successful development of robust biometric identification algorithms capable of high performance in uncontrolled environments is especially of interest to the intelligence community (e.g. CIA, FBI, Homeland Security) and would represent a major contribution to the field of biometrics. TBA.
General Engineering Creative Inquiry Choices – Fall 2018

Sponsored by Electrical & Computer Engineering

Project 10: Industrial Assessments  ECE 1990-004  Dr. R. Singh and G. Venayagamoorthy
This project is dedicated to training students to help with Clemson’s Industrial Assessment Center. Students will learn how to conduct energy audits around campus and will analyze potential efficiency projects which may be implemented by Clemson’s Sustainable Energy Fund. Students will work in teams to identify, plan, implement, and then monitor energy efficiency projects. They will then also track related sustainability metrics such as energy and greenhouse gas emission savings. Students should expect to enroll in this project for at least 2 semesters. TBA.

Project 11: Advanced Cyberinfrastructure Projects  ECE 1990-007  K. C. Wang
This creative inquiry project is hosted by the Center of Excellence in Next Generation Computing & Creativity, connecting students of all levels to advanced cyberinfrastructure research projects. Students will join active research projects to learn and help develop advanced networking and computing solutions, including but not limited to, software defined networks, cloud computing, high performance storage, big data computing and visualization. TBA.

Project 12: Novel Applications of Photovoltaics  ECE 1990-008  Dr. R. Singh
Due to constant reduction of prices of photovoltaic (PV) modules, the generation of electricity costs less than other energy sources. Without investing about $5 million per mile in long haul transmission of electrical power, the local generation of resilient and sustainable electrical power by photovoltaics is transforming the global electricity infrastructure. As a personal source of smart electrical power, we can use photovoltaics all over the world with minimum cost of electrical power infrastructure.

Team 1 is building a table that has electricity provided by a Photovoltaic (PV) system for charging laptops, cell phones, etc. The tables will be placed in the Watt Family Innovation Center. Team 2 is converting a golf cart so the source of power is from PV. This will demonstrate that PV integrated with Transport system (car, buses, trucks, rail, etc.) and coupled with a DC charging station (PV generates DC power and batteries store DC power) have the potential of replacing more than 90% fossil fuel based transport system. Students will learn real world engineering. Publications are expected. TBA.

Project 13: Future Engineers & Scientists  ECE 1990-013  M. Crawley Smith
This project uses an undergraduate/graduate mentored after-school program to excite elementary school students and recreation camp participants about STEM disciplines through hands-on project experiences. The program has operated at Clemson Elementary School since fall 2008 serving 4th and 5th grade students. Our objective is to expand this program to other schools, especially those in rural and predominantly minority areas. We will recruit and train undergraduate/graduate teams to work directly with partner schools in six-week modules during after school club or in-service programs.

Moreover, we will collect empirical data on the effects of the program on the longitudinal academic career paths of elementary students, as well as professional career paths of the undergraduate and graduate students involved. Finally, we wish to involve Education students to promote and develop new hands-on modules for K-12 classrooms, and to utilize PRTM students to expand our work in camp settings to meet the increasing demand. TBA.

Project 14: Robot Networks  ECE 1990-014  Y. Wang
The technological developments of the last decade in robots, computing and communications have led to the design of robotic and automation systems consisting of networked vehicles, sensors, actuators and communication devices. These developments enable researchers and engineers to design new robotic systems that interact cooperatively with human beings and other robots. Applications span surveillance/monitoring, manufacturing, intelligent vehicles, exploration, and many others. In this CI project, we will explore some basics of robot networks and build robotic cooperation using several intelligent ground robots available in the lab. No knowledge of distributed dynamical systems or robotics is needed. TBA.
General Engineering Creative Inquiry Choices – Fall 2018

Sponsored by Electrical & Computer Engineering

Project 15: Videogame Development-Fun Learning & Distributed Dynamical Systems  ECE 1990-015  Y. Wang
This project aims to develop a car racing video game to enhance the student learning experience of distributed dynamical systems and intelligent transportation systems. The project is built upon existing work which already created a sophisticated vehicle simulator, a game framework, and a graphics engine. Students will focus on developing an interface between existing work and student learning process. The game development itself will be a fun learning process. Knowledge of Linux and C++/C is preferred, but not required. No knowledge of distributed dynamical systems is needed. TBA.

Project 16: Videogame Development-Fun Learning & Distributed Dynamical Systems  ECE 1990-016  Y. Wang
ECE 1990-016 is the same project as Project 15, but is restricted to students enrolled in the Calhoun Honors College. TBA.

Project 17: Deep Learning & Big Data Research (DL/BD)  ECE 1990-018  M. Crawley Smith
Deep Learning is currently a very popular paradigm of machine learning research used for applications such as image processing, natural language understanding, or even controlling a vehicle. Deep Learning has become so successful in recent years due in part to the availability of modern high-performance computing resources such as GPGPUs, but also because of the sudden influx of more and more labeled data for training these huge neural networks.

The goal of this Creative Inquiry is to equip students with a better understanding of how Deep Learning networks operate, how they are directly affected by the training set used to teach them, and the methods and best practices for designing a training set for meeting a certain goal. Students should expect exposure to high-performance computing hardware, cutting-edge machine learning software, and the latest sensors used in dataset creation. TBA.

Sponsored by Engineering & Science Education

Project 18: Conation and Creativity in Engineering  ESED 1990-001  C. Dancz and K. High
Students from across campus work together on projects that explore conation (instinctive problem-solving) and creativity in engineering at Clemson University. Students will participate in a conation workshop led by KolbeTM certified consultant, Dr. Dancz, where they will learn about each other’s problem-solving instincts and how to operationalize conative diversity when working with others. Dr. High will lead students in active exploration of innovation and creativity in engineering adapted from Disney’s Imagineering. Students will work in small teams to define their own project exploring current or future implementation for creativity in engineering courses at Clemson. Tuesday 4-6 pm. TBA.

Sponsored by General Engineering

Project 19: Engineering Innovation Studio  ENGR 1900-006  Dr. J. Maier
Freshmen students will research ideas for innovative products and conduct conceptual design, prototype development and testing, hopefully leading to patent applications. TBA.
Project 20: Developing & Assessing Maker Space Standard Operating Procedures ENGR 1900-219 Dr. Schweisinger
The Clemson Makerspace provides students and staff with the ability to collaborate and innovate using current technologies such as 3D-Printing, laser cutting, textiles processing equipment, and electronics. The Makerspace educates and trains students of all majors on machines and processes. Students in this CI will learn to operate key equipment in the Makerspace such as CNC machines, 3D scanners, 3D printers, laser cutters, electronics, embroidery and sewing machines, t-shirt printers.

The objective is to develop a safe set of Standard Operating Procedures (SOPs) for training students on makerspace equipment within the culture and requirements of the university. Students will research, implement and evaluate the effectiveness of training methods that will likely include manuals, videos, and presentations. This CI has a strong hands-on component, and a team leadership aspect. TBA.

Project 21: Improving Efficiency of a Savonius Wind Turbine ENGR 1900-619 Dr. T. Schweisinger & Dr. J. Wagner
The growing need for clean energy is one of the major concerns of today’s world. Some of the solutions include adopting renewable energy resources such as wind, solar, hydroelectric, ocean, geothermal and other regenerative power supplies.

Vertical wind turbines are typically used to generate electricity on a small scale. A Savonius wind turbine is a vertical axis wind machine with a drag-type configuration. A prototype Savonius wind turbine has been fabricated. It converts rotational mechanical energy of the turbine rotor into electrical energy by a permanent magnet synchronous generator (PMSG) for low wind applications.

Preliminary results and real-time parameter measurements from the experimental setup using data acquisition equipment indicate that the electrical power output of the system does not meet expectations. The student team will repeat the initial test results using data acquisition equipment to measure real-time parameters. Then the team will redesign and modify the existing system to increase power output. TBA.

Project 22: Incentivizing Litter Collection & Storage in Developing Areas ENGR 1900-819 Dr. T. Schweisinger
Widespread litter, mostly comprised of plastic bags, plastic beverage containers, paper, and assorted refuse, vexes large parts of the world, particularly under-developed regions with no centralized trash and garbage collection. One practical solution involves locals collecting and transporting accumulated litter to central collection points and establishing incentives for participation.

An important component is developing a practical process allowing individuals to compact litter into small, manageable units, for which they could be compensated piece by piece, somewhat like collecting deposits on discarded beverage containers in some communities. Students will develop a way to compact litter into dense units that can be transported easily to central collection facilities by personal conveyances such as bicycles, motorcycles, push carts, bicycle rickshaws, and bullock carts. Apparatus used should be able to be made locally from readily available materials, including recycled automobile and bicycle parts, scrap metal, and the like using modest welding, blacksmithing, and fabrication methods commonly found in undeveloped regions. Any method or materials used to bind compacted litter into stable units should be derived from litter components. TBA.

Project 23: Developing a Microfluidic Biochip ENGR 1900-031 Dr. X. Xuan
The goals of this project are: 1) to learn how to fabricate micro-channels using soft lithography technique; 2) to study how fluids and particles (beads, cells, and molecules) move through micro-channels in response to electric and/or magnetic fields; and 3) to apply the developed electric and/or magnetic approaches to manipulate samples for useful biomedical and chemical applications. TBA.

Project 24: ASME Student Design Competition ENGR 1900-078 Dr. H. Zhao & C. Peruffo
Students will design and engineer a small affordable prototype to address a real-world inspired problem. Previous project themes include “Robots for Relief” which focuses on building a robot that can maneuver challenging terrain while transporting objects to a destination and “Lighter than Air” building a reliable device that can carry and drop a payload onto a target. Students will design build, and test their prototypes before going to the competition in spring semester. TBA. Instructor consent required.
Projects 25-32 Restricted to RiSE Students

Project 25: Kinetic Art for Greenville’s Artisphere  ENGR 1900-012  Dr. C. Norfolk
Participants will design, prototype, produce, and present art pieces which incorporate movement at Greenville’s Artisphere art show.  **Thursday 11:30 am – 12:30 pm. Instructor consent required.**

Project 26: Prosthetics Technology  ENGR 1900-013  Dr. C. Norfolk
Team will divide up to test and develop two systems with promise to improve the quality of life for amputees. One is a system which tests the degree of fit for the prosthetic system, the other is a system which tests the efficacy of cooling technologies which can be added to the prosthetic socket.  **Tuesday 11:30 am – 12:30 pm. Instructor consent required.**

Project 27: Design for All Abilities  ENGR 1900-020  Mr. M. Miller
This project will guide students through research on principles of universal design and identification of a project to improve the accessibility and utility of the Clemson campus. By gaining an ability to design for people of all physical and cognitive abilities—including an understanding of the cultural implications on accessible and diverse design—students will be able to empathize with users of varying levels and forms of ability and truly think outside the box when developing solutions to meet stakeholder needs. The experience and perspective gained will enable students to be more innovative and entrepreneurial in their engineering mindsets.  **TBA.**

Project 28: Using an Arduino for Tech Development  ENGR 1900-023  Dr. W. Martin
Arduino microcontrollers are very versatile tools. We will first work through some basic projects to become familiar with how to program and build projects with Arduinos. Then the team will use an Arduino to build a water quality monitoring station for use on campus.  **Wednesday 1:25 – 2:15 pm.**

Project 29: Coupling Green Roofs, Rainwater Cisterns, & Urban Agriculture  ENGR 1900-024  Dr. W. Martin
Independently green roofs and rainwater cisterns benefit urban storm water systems, but they also have drawbacks. This project investigates how these two green infrastructure technologies may possibly be used together in ways to mitigate their weaknesses and to create a more effective and resilient system. As a bonus, coupling these systems may allow for their use in urban agriculture. We will implement a pilot study system complete with monitoring systems to see how the system actually behaves. Then we will modify the design based on performance.  **Thursday 9:30 – 10:45 am.**

Project 30: Survey of Clemson Infrastructure  ENGR 1900-025  Dr. W. Martin
“Restore and Improve Urban Infrastructure” is one of the 14 Engineering Grand Challenges and this CI will explore what infrastructure is and its role in our lives. Initial semesters will focus on storm water infrastructure and use Clemson’s campus as a case study. Participants will map the system with GPS equipment, analyze it using GIS software, and eventually build a model of the system. Students will identify infrastructure issues and propose and design new solutions.  **Tuesday 2 – 3:15 pm.**

Project 31: Sustainable Spools  ENGR 1900-028  Dr. S. Grigg
This project will focus on reducing the impact of 3D printing on the environment by developing sustainable methods of producing printing filament by utilizing waste plastic to generate 3D printing filament for use in prototyping.  **Wednesday 3:40 – 5:00 pm.**

Project 32: MakerSpace Design & Exploration  ENGR 1900-026  Dr. J. Maier
In the fall semester, students will participate in the design of the RiSE MakerSpace in Lever Hall, including the configuration of the space and desired furniture, tools, and prototyping materials.  In the spring semester, students will utilize the MakerSpace they have designed, and create an advertising and awareness campaign to maximize utilization of the new MakerSpace.  **TBA.**