An unmanned air vehicle (UAV), also known as a drone, is an aircraft that operates autonomously without a human pilot on-board. The goal of this project is to design and implement a robust and flexible flight system for a quad-copter to achieve autonomous command and control in a dynamic and uncertain environment. This autonomous command and control flight system must be contained fully on-board of the UAV with no use of external assistances. This is important for UAV use in GPS denied environments (e.g., indoor areas, subway stations, buildings, coal mines and dense forests), with the most popular approach being simultaneous localization and mapping (SLAM).

Visual-based SLAM can deliver accurate localization and mapping information, but the practical optical sensing systems are generally very expensive. Fortunately SLAM research has been significantly boosted as of late due to the emergence of relatively inexpensive, high quality RGB-D sensors. The visual sensor serves as a good platform for obtaining accurate positioning data in GPS denied environments.

This project used an X-frame quad-copter to contain the entire UAV system. A microprocessor was used to emulate control signals for the local NAZA controller based on altitude and gyroscopic data from laser and IMU sensor feedback. Communicating with microprocessor is the Pandaboard, which was used to process visual sensor data to execute SLAM and path-planning algorithms.

The quad-copter is tested in a contained environment with static dimensions and obstacles. The quad-copter maps the 3D environment with a 360° rotation in mid-air. Using this dynamically generated map, the quad-copter can navigate autonomously through the test environment.
In recent years, there have been an increasing number of counterfeit integrated circuits (ICs) entering into the electronic component supply chain. According to a report from HIS, the number of reports of counterfeit parts has quadrupled from 2009 to 2012. This significant increase suggests rapid growth of counterfeit ICs in the future, becoming a problem that must be addressed quickly and efficiently.

In addition to the raw numbers of counterfeit ICs, the impact of counterfeits on critical systems can be catastrophic. In military and medical applications, the failure of a critical electronic system due to reduced performance or shortened life can cause the loss of life. This threat is very real, as over one million counterfeit chips were found in DOD’s supply chain from 2009 to 2010. With these factors taken into account, counterfeit ICs cannot be ignored as a current and future issue.

Certain tests have been developed in order to identify whether an IC is authentic or counterfeit, based on specific defects that can be found with different features. Among these tests are visual inspection, X-ray inspection, material analysis, electrical tests, etc. Some of these tests are destructive to the IC, many are time consuming, and all require an expert’s judgment to determine authenticity. These drawbacks make large-scale and low-cost authentication of ICs very impractical and in some cases impossible. However, by automating visual inspection for defects, we aim to improve the viability of large-scale and low-cost authentication of ICs.

Our project focuses on creating an automated process of acquiring images of suspect integrated circuit chips, processing the images using a detection algorithm, and returning altered images with highlighted defects. The detection algorithm should also be able to determine the location and type of defects on the chip. The proposed detection methods thus far (1) consider presence of golden-IC analysis, (2) perform self-reference analysis without the need to golden IC, and (3) perform group comparison analysis among a set of same ICs.
Electronic components have a definitive lifecycle. High demand applications require electronic components to run within specification. Electrical components within, or near the end of their lifecycle will may run out of specification and/or fail. Unfortunately, the supply chain has been tainted with “counterfeit” ICs. These chips are the result of electronic waste which has been recycled, often repainted and resold into the market as new. As a result, both military and commercial interests require that electrical components sold as new parts are new.

The Center for Hardware Assurance, Security, and Engineering has developed a chip testing process which measures transient and leakage current of a 40 pin DIP. Our project aims to virtualize the current laboratory setup. This will allow outside interests to compare their chips to known new and known counterfeit chips in our laboratory via a web application. The web application will control our test setup, which will be expanded to run many chips under the same condition, retrieve the outputs into an acceptable format and send the results for the outside interest to compare.
Testing and analysis of a system prior to finalizing development is pivotal in the industry process to ensure success after product distribution. Product testing establishes device reliability within industry, which is essential for any esteemed company. Carrier, a brand of United Technologies Building & Industrial Systems (UBIS), has developed a proprietary Scalable Digital Control Engine (SDCE) to be used within the Power Electronics & Motors (PEM) group. SDCE can be used in inverter, power supply, generator control and power factor correction designs. To coalesce UTC projects and SDCE, a debug tool is used to interface and monitor the system’s overall performance. Presently, the debug tool is an elementary device. Interaction with the DSP is made through limited commands. These include: reading and writing values of the DSP, as well as streaming variables for data collection and analysis. There are multiple flaws with the existing version of the debug tool.

Our project, which encompasses two main objectives will facilitate an increase in reliability and efficiency of the testing or simulation process of future UTC projects. These objectives include implementing a communication protocol for the Debug Tool including a Controller Area Network (CAN) to complement the RS-485 standard communication already available on the device. Two types of communication allows for more versatility of the device, decreased debug protocol throughput, and a larger range of devices for Debug testing. Simultaneously, reliability of the debug tool will be improved through code restructuring and added GUI options. Initial bugs of the device have been resolved providing added functionality without sacrificing device simplicity.
Device quality testing is an important part of today's manufacturing process. Every manufacturer of any good must guarantee that their products will work as expected. This helps the company maintain a good image in the eyes of the consumer, as well as keep the operation costs down by avoiding unnecessary returns and repairs. Therefore a well designed and well functioning quality control system is a necessity. It is especially important when your devices are application critical; then every device that comes off of the assembly line must be tested 100%. In this case a quality control system that is easy to use, requires little overhead and is easy to deploy, is critical to satisfy the demand.

Phonon Corporation was founded in 1982 in Simsbury, Connecticut. They are the industry leader in both design and manufacturing of SAW (Sound Acoustic Wave Devices) devices. Types of SAW devices that Phonon designs and manufacture include filters, delay lines, modulators, oscillators, and correlators. The products are used for applications in the aerospace and defense industries. Phonon sells many of these products to the United States Department of Defense.

Phonon as a military contractor must test all of their devices and furthermore they must ensure that 100% of the devices they ship will perform to 100% of the specifications.

The quality control system that is currently employed by Phonon Corporation uses proprietary technology. Additionally it is based on antiquated and obsolete communication protocols and requires devices which are hard to obtain, deploy and are expensive, resulting in a fragile quality control system with large overhead costs and limited throughput.

Therefore we were given the task of developing a system that will be robust, easy to deploy, maintain and will be based on a communication protocol that will be supported over a long period of time. We chose to employ a USB based system, as it is proven to be reliable and future proof. Additionally we decided to base the device on a modern microcontroller, thus giving us the flexibility of control of the switches. To ensure that the switches are powered, a boost converters steps up the voltage from the USB source.
Team 180: Koffee Karousel:
Second Generation Koffee Karousel Machine

Sponsored by: KK Manufacturing
Sponsor Advisor: Paul Striebel and Dave Singer
Faculty Advisor: Helena Silva

KK Manufacturing, LLC is the vendor of The Koffee Karousel™ vending machine. This machine helps small businesses control, dispense, and profit from the dispensing of single-serve beverage pods, like the K-Cup®. The current version of this machine is a purely mechanical device. This machine is very reliable, has zero operating cost, a compact footprint, along with easy placement and installation. In order to remain competitive in the market a second generation of The Koffee Karousel™ machine has been created. This second generation Koffee Karousel™ machine is completely cashless. Additionally, this machine has more user friendly features due to the addition of an LCD display and push buttons.

In order to create the second generation Koffee Karousel™ machine the electrical team worked in conjunction with a mechanical team to integrate a new payment system. The goal of the electrical team was to implement a credit card reader which will allow users to operate the machine without needing physical coins. A wireless communication system that authenticates the user’s credit card information was created. A Beaglebone Black was used to program the credit card reader. Once swiped, the data from the credit cards is then sent to Authorize.net to process payments. Additionally, a configurable LCD display provides pricing information along with operating instructions. A power source and regulating power electronics were designed in order to power the electrical elements. The goal of the mechanical team was to develop a mechanical system to control the dispensing of the K-Cups®. For this, a stepper motor was used. The motor was programmed by the electrical team using the Beaglebone Black. Sensors were put in place to determine the position of the ejector arm in the machine. Several tests were performed in order ensure that the motor would properly dispense the K-Cups®. Another set of sensors were placed on the detent on the back of the machine to detect if the carousel was properly aligned to eject the K-Cup®.

These additions make the second generation machine more user friendly and viable in the modern world, while retaining the original concept of The Koffee Karousel™.
Linear variable differential transformers (LVDTs) are widely-used devices with applications in linear position and velocity sensing, as well as angular position sensing. They are used in many high-accuracy and high-precision applications, due to their infinite resolution. They are also very rugged, robust, and long-lasting devices, which makes them ideal for use in industrial and extreme applications. One drawback, however, is that they require AC input signals, and deliver AC signals at their output. Many devices that are used with LVDTs supply DC power and use DC analysis tools. As such, signal conditioners, specifically an oscillator for the LVDT input and a demodulator for its output, must be used in conjunction with an LVDT device. Trans-Tek currently has an oscillator/demodulator product that must be improved upon to meet new specifications.

A design project was undertaken to build an oscillator/demodulator module that would fit inside the casing of an LVDT on a PCB. Additionally, it was specified that a new method of demodulation, using digital signal processing (DSP) was preferred over a hardware method. To accomplish this, the current oscillator circuit must be modified to meet new specifications, and scaled down to fit inside the LVDT housing. A prototype was first built, in order to correctly modify the current oscillator circuit for the new specifications. A PCB oscillator circuit will then be built according to the new circuit. To achieve demodulation through DSP, a microcontroller will be used, and analysis will be performed through software. This will reduce the amount of hardware necessary, and increase the accuracy of demodulation. A prototype of the demodulator will be built as well, to perfect the design, before moving on to the PCB. Below, from left to right, is an LVDT alongside the current oscillator/demodulator module, the preliminary prototype of the oscillator circuit, and the algorithm through which demodulation will be achieved.
Lenze is a leader in variable frequency drives (VFD) for industrial use in environments requiring motion control systems, including manufacturing automation, material handling, and packaging. Each VFD is controlled through a series of parameters that alter the drives' function, ranging from output speed to fault protection. Currently, each VFD can be programmed manually from a remote keypad or be individually connected to a PC in order to communicate with Techlink, the proprietary software from Lenze developed exclusively for programming VFDs. Since there could be certain industrial environments requiring the use of many VFDs at a given time, the current design is cumbersome and inefficient.

The goal of this project is to develop an interface to wirelessly control multiple VFDs from a central location. This would allow industrial users of VFDs to avoid the time-consuming process of programming each VFD individually. It would also lessen the overhead involved with the need for individual connections from each VFD to a control PC.

To solve this problem, we started with the design shown in the bottom left. Techlink sends data via USB which gets converted to RS-485 since the VFD’s were originally designed to communicate via the Modbus protocol for wired connections. The differential pair, half-duplex signal is converted into full duplex and level shifted for an MCU serial (UART) input. Then the data is transferred wirelessly to another MCU on the receiver side. This signal is then converted back to RS-485, where the instructions are sent to the VFD. We wrote firmware for an Atmel microcontroller so that they can send and receive the data via an embedded Zigbee transceiver. A high level description of the Zigbee payload structure is shown in the figure in the bottom right.

Finally, the end goal of this project was to turn our prototype into a PCB that can fit into its designated slot on the VFD. Thus, when a user wants to change a parameter on the VFD, he no longer has to physically walk up to the VFD. He can change the parameters on multiple VFDs from one central PC.
An HVAC (heating ventilation and air conditioning) system is a large, complex mechanical system with many different sensors and ducts. An HVAC system heats and cools every room by what is inputted into the thermostat. Any complex system like a large building’s HVAC system is very vulnerable to problems. That is why it is essential to monitor this system and be able to quickly debug any failures that arise. With a program called TEAMS (Testability Engineering and Management System), created by Qualtech Systems Inc. (QSI), we can estimate the cost and time to fix the failure, and the probability that a certain error occurred, due to an error in the sensor value. QSI is a worldwide leader in health management software solutions and diagnostics. QSI was founded in 1993, and is located in East Hartford, Connecticut. Krishna Pattipati, a UConn professor, is a co-founder and CEO of the company. QSI designs maintenance programs with guided troubleshooting that are quick and simple.

TEAMS is a user-friendly interface that quickly isolates failures in a system. There are three different parts of TEAMS; TEAMS Designer, TEAMS-RDS, and TEAMS-RT. TEAMS designer is a diagnostic modeling tool that only measures the failures that can occur in a given system. The program shows a tree diagram that considers every failure in the system. It also outputs the probability of each failure, and what some of the possible causes of the failure could be. TEAMS RDS is the main framework of TEAMS that connects everything together. It is a server that outputs and stores the diagnostic solutions. TEAMS RT is a system within TEAMS RDS that provides diagnostics and system health monitoring in real-time as a compact reasoner. It runs on any system’s on-board computer. It becomes less efficient checking every failure manually, especially if the system is very large and complex. TEAMS-RT can present a quick matrix solution that is easy to see. We are using TEAMS to model the HVAC system of the Information Technology and Engineering Building (ITEB) of the UConn campus. The HVAC system is located in the penthouse where it is is split into two subsystems, the east and the west HVAC system. Cold water and steam is pumped from the basement of the building to the penthouse through pipes. There are multiple sensors on each floor that detect values like temperature and humidity for example. These sensor values are sent straight to a facilities website, Schneider Electric.
Team 184: Command and Control of Unmanned Underwater Vehicles

Sponsored by: UConn ECE Department, L.I.N.K.S., and UWSN
Sponsor/Faculty Advisors: Shalabh Gupta and Shengli Zhou

A team of unmanned underwater vehicles (UUVs) that can localize themselves in real time, move to specified locations, and communicate information is crucial to facilitate research of underwater environments. A team of UUVs can be utilized for military purposes and for the detection of environmental hazards, such as oil spills, and adverse weather conditions. Previous senior design and research teams developed control hardware and software for a Neptune SB-1 underwater vehicle that allowed the vehicle to move and request to be localized in real time.

Our senior design team’s goal was to enhance this control hardware and software, facilitate the real time localization of multiple UUVs simultaneously, and establish a team of three UUVs that would be controlled via a Centralized Control Station and tested in an athletic swimming pool. Three Neptune SB-1 underwater vehicles were procured, and control hardware for each UUV was assembled, encased in a waterproof container, and mounted upon the UUV. Enhancements made to the existing control hardware included eliminating and adding various hardware components as well as reorganizing these components. Enhancements made to the existing software included the addition of a passive localization algorithm to allow multiple vehicles to be localized simultaneously. The functionality of the UUVs was tested in an athletic swimming pool. The Centralized Control Station was selected to consist of control software executed on a laptop that was attached to an underwater acoustic modem. Leader-follower control algorithms were chosen, simulated, and coded for the station such that a leader vehicle and its follower vehicles could move to specified locations without collision.

Our team of UUVs consists of a leader and two followers. The leader UUV requests to be localized in real time by transmitting signals to four underwater acoustic modems, or anchor nodes, with known locations and receiving signals from these nodes. The follower UUVs are localized simultaneously by “listening” to these signal transmissions. Each UUV calculates its position based upon the signal transmission data and communicates its position to the anchor node at the Centralized Control Station. The station then uses leader-follower control algorithms to command the UUVs to move to user-specified locations while avoiding collisions.
The objectives of this project were to identify the network vulnerabilities across underwater networks with different modulation schemes and develop robust solutions. The team has access to five different commercial underwater acoustic modems: AquaSeNT OFDM, Benthos ATM-885 FSK, LinkQuest UMW200H DSSS, Evo Logics S2C, and DSP Comm modems. The various modulation schemes present different challenges in terms of security they are briefly explained here.

Frequency Shift Keying (FSK) is the oldest and best understood method, which has been secured to the degree that the military is confident using it. Direct Sequence Spread Spectrum (DSSS) is a very well developed technology but has security limitations and is not the most efficient with respect to bandwidth. Sweep Spread Carrier Technology (S2C) has promising security characteristics, which arise from the constant sweep of the signal. Lastly, Orthogonal Frequency Division Multiplexing (OFDM) offers very efficient use of bandwidth, and is currently used on most cell phone networks. These types of modulation had to be tested and fully understood before the group could proceed to improve each network’s defense measures.

To investigate the communication performance in the presence of jamming, team 185 has setup a testing system using a pair of Dell laptops, an NI sampling card, various power sources, and the modems. The team has designed a synchronized jamming test setup that uses telnet as a conduit to control more than one computer. This system allows for millisecond accuracy when attacking specific portions of the signal. The team has also developed a recording system that utilizes National Instruments sampling card operated through a Matlab script that is capable of recording signals from 0-100 kHz. Modem analysis includes power spectrum, spectrogram and time domain analysis of the signal. At the bottom-right of this brochure there is an example of team 185’s output. The graph contains, a time domain graph (center bottom), the power spectrum density (top left), and a spectrogram (top right). The combination of these outputs allowed the team to identify weaknesses in the signals tested. Three different types of jamming signal were used for each modem, these are: zero mean noise, a chirp signal, and a pre-recorded signal from the modem being tested. The jamming signals were injected into the modem signals at the preamble, after the preamble, and mid-signal in order to determine the response of the various systems. The preamble was found to be the area of the signal that determined the success or failure of the entire message. The group conducted various tests in a controlled environment by using tanks in the Underwater Sensor Network Lab. Similar tests would also be conducted in swimming pools to simulate a real environment while maintaining a fair amount of control.
Imagine having a relatively small and portable station where you could attach any energy storage device and receive information in real-time regarding many useful operational properties as well recharge the device itself. The status of any battery regardless of composition such as lithium-ion, lead-acid, and even hydrogen fuel cells, could be diagnostically measured and displayed instantly.

This project is aimed at developing a proof-of-concept multi-functional diagnostic testbed for potential use in batteries, fuel cells and all major versions of electrochemical energy storage devices. Our system will focus on the development and implementation of a universal sensor circuit which will be operated in conjunction with battery charging technology developed by a previous senior design team. This testbed will allow dynamic diagnostic monitoring through a digital interface with a microcontroller using a real-time implementation and handling processing system. The aforementioned sensor and conditioning circuit will relay useful diagnostic data related to the electrochemical storage device being monitored to a computer, where the data can be read and analyzed with ease. Some of the functional data will be related to voltage, current, temperature, resistivity, state of charge, state of health and remained useful life of battery. The associated battery charging design will be able to implement different charging techniques based on battery life including trickle, equalizing and normal operation charge states.

The goal of the project is to create a system that can improve batteries; everything from the charging time to the useful lifetime. In order to do this this project implements the hardware-in-the-loop approach. This allows the development of both the software and hardware to be done simultaneously and reduces the cost and duration it might take to improve a battery. For this project, we need a solid understanding of circuit design, sensors, analog to digital conversion, and digital signal processing, along with knowledge of software simulation and data extraction/output.

Our setup will include the use of the dSPACE microcontroller and interface board, along with an external sensor and interface for the hardware under test. dSPACE allows the functions of digital output, PWM generation and an ADC, which will be used to monitor a great range of energy storage devices in terms of quantity, and highest voltage and current levels.

This particular hardware in the loop test bed has many real life applications, including universal battery health diagnostics, increasing battery life, and increasing the speed of charge of many kinds of batteries through algorithms designed based on the diagnostics to charge batteries in the most effective way.
Team 187: Hybrid Go-Kart

Sponsored by: UConn ECE Department and C2E2
Sponsor/Faculty Advisor: Sung-Yeul Park

The 21st century faces many challenges regarding the current state of transportation. There is a finite supply of fossil fuels, and that supply is becoming harder to find and extract which is creating more risk and costing more money. The gasoline engine dominates the vehicle market burning this dwindling resource at energy efficiency from 25% to 30% and the by product from current engine technologies are emitting carbon dioxide further polluting the air we breathe and warming the planet at an alarming rate. The need for alternative sources to power our vehicles is a critical step towards confronting these challenges now and into the future. There have been several gasoline electric hybrids technologies that have emerged along with very few fully electric vehicles.

The goal of our project is to design a power electronics system, which will modify an existing hydrogen fuel cell powered electric go-kart to drive the 1.12kW DC motor with a photovoltaic (PV) panel, ultracapacitors and a battery. The ultracapacitors provide an immediate source of power to the motor, while the battery provides a steady supply over long periods of time. The photovoltaic panel provides an infinitely renewable power source that can be used to either directly contribute to driving the motor, or can be used to the charge the other sources. On-board microcontrollers will govern the use of the PV panel to charge the battery and ultracapacitors, and also guide the panel’s power output via Maximum Power Point Tracking (MPPT). Along with the project, Electrochemical Impedance Spectroscopy (EIS) experiments will be performed to investigate and understand the impedance characteristics of the battery and ultracapacitors at charging and discharging stages.
Team 188: Diffused Optical Tomography Optimization and Miniaturization

Sponsored by: UConn ECE Dept.
Sponsor Advisor: Dr. Quing Zhu

Diffuse optical tomography is a breast cancer imaging technique used in conjunction with ultrasound to differentiate between benign and malignant tumors. The previous system was designed using almost entirely commercial components with individual shielding boxes. This resulted in large packaging, increased weight, and high cost. Due to the large number of wire connections, the reliability of the system was diminished, upon transportation from the lab to the hospital and between patient rooms.

In order to improve upon the past design, the National Instruments (NI) PCI Data Acquisition cards were replaced, allowing for the miniaturization of the system. A Cyclone IV FPGA with an embedded processor controls the EVAL-AD7609 analog-to-digital conversion boards, photomultiplier tube voltage gain, and optical switches. Other functions performed by this system include PC interfacing and video acquisition.

To acquire data from the AD7609 chip, a VHDL module was designed. The implementation of this code is a time deterministic system, necessary for consistent sampling frequency across all 16 channels. This is required for frequency domain digital signal reconstruction and processing. The module is controlled using a customized Qsys system utilizing a Nios II soft-core processor and various other Altera IP. The data acquired was sent to the host PC using a FTDI 232R, UART-to-USB interface. This allowed for the control of the system through a customized GUI. In order to connect to modules and reduce the system noise, two PCBs were designed and ordered.
In today's society, the need for sustainable and renewable energy has never been higher. One major source of sustainable and renewable energy is photovoltaic or solar energy. This type of energy can be harvested with PV, or solar panels. However, these panels generally have a low (15-20%) efficiency. A lot of the wasted power is in heat generated on the solar panel. The idea behind our project is to take advantage of this heat, or application-specific heat sources, by using TEGs, or thermoelectric generators. These TEGs are devices that are comprised of two parallel plates, with the energy being derived from the heat difference between these two plates.

We plan on designing several different configurations with which to build a system integrating these two energy harvesting devices. We will mathematically model these different configurations, and, upon deciding which produces the most power and has the highest efficiency, build the system. We will also be exploring several different physical configurations for our system. The first of these will be creating a baseline with TEGs on the back of a solar panel with which to compare the rest of our results to. The second physical configuration will utilize partial shading to create 'hot spots' on the panel. Finally, the third configuration will use a focusing lens, to increase the heat on one side of the TEG, leading to a higher total heat difference between the plates.

This senior design project is being run out of the Advanced Power Electronics and Electric Drives Laboratory (APEDL). All three of the members of this senior design team are a part of this lab. We hope to include a public outreach aspect to our project by using our design to participate in Service Learning. This will involve representing our ideas and solution approaches in easy to understand, visual modes. We can then present these ideas to a local high school in order to increase awareness in emerging novel methods in sustainable energy, as well as generate interest in our field so that more students can be encouraged to consider pursuing a future in engineering, and clean energy in general.
Team 190: Linear Induction Motor (LIMO) Modular Test Bed for Various Applications

Sponsored by: UCONN ECE Department and APEDL
Sponsor/Faculty Advisor: Ali Bazzi

Linear induction motors (LIM) can be utilized to drive linear loads without the use of crankshafts, screws or intermediate gears. These machines take after the principle and topologies of regular rotary induction motors by the simple idea of cutting and unrolling them. A vast variety of applications such as conveyor systems, liquid metal pumping, machine tool operation, and launching systems involve the operation of linear induction motors. In order to begin modeling and developing LIMs, it is necessary to have a modular test bed in order to develop and optimize the performance of these motors.

The desired outcome of this project will be a design having a high degree of modularity for extensive testing and applications. The LIM will be mounted to a fully adjustable rail system to allow flexibility of testing. To maximize experimental utility, the system will be designed to allow for various rotor materials and sizes, use highly accurate position sensors for a fast system response, and acceptable motor efficiency. Position sensors will be integrated into the design to monitor the position of the rotor in conjunction with variable frequency drives (VFDs) to control rotor movement. This modular LIM test bed will allow for complete customization in order to accommodate its test bed requirement. This will include motor design topology as the design will allow for three distinctly different stator configurations. Furthermore, design parameters such as machine air gap can be manipulated to explore its connection to machine efficiency and control precision.

LabVIEW will be interfaced with VFDs and embedded linear encoders to control the speed and force of the LIM. The system will be constructed as a standalone unit where it can be brought and placed anywhere with three-phase power availability. Thermocouples will also be integrated into the windings of the stators to observe thermal characteristics of the motor while in operation. The LIM test bed will make use of a fully adjustable rail system to support the stator and rotor assemblies and provide for smooth movement. The end result of this modular test bed will be a design that is incredibly flexible for machine learning applications and overall machine optimization.
Traditional coffee machine designs are outdated and inefficient. As a result, the purpose of our project is to Bluetooth enable a coffee machine. This will allow users to operate their coffee machine from the convenience of the next room, or another area in the vicinity. A recent survey taken by UConn students has shown that out of 402 students 52% of them prefer to use a Keurig while only 23% prefer a drip coffee maker and the remaining 25% use other forms of coffee makers. As a result, a Keurig Single Cup Coffee Machine will be used the purpose of this project.

This coffee machine will have many features that a regular coffee maker does not. Through Bluetooth enabled, the user will be able to control various features from their smartphone or other handheld device. Some of these features include: commanding it brew on command, choosing a specific time for the coffee maker to brew, selecting a flavor of coffee to dispense, and selecting a volume of coffee to dispense. This technology is currently developed for an Android application; later on there are possibilities that it can be designed for tablet and even Apple products. This has the ability to revolutionize how the consumers obtain their cup of coffee. Our project is sponsored by iDevices LLC, an App-enablement and consulting company that create products that incorporate wireless connectivity to popular smartphones and tablets.
Sikorsky Aircraft Corporation is a leading manufacturer and producer of military and commercial grade helicopters. We are tasked to design a device to measure the atmospheric pressure and air temperature in order to obtain the power available versus required for the low-cost commercial helicopters. This project is joint with the Mechanical Engineering team. They will be testing and designing the housing for the electrical components. The implementation of this device must meet certain requirements such as: keeping the apparatus cost low, having the unit be portable and it must work from sea level to 2,000 feet. Simple indications should give the user an understanding of the power margins, while also accepting variables to configure their thresholds. The continuous real time measurements allow the system to calculate the power margin and inform the pilot through a LCD and three LEDs.

Our solution is to develop a unit which measures pressure and altitude in a secure enclosure mounted on the bottom of the helicopter. This unit will then connect to a display located in the cockpit. The sensor data will get fed to this main control unit and here, with the pilot's input values of weight, ambient pressure and fuel consumption the power margins will be calculated and displayed to the pilot via a tri-color LED. This LED will indicate if the pilot is safe, should consider changing his altitude or land immediately. Other metrics can be displayed or altered with the control unit on the LCD display.

The prototype consists of four pressure and temperature sensors spaced at ninety degree intervals in an aluminum cylindrical housing designed by the Mechanical Engineering team. Two sets of testing will be conducted to compare our readings with our control data on pressure, altitude and temperature obtained from a weather device. These tests will be conducted in different weather conditions and locations in order to allow us to prove the accuracy of our data.
Team 193: Sikorsky Wireless Test Instrumentation for Rotating Parts

Sponsored by: Sikorsky Aircraft Corporation
Sponsor Advisors: Paul Inguanti, Chris Winslow, Daniel Messner

Faculty Advisor: Rajeev Bansal

Sikorsky aircraft rely on various rotating systems. These systems are crucial to achieve optimal device performance; therefore, these components must be monitored in order to detect system faults as soon as they occur. The current monitoring system consists of wired sensors and slip rings. These slip rings, however, are utilized extensively at high rotational speeds and often fail due to erosion. The wires from the sensors also are adding unnecessary weight to the aircraft. In an effort to produce the optimum product design, Sikorsky has requested a proof of concept for a wireless sensing system. The proposed wireless solution will monitor the pitch change bearings of the S92 helicopter.

The team was allocated a budget of $2,000 in order to update and redesign the system produced by the previous, 2012 – 2013, senior design team. The requested electronic monitoring system is to be designed within a specified rotating compartment, with dimensions, 1.5” x 5.1”, in the tail rotor of the S92 helicopter. The proposed system will more efficiently monitor device parameters such as temperature, noise, stress, strain, and vibrations. The system must be able to transmit a clean signal at least 40 feet under normal operating conditions; two sensors must be utilized in this operation. The system must also be able to function for a minimum of 12 hours per day for a full year and continue functioning after a 30-day period of inactivity.

In an effort to satisfy sponsor needs at minimum cost and maximum operability, the team has proposed a solution with an Arduino Nano v3.0, a WiFly module attachment, and several sensor types including an accelerometer, a microphone, an infrared thermometer, and an ambient thermometer. The team designed a unit powered by a 2-cell lithium polymer battery; the battery is coupled with energy-harvesting circuitry that will recharge the battery while the unit is rotating.

All components were thoroughly tested to ensure reliability. The primary objective of producing a clear, high quality signal is tested by comparing the generated signal with a calibrated signal. The secondary objective of increasing the battery life through energy harvesting methods was implemented to the best of the team’s ability.
Joint Team EE 194 and ME 47: F4U Corsair Flight Simulator Restoration Project

Sponsored by: Connecticut Corsair
Sponsor Advisor: Craig McBurney
Faculty Advisors: Rajeev Bansal and Stephen Stagon

Connecticut Corsair has sponsored an interdisciplinary team of senior engineering students to restore three axis movement to a damaged Gyro IPT flight simulator with obsolete components and software developed by Environmental Tectonics Corporation, (ETC). The simulator will be FAA certified and used for professional flight training. The goals of this project are to redesign efficient lower scissor arms and have the simulator respond to user input via a joystick throttle such that the simulator mimics the flight patterns of the F4U-4 Corsair aircraft. Visual simulation is also incorporated into the overall system using the Prepared3D flight simulation software.

The restoration project is in its second phase of a multi-phase plan as proposed by the initial capstone senior design team. Last year’s work centered on system analysis and research. This year’s team focused exclusively on the simulator’s base; which is responsible for total system motion. The simulator cockpit was removed to emphasize the base as the priority and to make safety paramount as modification took place. The Gyro IPT flight simulator model has a triangular base with three actuating pushrods, three scissor-arm attachments and a central supportive spring.

The simulator was operational as a proof-of-concept prototype and kept in storage for an extended period of time. It was one of the first of its kind to move from hydraulic based motion to electromechanical. While in storage, components were stripped to support in-use, commercial models. A number of different options were explored, and ultimately motion restoration was accomplished by calibrating and installing a unique combination of both braking induction motors and servo motors. An effective balance of new and old technologies was most practical for the projects inherent constraints.

To summarize, the key deliverables of this project were properly sized and mounted motors, the redesign of the simulator’s lower scissor arms, control of the drive motors through the integration of Prepar3D simulation software, and establishing user control of the motors with a joystick input.
Advances in the field of robotics have led to the automation of many tasks, especially in static locations. Through swarm robotics, automation can be taken a step further, allowing teams of robots to accomplish a common goal in a dynamic environment. With an intelligent system of communication between robots, tasks can be accomplished with higher efficiency. For example, if a group of robots were tasked with finding and retrieving an object, then a broader area can be searched in less time because the robots will share information and act accordingly. The use of different classes of robots expands the capabilities of the swarm. If one robot finds the object, it will alert other robots to stop looking. This project aims to implement a primitive form of a search and rescue situation. One smaller scout robot will search the designated areas for an object of interest. Once the object is found, the scout will alert the larger lifter robot of the item's location, and the lifter robot will extract the item from the field.