UNIVERSITY OF SOUTHERN MAINE
Department of Engineering

List of Opportunities for EGN 402 – Senior Design Project

2019-2020 Academic Year

SECTION 1 Mustafa Guvench

Advisor:	Prof. M. G. Guvench
Semester:	Fall 2019 or Spring 2020 (can be extended as EGN403 in Spring 2020)
Area:	3D Printers and 3D Printing
Topic:	**3-D Printing of PiezoElectric Materials and Devices** for **Sound and Vibration Sensing**
Group preference:	1 or 2 students (1 EE and 1 ME preferably)
Description:	This project's goal is to use our home-made 3D DLP Printer and employ its inherent high resolution capability to create piezoelectric structures which can produce charge and voltage when exposed to force or vibration. Focus of this project will be investigation of additives to 3D printer resin to achieve piezoelectric effect in the structure printed. Strong interest in 3D printing, Solidworks background and programming (This project is eligible to apply for **UROP** funding. See Prof. Guvench.)

Advisor:	Prof. M. G. Guvench
Semester:	Fall 2019 (can be extended as EGN403 in Spring 2020)
Areas:	Acoustics and Vibrations, Electronic Circuit Design
Topic:	Design, Implementation and Testing of Piezo-Electric Directional Microphones
Group preference:	2 students : 1 strong Electronics + 1 Solidworks simulation background
Description:	Design, Implementation and Testing of Piezo-Electric Directional Microphones, based on Biomimetics of Ochria Fly's Ears. Project will involve mechanical design and Solidworks simulation of the sensor structure, laser and/or stamp cutting of piezoelectric sensors to the design shapes, building of a test setup comprised of sensitive amplifiers, a sound generator and a rotary platform for direction sensitivity. Reports are available from earlier works by Josh Perry (EE), Shaun Sylvester (EE), James Fitz (ME). (This project is eligible to apply for **UROP** funding. See Prof. Guvench.)

Advisor:	Prof. M. G. Guvench
Semester:	Fall 2019 or Spring 2020
Area:	Electronic Circuit Design, Optics
Topic:	**Watt Balance,** Phase II: adding electronics and control
Group preference:	Team of two 2 EE students with strong Electronics background
Description:	Testing, Evaluation and Improvements on a "Watt Balance" set up already built by James Fitz in 2018 (report is available).This work will involve design and construction of optical sensing and amplifying electronic circuits and controls. (This project is eligible to apply for **UROP** funding. See Prof. Guvench.)

Advisor:	Prof. M. G. Guvench
Semester:	Fall 2019 (can be extended as EGN403 in Spring 2020)
Area:	RADAR motion detection, Solar Panels, Street Lighting,
Topic:	Design and Implementation of a Solar Powered Street Light System For Detection of Moose Crossing and Traffic Safety in Rural Maine Roads
Group preference:	Team of 3 students: 2 EE + 1 ME
Description:	Design and Implementation of a Solar Powered Street Light System for Detection of Moose Crossing and Intermittent Lighting of Rural Maine Roads for traffic safety. It involves **RADAR** motion detection, Solar Electric Power and Storage, Power LED Lighting and Control, Tower Design. Team work involving 3 students. (2 EE + 1 ME (SolidWorks) or EE) (This project will be funded by **Maine DOT** with possibility of paid internship during the project).

Advisor:	Prof. M. G. Guvench
Semester:	Fall 2019 or Spring 2020 (can be extended as EGN403 in Spring 2020)
Area:	3D Printers and 3D Printing
Topic:	**3-D Printing of Microstructures** for **Biomedical Research** and **Microfluidics** Applications
Group preference:	1 ME or (1 ME + 1 EE)
Description:	This project's goal is to vitalize a home-made DLP 3D Printer and employ its inherent high resolution capability to create microstructures needed for nerve growth experiments in Biomedical Research and also in producing Microfluidic devices. Strong interest in 3D printing, Solidworks background and programming. (This project may be eligible for **UROP** funding. See Prof Guvench.)

Advisor:	Prof. M. G. Guvench
Semester:	Fall 2019 or Spring 2020 (can be extended as EGN403 in Spring 2020)
Area:	Sensors, Electronics, Cell Phone Applications
Topic:	**Wearable Sensors for Sensing and Communicating Body Functions to a Cell Phone**
Group preference:	1 or 2 EEs with background in practical electronics and programming.
Description:	This project's goal is to implement wearable sensors to detect and communicate to a cell phone biomedical data such as temperature, skin resistance, EKG, EMG, heartbeat, blood oxygen, pressure, etc.., by using off the shelf sensor products. The project's scope will be limited to one or two of the functions listed but can be expanded and extended to EGN403 in Spring. Also, it can be modified to sense and communicate other functions tailored to the *interests of the students,* and can involve *pets or plants*. (Talk with Prof. Guvench about the application of your interest.)

SECTION 2 Mariusz Jankowski

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	Digital logic
Topic:	Programming the ADALM1000
Group preference:	1 or 2 students.
Description:	ADALM1000 is an inexpensive circuit trainer from Analog Devices. It comes with C, C++, and Python bindings. The goal of the project is to add to or modify the available sources to expand the current capabilities of the device.

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	Digital logic
Topic:	Wolfram Language interface to the ADALM1000
Group preference:	1 student (EE).
Description:	ADALM1000 is an inexpensive circuit trainer from Analog Devices. Create an interface between this device and the Wolfram Language using its connected devices framework for purpose of data acquisition and experimentation.

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	Digital logic
Topic:	Digital logic toolbox
Group preference:	1 student (EE).
Description:	Create a VHDL/Verilog library of combinational and sequential components and circuits, combinational and sequential to support ELE 172. Circuit examples include full-adder, ripple-carry adder, look-ahead adder, combinational unsigned multiplier, shift-add multiplier and more.

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	Digital logic
Topic:	Digital logic tutor
Group preference:	1 student (EE).
Description:	Create a Wolfram Language based trainer for digital logic. The software will create random combinational and/or sequential logic problems for self-study purposes to assist students in areas of logic minimization, Boolean algebra and binary arithmetic.

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	Image processing
Topic:	Shape description and recognition
Group preference:	1 student (EE).
Description:	Fourier descriptors are small collection of methods to encode contours of objects using the Fourier transform. The goal of this project is to test the various methods and use them to classify/recognize shapes from contours.

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	DSP: digital filter design
Topic:	Improve existing digital filter design software
Group preference:	1 or 2 students (EE).
Description:	The goal of this project is to test, debug, and improve an existing filter design program based on the so-called Parks and McClellan algorithm. ELE 314 and familiarity with Wolfram Language is required.

Advisor:	Mariusz Jankowski
Semester:	Fall 2019 or Spring 2020
Area:	DSP
Topic:	Real-time digital filters and algorithms using DSP
Group preference:	1 or 2 students (EE).
Description:	Create a platform, or demonstration, or experiment showing real-time digital signal processing using a selected DSP evaluation kit. Typical projects: DTFM generator, receiver, real-time FFT, spectral analysis, FIR filtering.

SECTION 3 Carlos Luck

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	robotics
Topic:	Microbot modification for redundancy
Group preference/ background:	2 students (at least 1 MEE), familiarity with programming in C and the Microbot; having taken a robotics course
Description:	Modify one of the microbots to become a planar redundant serial arm and implement algorithms for redundancy resolution, following Dr. Lück's semi-singularity papers. The project includes: 1. mechanical hardware modifications of the robot and construction of a background board; 2. programming the microbot to move according to the algorithms provided.

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	robotics
Topic:	Microbot path/trajectory planning
Group preference/ background:	1 student; familiarity with programming in C and the Microbot; having taken a robotics course
Description:	Write programs in C++ to implement path and trajectory planning using the Microbot instruction set. Paths would include straight-line motion, circular motion and combinations of those in the task space using the Microbot instruction memory.

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	robotics
Topic:	Autonomous navigation
Group preference/ background:	2 students (at least 1 MEE), familiarity with Java programming
Description:	Take it from where Kayla Artynian ended her senior project with our autonomous robot, incorporating vision feedback for localization and autonomous navigation. The project includes: 1. Extracting visual cues from the netbook webcam; 2. Commanding the robot to move from point A to point B autonomously in the presence of obstacles; 3. Other tasks as the mobile vehicle platform evolves.

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	robotics, machine vision
Topic:	Rubik's cube solver
Group preference/ background:	2 students (1 MEE, 1 ELE with CE concentration), having taken a robotics course
Description:	Control the Stäubli robot to manipulate a Rubik's cube and solve the puzzle, continuing the work started by Isaiah Marvin. The project includes: 1. Design and fabrication of mechanical hardware (fixture, gripper) for the manipulation; 2. Programming of robot motions to rotate the cube; 3. Using camera shots to identify the square colors at each face; 4. Implementing a solution algorithm; and 5. Running the program from start to finish without human intervention.

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	electric machinery
Topic:	Lab experiments involving motors and generators
Group preference/ background:	2 students who passed ELE 323 and EGN 329
Description:	Use the workbench and devices in the machines lab to design a series of experiments involving DC and AC motors and generators, producing a lab manual with solutions.

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	Power systems
Topic:	Transmission line model
Group preference/ background:	2 students who passed ELE 327
Description:	Construct and test a reduced-size, high frequency model of an overhead transmission line and instrument the input/output relationships.

Instructor:	Carlos Lück
Semester:	Fall 2019 or Spring 2020
Area:	Power systems
Topic:	AC generator paralleling
Group preference/ background:	1 or 2 students who passed ELE 327
Description:	Design and build a setup to connect a new 3-phase generator unit to an existing energized grid, and to control its supply of real and reactive power to the grid.

SECTION 4 Michael Davis

Instructor:	M. Davis
Semester:	Fall 2019 or Spring 2020
Area:	Measurement/Instrumentation
Topic:	Cycling power meter
Group preference:	1 EE or 1 EE/1 ME
Description:	The sport of cycling depends heavily on measuring an athlete's power output while on the bike for proper training. Commercially available power meters vary widely in their measurement location on the bike and are prohibitively expensive for most recreational riders. The goal of this project is to develop and fabricate a low-cost device capable of measuring the power output of a cyclist.

Instructor:	M. Davis
Semester:	Fall 2019 or Spring 2020
Area:	Dynamics/Fluid Mechanics
Topic:	Underwater Glider 2.0
Group preference:	1 ME or 1 ME/1 EE
Description:	Underwater gliders are unique vehicles that maneuver underwater by shifting their centers of mass and buoyancy. They can be a low-cost, simplified solution for underwater autonomous vehicle applications such as remote sensing and oceanographic data collection. Students selecting this project will be tasked with creating a simulation for the dynamics of an underwater glider constructed by EGN402 students in 2017/2018.

Instructor:	M. Davis
Semester:	Fall 2019 or Spring 2020
Area:	Wind power
Topic:	Static thrust stand for wind turbine blade evaluation
Group preference:	2 ME or 1 ME/1 EE
Description:	The Maine Wind Blade Challenge is a statewide competition for high school students to learn about wind energy and design and fabricate small scale wind turbine blades. To potentially aid in the development of the blade designs, this project proposes the design and construction of a test stand capable of measuring the aerodynamic performance characteristics of wind turbine blades.

Instructor:	M. Davis
Semester:	Fall 2019 or Spring 2020
Area:	Measurement/Strength of Materials
Topic:	Design of Experiment for Strength of Materials Laboratory
Group preference:	1 ME
Description:	This project involves the design and fabrication of an experiment (of the student's choosing) for use in the MEE259 Strength of Materials Laboratory course.

Instructor:	M. Davis
Semester:	Fall 2019 or Spring 2020
Area:	Measurement/Fluid Mechanics
Topic:	Flat Plate Boundary Layer Experiment
Group preference:	1 ME
Description:	This project involves the design and fabrication of an experiment to measure the velocity and thermal boundary layer profiles of a flat plate using the wind tunnel.

Instructor:	M. Davis
Semester:	Fall 2019 or Spring 2020
Area:	3D Printing/CAD
Topic:	Design of Project for Introduction to Engineering
Group preference:	1 ME
Description:	This project involves the design and fabrication of a suite of activities centered around Solidworks and 3D printing for a newly developed introduction to engineering course.

SECTION 5 Mehrdaad Ghorashi

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Composites
Topic:	Modelling a Composite Morphing Blade by SolidWorks
Group preference:	2 ME
Description:	The composite beam theories developed in MEE 352 and a few research papers will be used to develop the model of a morphing blade using SolidWorks. For more information please meet the instructor.

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Machine Design
Topic:	Analyzing Fatigue in Offshore Structures
Group preference:	2 ME
Description:	The fatigue design theories and SolidWorks simulations studied in MEE 372 will be used for analyzing fatigue in offshore structures. For more information please meet the instructor.

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Dynamics and Vibrations
Topic:	Dynamics and Vibrations Experimental Design
Group preference:	2 ME
Description:	Developing innovative experiments and simulations for the MEE 379 lab. For more information please meet the instructor.

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Dynamics, Fluid Mechanics, and Vibrations
Topic:	Heave and Pitch Motion Analysis of a Ship Model
Group preference:	2 ME
Description:	Heave and pitch motions of a ship model are analyzed by theory and by SolidWorks. For more information please meet the instructor.

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Strength of Materials and Machine Design
Topic:	Analyzing Dynamic Buckling in a Column
Group preference:	2 ME
Description:	Dynamic buckling of a column is analyzed theoretically and by use of SolidWorks. For more information please meet the instructor.

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Plasticity and Metal Forming
Topic:	Developing a few metal forming experiments and simulations
Group preference:	2 ME
Description:	For more information please meet the instructor.

Instructor:	Dr. Mehrdaad Ghorashi
Semester:	Fall 2019 or Spring 2020
Area:	Dynamics and Vibrations
Topic:	Simulation of the Bounce and Pitch Motions of a Car Model
Group preference:	2 ME
Description:	Solving the bounce and pitch motions of a car model by theory and by SolidWorks. The project is based on the simulations performed in the MEE 379 lab. For more information please meet the instructor.

SECTION 6 Asheesh Lanba

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Advanced materials applications
Topic:	**Shape memory alloy (SMA) actuated gripper**
Group preference/ background:	Up to 3 ME students
Description:	The shape memory effect (SME) in SMAs allows them to recover large deformations upon heating. The SME offers unique opportunities for the use of simple and reliable actuation without the use of motors. The aim of this project would be to design and fabricate a gripper like a human hand, with the finger movement being actuated by SMA wires.

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Advanced materials applications
Topic:	**Compliant tire with shape memory alloy (SMA) embedded in rubber**
Group preference/ background:	Up to 3 ME students
Description:	The unique superelastic behavior of SMAs allows the recovery of large loading deformations upon unloading. This behavior presents unique opportunities for compliant mechanisms such as tires. But due to the expense of manufacturing these alloys, widespread use of pure SMA tires remains out of reach. A possible compromise would be to reduce the amount of SMA material needed by embedding it in rubber to make a tire of SMA/rubber composite. The aim of this project would be to design and fabricate a SMA/rubber tire that can be scaled for different applications.

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Advanced materials applications
Topic:	**Analytical modeling of smart composite material**
Group preference/ background:	1 ME student
Description:	Shape memory alloy (SMA) fibres in reinforced polymer composite materials have been studied to improve damping/vibration and impact properties. Advances in biosynthetic (mimicking squid ring teeth (SRT) proteins) allow for tuning of mechanical properties by controlling the number of repetitions in the underlying protein-inspired cross-linked polymer chains. Combining these two materials would result in a smart composite material whose properties could be tuned in both the polymer matrix and SMA fibers. This project will be the first step towards developing a smart SMA-fiber-reinforced composite in an SRT-inspired biosynthetic polymer matrix. Currently available experimental data will be used to create analytical models for the composite material. Various geometries and volumes of the reinforced SMA material will be contrasted.

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Systems Integration
Topic:	**Integration of various components in laser ablation tomography**
Group preference/ background:	1 ME or EE student with experience in instrumentation and basic programming
Description:	Laser ablation tomography (LATscan) utilizes a high-powered ultrafast laser to serially section material, while imaging the sections prior to ablation. The images can then be digitally stuck together to make 3D models. Currently, the major components of the system are controlled disparately with little to no communication in between them. These components include the laser, the scanner which moves the laser beam, motion control for positioning and feeding the sample into the ablation path, and camera for imaging. The purpose of this project is to integrate these disparate components, both at the back and front end, to create an integrated solution for users that does not require controlling the individual components separately.

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Imaging and Microscopy
Topic:	**Chemical analysis to complement visualization via laser ablation tomography**
Group preference/ background:	1 ME or EE student with experience in systems design
Description:	Laser ablation tomography (LATscan) utilizes a high-powered ultrafast ultraviolet (UV) laser to serially section material, while imaging the sections prior to ablation. The images can then be digitally stuck together to make 3D models. The images obtained via LATscan are in full color due to UV-induced fluorescence. This fluorescence is directly related to the chemistry. At the meso-scale where LATscan is conducted, there is no competing technology that does 3D chemical mapping. The aim of this project would be to design a chemical analysis system as an add-on to existing LATscan equipment.

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Machine learning
Topic:	**Building an image classifier to categorize mutant nematodes**
Group preference/ background:	1 ME or EE student with background in programming, linear algebra and basic calculus
Description:	Researchers in the field of molecular biology work with the model organism *Caenorhabditis elegans.* These organisms are nematodes whose genomes have been mapped. Currently, researchers must manually categorize these nematodes based on the expression of fluorescent protein from microscopic images, which can be a time-consuming process. This project aims to build an image classifier that will categorize a mutant nematode from its microscopic image.

Instructor:	Asheesh Lanba
Semester:	Fall 2019/ Spring 2020
Area:	Machine learning
Topic:	**Assessing different algorithms for image segmentation**
Group preference/ background:	1 ME or EE student
Description:	Open source machine learning software for image segmentation and classification let users extract features from images that precludes manual work. This project aims to look “under the hood” of such software, assessing and understanding the algorithms offered.

SECTION 7 James Masi

Instructor:	Dr. James Masi
Semester:	F 2019
Area:	Optics, computers, electrical
Topic:	Cell Phone Spectrometer: Spectrophotometry by Building and Characterizing an Instrument
Group preference:	1 or 2 EE
Description:	The wide availability of cellular telephones equipped with CMOS cameras (and of digital cameras directly exporting JPG files) opens many opportunities for inexpensive, portable photometric measurements. Spectrophotometry makes more sense when you can see the graphical wavelength spectrum of light intensity changes when passed through a sample. In this study, the student will design the hardware, software, and laboratory instructions for a diffraction spectrograph/cell phone (or digital camera) array detector.

Instructor:	Dr. James V. Masi
Semester:	F 2019
Area:	Vibrations/acoustics
Topic:	Spectral response of musical instruments
Group preference/ background:	2/ME or 1ME and 1 EE
Description:	The student(s) will design, build and test equipment for both input and output generation, testing, and measurements of musical instruments for spectral response, impulse response, and add-ons for tonal modification.

Instructor:	Dr. James Masi
Semester:	Fall 2019
Area:	Acoustics/mechanical/electromechanical
Topic:	Acoustical testing of tool wear
Group preference:	EE-ME team
Description:	Currently there are no efficient or inexpensive methods of determining the wear condition of a tool in cutting machines. In the past, people have used load cells and strain gauges embedded into a milling machine to detect tool wear. Using broad band microphones in addition to the machine mounted accelerometers and strain gauges, data analyses are more meaningful. By analyzing the vibrations produced by a lathe, milling machine, or saw as a tool becomes worn, the student(s) will gather data, perform spectral analyses, find patterns of wear, and develop a more efficient method

	of determining the condition of a tool.

SECTION 8 Maine DOT

Instructor:	Ron Cote/ Mariusz Jankowski
Semester:	F2019/S2020
Area:	Controls
Topic:	Traffic Signal Controller – Interface for Feedback
Group preference:	1 or 2 EE
Description:	This project is being offered through the Maine Department of Transportation. See attachment for further details

Instructor:	Ron Cote/ Mariusz Jankowski
Semester:	F2019/S2020
Area:	Solar Power
Topic:	Solar Powered Overhead Lighting for Moose
Group preference:	1 or 2 EE
Description:	This project is being offered through the Maine Department of Transportation. See attachment for further details

Instructor:	Ron Cote/ Mariusz Jankowski
Semester:	F2019/S2020
Area:	Communications
Topic:	Dedicated Short Range Communications for Plow Vehicles
Group preference:	1 or 2 EE
Description:	This project is being offered through the Maine Department of Transportation. See attachment for further details

SECTION 9 Scott Harding

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Demonstration Projects using Texas Instruments Microcontrollers
Group preference:	2 EE students who passed ELE271
Description:	This project will showcase applications of microcontrollers by demonstrating their use in several small design projects. The target microcontroller will be the Texas Instruments MSP430. Applications include the control of DC, stepper, and servo motors; the use of sensors including light, sonic, capacitive, MEMS, voltage, and keypads; controlling output devices such as LED, LCD, and graphic displays; the use of common communications protocols such as UART, I2C, SPI, USB; and, finally, the use of wired and wireless communication using Ethernet, WIFI, Bluetooth, or Zigbee.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Demonstration Projects using the Beagle Board
Group preference:	2 EE students who passed ELE271
Description:	This project will showcase applications of the Beagle Board, a credit-card sized, low-power, open-hardware single-board computer. By demonstrating its use in several small design projects, students and professionals can gain an understanding of the capabilities of the device. Applications include motion control using DC, stepper, and servo motors; the use of sensors including light, sound, touch, force, voltage, and keypads; optionally output to display devices such as LED, LCD, and graphic displays; the use of common communications protocols such as UART, I2C, SPI, USB; and, finally, the use of wired and wireless communication using Ethernet, WIFI, Bluetooth, or Zigbee.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Modelling of Texas Instruments MSP430 CPU Using Verilog
Group preference:	2 EE students who passed ELE271
Description:	This project will use Verilog to simulate the Texas Instruments MSP430 microcontroller. The MSP430 is a 16-bit RISC architecture with an Instruction Set consisting of only 27 instructions. This project proposes using the Verilog Hardware Description Language to model, simulate, and synthesize the MSP430 CPU core. The Verilog Hardware Description Language, standardized in IEEE 1364, is widely used in commercial applications to simulate, synthesize, and verify the functionality of digital integrated circuits. The Verilog model can also be used as a teaching aid for studying microprocessors.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Multi-axis robotic arm using a USB interface.
Group preference:	1 EE + 1 ME
Description:	The purpose of this project is to build a robotic arm which is similar to the Microbot educational robot. The project will use an embedded controller which accepts commands from a host PC via a serial interface. Stepper motors will be used to control the movement of the arm.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Echo location for autonomous robot navigation.
Group preference:	2 EE students who have passed ELE271
Description:	Using stationary echo locators, this project proposes to use triangulation to determine the coordinates of an autonomous robot. The coordinates will be used in a closed-loop system to control the position of the robot. If the robot deviates from a set position, its current position will be modified until the error is zero. The main controller is fixed instead of being on the robot. It monitors the outputs of the echo locators and sends a control signal to the robot using wireless communication such as telemetry. There will be a smaller slave microcontroller on the robot.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Stepper motor slippage measurement.
Group preference:	1 EE
Description:	Stepper motors are generally operated in an open loop configuration. Consequently, there is no way to determine if a pulse sent to the motor has produced the desired motion. An encoder can be used, but this requires extra hardware. This project proposed to analyze the signature of the current waveform through the motor coils to determine if motion has occurred.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Automatic Footwear Fastener
Group preference:	1 EE + 1 ME
Description:	An electronic ratcheting system to fasten footwear is proposed. Using a similar concept to the Boa ratcheting system, the tightness of a shoe or boot can be optimized by measuring the pressure that it exerts on the foot. This is typically done manually, but this project proposes to use an electric motor and sensors to control the ratcheting system to maintain optimal tension, pressure, comfort, and stability. The system can be used for everyday footwear as well as specialized applications such as sports or medicine.

Instructor:	Scott Harding
Semester:	Fall 2019 or Spring 2020
Area:	Microprocessors
Topic:	Remote Controlled Head Light
Group preference:	1 EE + 1 ME
Description:	This project proposes to use a remotely mounted light to follow the head movement of the user. Traditionally, strap-on head lights used for camping and precision work are often bulky and inaccurate. Since such units require a battery to power the lamp, the total weight of the device becomes a hindrance to the movement of the wearer, making precision work difficult. This project proposes mounting the light on a separate fixture so that only a lightweight sensor need be attached to the user's head, thereby making movement easier.