# ASSISTIVE TECHNOLOGY / SERVICE-LEARNING PROJECTS

## Kinpathic

*"Guided by CARES™, Kin:pathic is dedicated to promoting a **C**ompassionate, **A**ccountable, **R**esponsive, and **E**ngaged **S**ociety, where every individual can fully participate and thrive. We strive to embody these values in all of our interactions with each other, our clients, and the wider community. Kin:pathic CARES™ is the foundation of everything we do."*

**(1) Electronic Token Board** (ECE): Token boards are visual tools that therapists use to reinforce positive behavior in children with autism. Usually, they have spaces for tokens or stickers that can be placed to track awards for desired behavior or actions. Once filled, the child earns a reward. This project is to create a board for individuals with Autism so they can independently use it to track their own awarded tokens. Tokens can be a touch-screen with lights and pictures or push button switches.

**(2) Midline Exercise Activity** (ECE): Some students have difficulties with reaching across their body (crossing the midline). A device including buttons or switches that light up when triggered by the client, placed in a variety of locations on the device is desired so that clients can practice and increase their ability to cross the midline.

**(3) Wearable Heartrate Monitor** (ECE): A wearable (preferably wrist) biofeedback device that notifies a therapist of a client's increased heart rate is desired. Note that such a project will pose challenges from a battery life and miniaturization standpoint. While there are commercially available products such as smart watches that can monitor heart rate, the interface and display are inappropriate for the students targeted with this device.

## NEEDS Center

*"The North East Educational and Developmental Support Center (NEEDS Center) has been created to provide education, training and support to individuals with developmental disabilities to assist them to live meaningful lives, as independently as possible."*

**(4) Whack-A-Mole Tabletop Game** (ECE): This system will be similar to the classic Whack-A-Mole game where something pops up (rounded object) with an audible component when it pops up. There should be at least 6 pop-up areas on the board that allow someone to push it back down. It should be heavy enough not to be pushed off a table with ease but light enough to move. Also, there should be a timer and the ability to let two people play together. *Instructor's note: this project requires significant mechanical design and fabrication*.

**(5) Bubble Tower** (ECE): A water bubble tower that has the ability to change color and the amount of bubbles to help calm and relax someone who may be overexcited. Audio with calming music would be great. Timer needed. On/off switch. *Instructor's note: This will be rather large and will require some carpentry. It is best to have an off-campus location for fabrication*.

**(6) Standing Matching Game** (ECE): This will be a two-person touch screen matching game with audio and visuals. Games should be timed and have various difficulty levels. Results are scored.

## Seven Hills

*"Seven Hills Foundation provides exceptional integrated clinical, educational, and community-based supports to children and adults with disabilities and significant life challenges. Our professional staff is passionate about our work that helps people SEE the possibilities, BELIEVE in themselves, and ACHIEVE their dreams."*

**(7) Adaptive Drone** (ECE): A photography drone that can be controlled by someone who is a quadriplegic is desired. Most project work would be related to creating the adaptive control system, but some customization of the actual drone may end up being required.

**(8) Water Intake Monitor** (ECE): A device is needed that keeps track of how much water someone is drinking and report their water intake status. It might also remind the user to drink water.

## Bridgewell

*"Bridgewell strengthens communities by providing an unmatched range of social and human services that empower people with life challenges to live safe, self-directed and productive lives. Bridgewell delivers support through community housing, day programs, outpatient treatment, recovery services, as well as education and employment training."*

**(9) Emotion Expression Device** (ECE): A young woman with seizure and muscular disorders would benefit from additional assistance expressing emotions. She is able to ambulate and has fine motor skills, so she is able to utilize buttons and touch screens. A system where she could indicate emotions is desired.

**(10) Emotion Learning Game** (ECE): A young woman with an acquired brain injury would benefit from a game to learn to express emotions (perhaps some sort of cause-and-effect game); she loves insects and Kylo Ren/Star Wars. She is able to manipulate both buttons and a touch screen.

**(11) Voice Activated Interactive Device** (ECE): A woman with dementia currently engages with Care Coach (see website www.care.coach) but due to privacy issues, the device needs to remain in her bedroom. She would enjoy having something similar to interact that she could use out in common areas of her home. She would enjoy some sort of voice-activated item to interact with. She loves animals and misses having pets.

**(12) Communication Board** (ECE): A man who has an acquired brain injury currently uses a communication board his wheelchair tray. The board has letters and pictues he can point to so that he can spell out words to communicate. An electronic device arranged in a similar way, where he could type words and utilize predictive text would enable him to communicate more quickly and effectively.

## American Training

*From their website: "American Training, a passionate and dedicated family of Colleagues, creating meaningful, life-changing experiences. Premier, uniquely developed programs provide dramatic results to people from all walks of life. Award-winning workforce development, day habilitation, education, and specialized housing plans help those who are unemployed, under-employed, at risk, people with disabilities, as well as those with limited marketable or language skills. American Training's passion is evident in our commitment to bringing out the best in everyone we touch. We promise to make Every Life Matter!"*

### (13) Communication Board (ECE)

Many guests of American Training are non-verbal and require an adaptive communication device such as an iPad with a special program running on it that speaks when the guest touches the corresponding image. However, the guests often do not want to use the iPad making communication difficult. A communication board that encourages their non-verbal Guests to use it to tell us what they need or want is desired by their staff. A reward system or instant reward for using the communication board is suggested as a solution to encourage guests.

### (14) Lighted Wall Panel (ECE)

A lighted wall panel game is requested where when the user turns the knobs, colors of lights on the panel change color, four colors per knob. A 20x20 array is requested. The idea is to be able to change the design of the light pattern or maybe even play games such as Connect Four or other games. Some sort of audio component would be a nice addition as well.

## Incompass

*Incompass Human Services offers a comprehensive range of programs and services tailored to meet the diverse needs of individuals with intellectual and developmental disabilities (IDD) and acquired brain injuries (ABI) and their caregivers and family members. Services include residential support and placement, day habilitation, employment and vocational training, recreational activities, family support, clinical support, respite care, autism support, and rep payee services among many others.*

**(15) Busy board** (ECE)**:** A busy board is a device that contains a number of different activities which will keep the user occupied and offer some motor control training. For this special busy board, a sequence of tasks will be expected, and the system will talk out the desired sequence of steps to complete the pattern. The system will light up green when the sequence is successfully completed and red if completed wrong. The system is to be used on a tabletop or on a wheelchair tray and must have a means to secure it to the surface. It shall be no larger than 12 inches x 16 inches. A means to secure to wheelchair tray or table is required. Ideally, the busy board will revolve around life skills such as Want it be a functional activity such as: brushing teeth, folding a face cloth, etc…

## CLUBS & COMPETITIONS

### (16) Collegiate Wind Turbine Competition (4 EE / 2 CpE)

The Wind Energy electrical design challenge involves the development of an AC-DC power conversion, control and energy dissipation system for a small-scale wind turbine. This turbine's design and efficiency will be tested for points by the Department of Energy (D.O.E) through a wind tunnel test at the Collegiate Wind Competition (CWC) in May 2025. This electrical system will be tasked with enabling a stable power curve, controlling turbine speed via resistive loads and engaging the brake and pitch systems via an Arduino microcontroller and supporting sensors (RPM, current). Students will have the opportunity to cross-collaborate with the teams' mechanical engineers (enrolled in another course), who are responsible for designing and machining all the hardware (blades, housing, tower, mounts) for this turbine. Overall, as part of the competition itself, final deliverables will include a technical design report (3-4 pages due by December 2024) and assembly video of the onboard electrical system, based on which D.O.E judges will score the team. The 1st semester will involve onboarding, design and prototyping work, whereas the 2nd semester will be entirely focused on testing and data collection with the final electronics in UMass Lowell's wind tunnel in Ball Hall. Note that the overall team will be comprised of sub-units: Aero/Mechanical Turbine Design (4-6 ME), Electrical & Control Turbine Design (4-6 ECE), Wind Farm Proposal (4-6 total of ME, ECE, Civil). This course will involve the Electrical & Control Turbine Design sub-team only).

### (17) NASA USLI (University Student Launch Initiative) (4 ECE)

The USLI is a program run by NASA that tasks various universities across the country with assembling a ground-up rocket design capable of carrying a payload that fulfills the contest guidelines. The project for this course entails assembling the payload computer and associated electronics that will, amongst other tasks, track various flight characteristics and broadcast them to the team’s base station and to the judges at the year ending flight event.

# FACULTY SPONSORED PROJECTS

## (18) Mind Mouse Design Project (4 ECE – 2 hardware and 2 software)

A 53 year old family man has amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease. He has just stopped working and is wheelchair bound. Hand controls are giving him trouble. The project is the design of a control system that will detect brain waves and muscle movement using technology based on electroencephalograms (EEG) and electromyograms (EMG). The general strategy is to use an instrumentation amplifier with active filters or DSP filters that will give a "mouse click" signal on a USB port into a laptop computer or Arduino / Raspberry Pi microcontroller. The mind mouse will interface with software that can be used to type, perform text-to-speech, control a tv, and other home automation. These programs will be adapted from existing programs. The main focus on eyebrow movement because it is the last body muscle to go before being "locked-in" where the person loses the ability to speak and move. See the following link for more information:

https://studentuml-my.sharepoint.com/:f:/g/personal/john_palma_uml_edu/EqYP7D6iVrlEvPxqZlR7xRkBPBPyh0hrYevRZAc-lBxTyg?e=wEUSrO

## (19) Open-Source Networking Simulator Development (4 ECE):

This capstone project offers students the chance to contribute to the development of a fully open-source simulator that models software-defined elastic optical networks (SDEON). The simulator is primarily implemented in Python with some Bash and is hosted on GitHub. It has gained national recognition, becoming a top competitor in the field of optical networking, with plans to expand into areas such as 5G, 6G, and smart grid networks. Students can choose from multiple tracks within the project, including:

- Graphical User Interface (GUI) Development: Enhancing the design and usability of the simulator's interface.
- Core Feature Development: Expanding the simulator's network modeling capabilities, with the option to incorporate artificial intelligence techniques such as machine learning and reinforcement learning.
- Testing and Documentation: Developing comprehensive tests to ensure the simulator's robustness and improving documentation for future users and developers.
- Project Management and Growth: Overseeing the overall development and outreach of the simulator, helping to organize the project's goals, expanding its user base, and driving growth in the open-source and research communities.

This project is ideal for students looking to engage in real-world research, contribute to an open-source ecosystem, and potentially co-author research papers.

Suggested Skills:

- Python programming (the primary language of the simulator)
- Familiarity with Git and GitHub for version control and collaboration
- Basic understanding of concepts from the network design course
- Strong problem-solving abilities and a willingness to learn and contribute

Optional Skills (Not Required but Beneficial):

- Knowledge of Bash scripting
- Experience with machine learning or deep reinforcement learning
- Familiarity with GUI development frameworks
- Understanding of testing methodologies and technical documentation writing
- Interest in project management, with skills in organizing, planning, and overseeing development efforts to grow the simulator's user base and capabilities

Students from diverse technical backgrounds are encouraged to apply, as the project fosters an environment where motivated individuals can develop new skills and meaningfully contribute to a recognized open-source initiative

## (20) ECE Stockroom Tracking System (4 ECE)

In the UML ECE labs, it is crucial to ensure that students have all the necessary material readily available. However, due to how many different components there are, keeping track of all of them is time consuming. It is proposed to integrate a system into the cabinets that would track the withdrawal of components, which would then notify when any component drawer was low in quantity. This is a continuation of a project from last year which needs significant design revision resulting from the lessons learned during the project's first iteration. Significant software work is required along with refinement of the electrical and mechanical systems, and design of proper pcbs to handle the large amount of wiring in the system. A student from last year is available to help get things going on this project.

## (21) Assembly Machine for Microelectrode Arrays

(2 ME and 3 CpE or EE with strong programming skills)

**Project Description**: This capstone project is part of a NIH-funded project entitled "Development of Low-Cost Automatic Machine for In-House Fabrication of Custom Microwire-Based Microelectrode Arrays for Electrophysiology Recordings". Microwire-based microelectrode arrays are an affordable and important brain-machine interface tool for neuroscientists to understand the nervous system but its potential is limited by the labor-intensive fabrication process. This NIH project develops key enabling technologies and a low-cost benchtop fabrication tool to have the simple, mature, but tedious manual fabrication tasks done by an automatic machine. The developed automatic tool delivered to the neuroscience community will enable previously impossible custom large-scale minimal-damaging-microwire-based microelectrode arrays as well as make low-cost chronic electrophysiological recording widely available.

In this capstone project, the student team with various background is expected to build upon existing setups and prior studies to further develop an image processing driven assembly machine for (1) machine-controlled placement of the processed microwires onto pre-determined circuit board locations, and (2) contactless violet laser-based microwire tip preparation. The ME students will gain valuable experience in machine design and prototyping through design optimization of the overall machine structure and procedure-specific custom fixtures. The CpE students will lead the effort on developing the control hardware and software for the image-guided motion during the assembly steps. Besides the faculty sponsor, the student team will also be supervised by graduate students and capstone members from previous years for proper training and smooth transition.

This capstone work is expected to generate journal-level publications if the deliverables meet expectations which will greatly strengthen the team members' resumes. Further research assistantship on the project is also possible after the end of the year-long capstone.

## (22) LoCCST Ground Station Expansion (ECE)

A past capstone group designed and built a ground station for the UMass Lowell Center for Center for Space Science and Technology (LoCSST) which will be used to communicate with future cube-sat projects. However, the ground stations capabilities need to be. You will design and build a 915Mhz transmitter and receiver chassis to be added the present satellite ground station. Electronics, RF design, programming, and some light mechanical design (modification of the chassis) will be needed.

## (23) Light therapy to inhibit rod photoreceptor dark current (2 ECE & 2 BME)

**Problem Statement**: Diabetic macular edema (DME) is a leading cause of vision loss in patients with diabetic retinopathy, driven by excessive vascular endothelial growth factor (VEGF) production due to hypoxia in the retina. Current treatments rely heavily on frequent intravitreal injections to control VEGF levels, which can be burdensome for patients and healthcare systems. The project aims to explore a novel complementary therapy using external light therapy to inhibit the rod photoreceptor dark current during sleep, thereby reducing VEGF production and potentially extending the interval between necessary injections. This project will involve the design, development, and testing of a custom external LED light strip device and assess its effectiveness and acceptability in a clinical setting.

**Expected Solution**: The proposed solution is the development and testing of an external LED light therapy device, spectrally tuned to 505 nm, designed to be worn during sleep. This device aims to prevent dark adaptation in rod photoreceptors, thereby reducing hypoxia-induced VEGF production and alleviating the symptoms of DME. The expected outcomes include a functional prototype of the light therapy device, validated through a pilot study using a wearable sleep-monitoring device, and comprehensive data on its effectiveness and patient acceptability.

**Required Team Skillset for ECE:** LED technology, circuit design, and device prototyping. Development of any necessary control systems or apps for device management.

**Mandatory Clinical Observation**: Clinical observation will be arranged in both ophthalmology and retina clinics to provide students with a comprehensive understanding of the workflow and treatment of diabetic macular edema (DME) within the eye care setting. Additionally, observation in the clinical sleep lab will allow students to witness the process of conducting sleep studies, including the setup and monitoring of patients. This hands-on experience will equip students with critical insights into the practical application of the device and its impact on patient care, enabling them to design more effective and practical solutions.

**Project Restrictions**: Students will comply with HIPAA regulations and all Lahey data security protocols. Any access to patient data will be conducted under strict supervision, and all software development must adhere to healthcare compliance standards.

## (24) Lowell Canal Cleaner (ECE)

The Lowell canal system is a unique and historic feature of the city, but unfortunately there is a tendency for garbage to collect in the water which is unattractive. The city, National Parks Service, and several community organizations have worked on keeping the canals clear of trash, but it is dangerous and time consuming. Several years ago, the university was asked to create an automated trash clearing system and much work has been accomplished. Recent efforts have revolved around autonomy of the system via LIDAR, ultrasonic sensors, and machine vision utilizing ROS – the Robot Operating System. In this new capstone sequence, students will continue to work on automated garbage collection via a wheeled robot and work on a small boat so that the system can be transitioned into testing the system in the water. The wheeled vehicle currently exists but a small boat will need to be constructed. This boat will simply be for test purposes and not for actual deployment.

# CORPORATE SPONSORED PROJECTS

## (25) Brooks Automation 1 – Automated Wafer Correction (4 ECE)

Note: Signing of an NDA required.

*Brooks Automation is a leading provider of semiconductor manufacturing solutions worldwide. They have been a key participant in the semiconductor industry for more than 40 years providing precision robotics, integrated automation systems, and contamination control solutions enabling chip manufacturers globally.*

**Statement of the Problem:** Brooks Automation designs and manufactures precision robots for handling silicon wafers. One feature of the robot is known as Automated Wafer Correction (AWC) by which slippage of the silicon wafer on the robot is detected by through-beam sensors and corrected. In real life, this process requires a real robot arm, a real wafer and real sensors. Since these are scarce resources, it is desired to create a test box that simulates the wafer breaking the through beam sensors without having the real-life components. This will allow for simulated testing at different sensor placements and without human intervention.

**Expected Solution:** The expected solution for this problem would be a test box based on a common microcontroller that would take as input the robot position data and the assigned coordinates of two through-beam sensors. Calculating a circular wafer and where it would intersect the sensors, the test box would generate the required sensor signals back to the robot. The test box would monitor the real time position of the simulated robot arm via a high-speed link and take as inputs the position of the through beam sensors and the radius of the wafer. A simple GUI on a companion PC using Python would be used to set the required configuration parameters.

**Required Team Skillset:** This project would require both hardware and software microprocessor development skills. The platform will be a commercial microprocessor platform like Arduino or Raspberry Pi. The software environment is likely to require real time interrupts and making calculations in a constrained amount of time. The hardware side will require interfacing a microprocessor to industrial logic (24V). The goal for hardware is to use a commercial microprocessor PCB and only make a custom PCB (think Arduino Shield) if required for the interface circuitry to the robot. The project will need to be packaged appropriately for use in a lab environment.

## (26) Brooks Automation – LiDAR Detection of Robot Arm Position

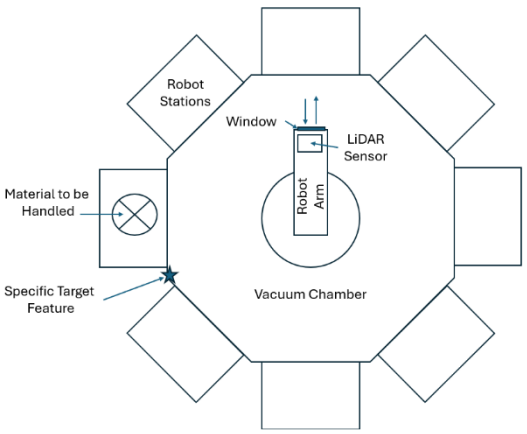
(1 EE, 2 CpE or software proficient EE, 2 ME) Note: Signing of an NDA required.

*Brooks Automation is a leading provider of semiconductor manufacturing solutions worldwide. They have been a key participant in the semiconductor industry for more than 40 years providing precision robotics, integrated automation systems, and contamination control solutions enabling chip manufacturers globally.*

**Statement of the Problem:** Brooks has a need to accurately and quickly locate a robot arm relative to its surroundings in a vacuum for the purposes of automatic teaching of stations, detection of a location feature, detection of obstacles, detection of materials to be handled, and mapping of the automation workspace.

**Expected Solution:** This is to be accomplished using a short-range LiDAR sensor in a vacuum robot arm. The robot arm will direct the sensor to necessary features inside the vacuum chamber environment to create a point cloud map.

- Selection of a LiDAR sensor based on system requirements. Sensor power and communication to a CPU will be required. Sensor interface may require additional circuitry depending on selection.
- Design of an arm capable of mounting to a Brooks vacuum robot drive, with mounting for the LiDAR sensor, and with a high vacuum window installed that does not interfere with the LiDAR sensing and accuracy.
- Design of a test chamber with stations and location features. The robot arm will be mounted to a Brooks supplied robot drive in the simulated environment.
- Software capable of generating a point cloud, identifying location features, station features, and material presence locations relative to the sensor location.




**Required Team Skillset:**

(1) Electrical Engineer for LiDAR selection, cabling, robot operation.

(2) Mechanical Engineers for robot arm design & build, window selection, design and build of simulated vacuum chamber with stations and location features.

(2) Engineers with software expertise for point cloud generation, feature identification, and determining location relative to robot arm position.

## (27) Brooks Automation – Python Scripts for Robot Testing (4 ECE)

Note: Signing of an NDA required.

*Brooks Automation is a leading provider of semiconductor manufacturing solutions worldwide. They have been a key participant in the semiconductor industry for more than 40 years providing precision robotics, integrated automation systems, and contamination control solutions enabling chip manufacturers globally.*

**Statement of the Problem:** Brooks Automation builds intelligent robots that process almost 500 different commands in twelve distinct technical areas. This project will be to create organized Python scripts to test and validate a portion of those commands. The Python scripts will generate Test Reports that indicate the compliance (or non-compliance) of the robot commands automatically in a fashion that requires no operator intervention. This project offers hands on experience controlling and operating a robot and other associated factory automation.

**Expected Solution:** The expected solution will include a software test plan, multiple test cases and lots of Python code containing tests designed for the robots. Test cases will need to cover normal operation as well as covering all projected error conditions. The team will be given access to simulated or actual robots as needed. One or more examples of a successful automated test will also be provided as examples.

**Required Team Skillset:** This project is primarily in Python in Windows environment but other common industry tools like FTP and TELNET will also be employed. This is a purely software project intended for students majoring in software development. The ability to read and understand technical specifications and convert that information into a recipe for testing multiple possible situations would be very useful. Exposure to other software tools like bug tracking systems, test plans, unit tests and specifications will be provided. The ultimate goal of this project will be to add significant new testing areas to the SQA testing already in place at Brooks Automation.

## (28) Raytheon Innovation Center Radar Simulator Kit

(2 EE & 2 CpE ***US Persons Only***)

*Raytheon is a technology and innovation leader specializing in defense, civil government and cybersecurity solutions, providing state-of-the-art electronics, mission systems integration, capabilities in C5I (command, control, communications, computing, cyber and intelligence), sensing, effects and mission support services.*

**Project Description:** For the past couple of years, the Innovation Center at Raytheon in Tewksbury, MA has been using radar simulator kits constructed out of Arduinos and Raspberry Pi's to teach employees basic radar concepts in a 3-hour class. The course assumes no prior engineering or coding knowledge. Although these kits have been successful, several improvements and additions to the kits are desired. These improvements relate to code to create reliable USB connections and an improved GUI, physical kit setup, and clearer documentation (to be made available on GitHub). It is also expected that students run experiments determining the radar's range and angular resolution and compare the results to radar theory.

## (29) BAE - Temperature Sensors for Individuals with Paralysis (4 ECE)

*BAE Systems, Inc. is the U.S. subsidiary of BAE Systems plc, an international defense, aerospace and security company which delivers a full range of products and services for air, land and naval forces, as well as advanced electronics, security, information technology solutions and customer support services. This project is with the BAE* Innovating for Impact *program which empowers university students and nonprofit organizations across the United States to design adaptive and inclusive technologies that assist disabled veterans with routine, recreational, and work activities.*

**Project Description:** Individuals who experience a traumatic injury, such as limb loss or paralysis, are often left without sensation in their limbs or the ability to regulate their body temperature. This loss of function can lead to potentially life-threatening situations exacerbated by activity, extreme weather and friction. In adaptive sports, this can present a barrier to participation for fear of frostbite, overheating, autonomic dysreflexia, and pressure sores. Adaptive Adventures in partnership with BAE Systems is seeking to develop sensors and an app that alerts individuals and/or their instructor that they are getting too hot or too cold to avoid damaging health conditions.

## (30) Draper Labs – Smart Pharmaceutical Asset Tracker

(4 ECE ***US Persons Only***)

*The Charles Stark Draper Laboratory is an American not-for-profit research and development organization headquartered in Cambridge, Massachusetts. The laboratory specializes in the design, development, and deployment of advanced technology solutions to problems in national security, space exploration, health care and energy.*

**Project Description:** It is estimated that the biopharma industry loses around $35 billion annually due to temperature failures, with the waste in temperature-controlled pharmaceuticals reaching up to 15%. Environmental factors such as humidity, temperature, and light all can have detrimental effects on the efficacy of pharmaceuticals. The *Smart Pharmaceutical Asset Tracker* project aims to create a small form-factor electronics module prototype that can easily be co-located with pharmaceutical products during transit. This module will provide and broadcast real-time insights and warnings to the end-users regarding environmental conditions during the transit of pharmaceutical products.

This project will require a small team of talented electrical engineering students with a passion for embedded systems, microelectronics, and RF. Additionally, the students will learn more about GPS positioning, sensor integration, power electronics, and project management.

## (31) L3Harris – Development of Common Electronic Ground Support Equipment (4 ECE ***US Persons Only***)

*L3Harris Technologies, Inc. is an American technology company, defense contractor, and information technology services provider that produces command and control systems and products, wireless equipment, tactical radios, avionics and electronic systems, night vision equipment, and both terrestrial and spaceborne antennas for use in the government, defense, and commercial sectors. The company was formed from the merger of L3 Technologies and Harris Corporation and is the sixth-largest defense contractor in the United States.*

L3Harris in Wilmington, MA designs, builds, tests, and delivers electro-optical payloads and subassemblies for spacecraft. These payloads are integrated into space vehicle assemblies by partner L3Harris sites or by our customers. Integration and test activities of these payloads often requires the development of electronic ground support equipment (EGSE). These EGSE come in several types, mainly subassembly controllers, test controllers, space vehicle simulators.

- Subassembly Controllers
    - These EGSE drive one or multiple subassemblies providing power, data, telemetry, and motor control.
    - The subassemblies may include
        - Opto-electronic assemblies like detectors
        - “Slow” Mechanical assemblies such as focus mechanisms
        - “Fast” Mechanical assemblies such as fast steering mirrors
- Test Controllers
    - These EGSE drive components of test setups
    - These components may include
        - Optical instruments
        - Thermal chamber systems
        - Electronic test equipment
- Space Vehicle simulators
    - These EGSE simulate a space vehicle or satellite bus interface, providing power, data, and telemetry
    - These EGSE typically provide a significant amount of power (>1kW) as to run a complete payload but have fewer total inputs and outputs than a subassembly controller.

L3Harris would like UML students to produce a design of a common EGSE that can support the interface requirements of standard L3Harris payloads. This EGSE should have:

- A standard interface that can be adapted to meet the connectorization needs of various programs and be modified with relative ease
- Redundancy to be resilient to file corruption, facility power interruption, and other foreseeable circumstances that would disrupt operation of a test set
- A method to provide adequate power to connected systems
- A method to interrupt power to connected systems via an emergency stop button
- A method to verify the EGSE is “Safe to Mate” to a connected system
- A power system capable of operating from industrial facility power on a standard plug (120V/208V, 1 or 3 phase)
    - This system should be safe and conform to all applicable standards in the National Electrical Code
- A test computer capable of controlling all EGSE functions
- A Human-Machine Interface to allow a user to efficiently interact with the EGSE during system operation

## (32) Red Hat – Friendly Fedora (2 ECE / 2 CS)

*Red Hat, Inc. is an American multinational software company that provides open-source software products to enterprises. Red Hat has become associated to a large extent with its enterprise operating system Red Hat Enterprise Linux. Red Hat sponsors the Fedora Project, a community-supported free software project that aims to promote the rapid progress of free and open-source software and content. Fedora aims for rapid innovation using open processes and public forums.*

**Introduction:** Fedora and Ubuntu are two of the most popular Linux distributions. Ease of installation is a major factor affecting people's Linux choice, but installation of the entire desktop/laptop system can vary a lot depending on hardware, desktop environment, tools, and which applications the user needs to use regularly. UMass Lowell students most frequently choose Ubuntu for their laptops. This project is aimed at building better, more "friendly" Linux systems that will better serve UMass students. This project also provides a chance for students to work with Fedora's open source community. They will be tasked to pick one or more of the initiative projects and work with the associated mentor to complete the project (https://fedora-arc.readthedocs.io/en/latest/initiatives.html#completed-review).

**Project Description:** The project goal is two-fold, to build useful Fedora systems for the UMass Lowell community, and to work with students and staff to make it easy for them to install and use the UMass Lowell "Friendly Fedora." The second one is to get the students acquainted with open-source culture and help Fedora's mission to lead the advancement of free and open-source software and content as a collaborative community.

In particular, the project should complete the following objectives:

- Investigate what features students need for a reliable and full-featured laptop that is also practical and supports popular student applications. Develop metrics for evaluating how well a system meets these goals and track Fedora usage at UMass Lowell.
- Determine what hardware platforms are common among UMass Lowell students (include both laptops and peripherals), and how best to support this hardware with Fedora.
- Establish a CM/CI process and student support system for this project to evaluate new software versions and allow laptop owners to easily update their systems for new releases and security updates. Decide how to distribute software to laptop users (e.g. flash drives, web delivery).

- Build and tune appropriate Fedora and accompanying system software to satisfy UMass Lowell student needs. Make the resulting software, configuration and tuning information available to the open-source community. Work with the community to register and resolve issues discovered in this process.
- Work with student users, student organizations such as ACM, and UMass Lowell centers using Linux, such as the Cyber Range and the Innovation Hub, to evaluate and improve systems.
- Share the results of this work with the open-source community. Use the student-developed metrics to evaluate the effectiveness of the project.
- Pick an initiative from ARC's initiative list based on their interest.
- Work with the mentor to scope, develop, test and deploy the project onto Fedora's infrastructure.

**Skills:** Past experience with building Fedora or other Linux systems, familiarity with RPM and dnf/yum, is desired but not required. Past experience with open-source software development and CI/CM tools (e.g. Git, Ansible) would be helpful. Experience with Python may be helpful for building and tuning tools. Students with an interest in Operating Systems and kernel software will benefit greatly from working with a Fedora expert. Students will need good oral and web communication skills for outreach to students and academic users, and to share results with the open-source community.

**General Information:** Red Hat experts will be available to students an average of four hours per week to support this project and can reach out to involve others at Red Hat and in the open-source community as needed. In addition, there are a myriad of support channels for Red Hat of which details will be provided once the project starts.

## (33) Teradyne – Improved Repeatability of Optical Connector Alignment

(3 ME, 1-2 EE)

*Teradyne, Inc., is an American automatic test equipment (ATE) designer and manufacturer based in North Reading, Massachusetts*.

**Project Description:** FC/APC optical connectors have variability when being mated. This shows up as an optical loss which varies from connection to connection, as the off-axis deflection varies when tightened manually by different people. For this project, you will familiarize yourself with the various standards for the connection and develop a baseline variability for typical operating conditions that might be encountered when the connectors are installed in a dense cabinet by different users. You will design a specialized torque wrench, suggest and/or implement design modifications, and determine the procedures needed to resolve the variability in optical alignment. You will calculate the torque needed for a vibration resistant threaded connector of a given size and fit. The goal is that anyone following the procedure will see a less than 0.1 dB of variability in power. Bonus: develop CAD, 3D print, and test a torque wrench that improves repeatability across user hand strength.