MIT Lincoln Laboratory

Remote Internship Projects

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MIT Lincoln Laboratory is an Equal Employment Opportunity (EEO) employer. All qualified applicants will receive consideration for employment and will not be discriminated against on the basis of race, color, religion, sex, sexual orientation, gender identity, national origin, age, veteran status, disability status, or genetic information; U.S. citizenship is required.

Selected candidate will be subject to a pre-employment background investigation and must be able to obtain and maintain a Secret level DoD security clearance.

Project: Image segmentation in SAR and polarimetric SAR

Group 105: Airborne Radar Systems and Techniques

Req # 31081

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/airborne-radar-systems-and-techniques

POC: Dave Burke; david.burke@ll.mit.edu

Description: The goal of this project is to develop image segmentation algorithms for Synthetic aperture radar (SAR) and polarimetric SAR

Internship is to label and train image segmentation algorithms to identify regions in SAR imagery, specifically grass, high foliage, low foliage building, various types of asphalt, man-made objects, ground vehicles, and air vehicles. This mapped image would then be used to support scene understanding algorithms – i.e. what is happening in this scene? Unlike optical imagery, the relative local magnitude statistics of SAR imagery and especially polarized SAR imagery are very directly correlated with surface properties, potentially enabling much more detailed scene understanding. This internship will work with data collected by our Airborne radar testbed to develop segmentation algorithms and high level analytics to assist in analyzing SAR imagery.

Desired Skills: The candidate should be pursuing an undergraduate degree. Desired concentration in Computer Science, electrical engineering, or applied mathematics or sufficient experience in python programming, computer vision or machine learning. Experience with deep learning frameworks (e.g. PyTorch or TensorFlow) is strongly desired. **U.S. Citizenship Required.**

Project: Radar Model Development

Group 105: Airborne Radar Systems & Techniques

Req # 31081

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/airborne-radar-systems-and-techniques

POC: Christopher Serino; christopher.serino@ll.mit.edu

Description: The goal of this project is to implement radar processing and control kernels to enable dynamic tasking of an airborne radar system and real-time data processing, product generation, and dissemination.

The ability for a radar system to adapt to changes in collection requirements without undue the latency between tasking and product dissemination creates an opportunity to explore a wide variety of new concepts of operation. To minimize this latency, radar control parameters should be generated in real-time by the radar system without a human-in-the-loop and the raw RF data must be reduced and processed into a standardized format in a low-level programing language. The student will collaborate with Laboratory staff to generate reusable, highly optimized C++ modules, adhering to standardized interfaces, from algorithmic descriptions in MATLAB to control the radar and process the return signals. These modules will be tested using synthetic and/or collected data so that they may be deployed to an airborne system operated by the Laboratory. This program will increase the student's knowledge of optimized code development, radar control, digital signal processing, and integrated software design.

Desired Skills: The candidate should be pursuing an undergraduate degree in computer science, software engineering, electrical engineering, or applied mathematics. Proficiency in C++ is required and experience with GPU computing and/or FPGAs is desired. **U.S. citizenship required.**

Project: Aircraft Flight Coordination App for Tablet Computer

Group 105: Airborne Radar Systems and Techniques

Req # 31081

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/airborne-radar-systems-and-techniques

POC: Dan Rabideau; danr@ll.mit.edu

The goal of this project is to create an tablet-based system for coordinating aircraft during flight operations. The tablet will run an app developed by the intern. The app should interface with a commercial radio devices that transmit position information from one or more remote platforms (either aircraft or ships). The intern-developed app should continuously smooth and predict the location of ownship and remote aircraft. The app should display aircraft locations on the tablet, overlaid upon a map. The tablet should also display designated ground locations, and/or locations of a designated surface vessel as reported by AIS. The app should calculate the bearing angles between each aircraft and the designated ground locations. The app should calculate bearing angle differences (often called "bistatic angles"). The app should recommend aircraft speed/heading adjustments so as to maintain a desired bistatic angle or aircraft separation, and optionally display the calculated bearing angles and bistatic angles.

Desired Skills: The candidate should be pursuing an undergraduate degree. Desired concentration in Computer Science, electrical engineering, or applied mathematics with sufficient experience in python, java and C++ . **U.S. Citizenship Required.**

Project: Software Development for Photon-Counting LIDAR Data Processing and Visualization

Group 106: Active Optical Systems

Req # 31071

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/active-optical-systems

POC: Diego Rivera; diego.rivera@ll.mit.edu

Description: The Active Optical Systems Group's mission is to establish a laser radar / lidar center of excellence through development of advanced laser radar technology. One of the major research thrusts in this pursuit is implementation and application of three-dimensional laser radars employing novel receiver technology featuring arrays of detectors that are individually sensitive to single photons. The group is currently addressing the development and operation of airborne and ground-based 3D lidars, along with data collection, data exploitation, and simulation and modeling efforts for various applications. The group is also pursuing significant efforts in the development of coherent laser radar, including adaptation of advanced radar techniques to the optical environment, pushing the bandwidth of coherent systems into the terahertz regime, and using photon-counting detector arrays in coherent receivers. The goals of these efforts range from laboratory demonstrations to development of field-deployable systems. The group is also developing technologies for advanced passive EO/IR sensing techniques, associated signal processing and algorithms.

The group seeks an intern to support software development for photon-counting LIDAR data processing and visualization.

Desired Skills: An intern with a background in Engineering, Computer Science, Physics, or Mathematics will be required to support the development of software solutions for the storage, processing, manipulation and visualization of LIDAR data. The ideal candidate will have completed two years of coursework in software development. The candidate must have strong experience with C++. Previous experience with Python, git, OpenGL and CUDA is desired. **U.S. Citizenship Required**

Project: Algorithm Development for Photon-Counting LIDAR Data Processing

Group 106: Active Optical Systems

Req # 31071

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/active-optical-systems

POC: Alex Vasile; alexv@ll.mit.edu

Description: The Active Optical Systems Group's mission is to establish a laser radar / lidar center of excellence through development of advanced laser radar technology. One of the major research thrusts in this pursuit is implementation and application of three-dimensional laser radars employing novel receiver technology featuring arrays of detectors that are individually sensitive to single photons. The group is currently addressing the development and operation of airborne and ground-based 3D lidars, along with data collection, data exploitation, and simulation and modeling efforts for various applications. The group is also pursuing significant efforts in the development of coherent laser radar, including adaptation of advanced radar techniques to the optical environment, pushing the bandwidth of coherent systems into the terahertz regime, and using photon-counting detector arrays in coherent receivers. The goals of these efforts range from laboratory demonstrations to development of field-deployable systems. The group is also developing technologies for advanced passive EO/IR sensing techniques, associated signal processing and algorithms.

The group seeks an intern to support algorithm development for photon-counting LIDAR data processing.

Desired Skills: An intern with a background in Engineering, Computer Science, Physics, or Mathematics will be required to support the development of novel and robust analysis solutions for the manipulation of LIDAR data. The ideal candidate will have completed two years of coursework in Engineering, Computer Science, Mathematics, or Physics. The candidate must have experience with high-level programming languages, such as MATLAB, Python, or C++. Previous experience with algorithm development, computer vision, and data analysis is preferred. **U.S. Citizenship Required**

Project: Real-time 3D LADAR Processing System Development

Group 106: Active Optical Systems

Req # 31081

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/active-optical-systems

POC: Alex Vasile; alexv@ll.mit.edu

Description: The Active Optical Systems Group's mission is to establish a laser radar / lidar center of excellence through development of advanced laser radar technology. One of the major research thrusts in this pursuit is implementation and application of three-dimensional laser radars employing novel receiver technology featuring arrays of detectors that are individually sensitive to single photons. The group is currently addressing the development and operation of airborne and ground-based 3D lidars, along with data collection, data exploitation, and simulation and modeling efforts for various applications. The group is also pursuing significant efforts in the development of coherent laser radar, including adaptation of advanced radar techniques to the optical environment, pushing the bandwidth of coherent systems into the terahertz regime, and using photon-counting detector arrays in coherent receivers. The goals of these efforts range from laboratory demonstrations to development of field-deployable systems. The group is also developing technologies for advanced passive EO/IR sensing techniques, associated signal processing and algorithms.

The Active Optical Systems Group is interested in full-semester intern to help develop a real-time 3D LADAR processing system. The intern will work closely with a mentor to help evaluate hardware architectures and suitability of porting existing 3DLADAR processing algorithms onto GPU/edge-computing solutions. The work will include performing timing and computational usage analysis, identify code optimization opportunities and implement algorithm or implementation changes to give desired performance.

Desired Skills: Experience with C++, GPUs, and CUDA is required, knowledge of Python, OneAPI and VITIS is desirable. **U.S. Citizenship Required**

Project: Sensor System Control Interface Development

Group 106: Active Optical Systems

Req # 31081

Website: https://www.ll.mit.edu/r-d/isr-systems-and-technology/active-optical-systems

POC: Ekaterina Sergan; ekaterina.sergan@ll.mit.edu

Description: The Active Optical Systems Group's mission is to establish a laser radar / lidar center of excellence through development of advanced laser radar technology. One of the major research thrusts in this pursuit is implementation and application of three-dimensional laser radars employing novel receiver technology featuring arrays of detectors that are individually sensitive to single photons. The group is currently addressing the development and operation of airborne and ground-based 3D lidars, along with data collection, data exploitation, and simulation and modeling efforts for various applications. The group is also pursuing significant efforts in the development of coherent laser radar, including adaptation of advanced radar techniques to the optical environment, pushing the bandwidth of coherent systems into the terahertz regime, and using photon-counting detector arrays in coherent receivers. The goals of these efforts range from laboratory demonstrations to development of field-deployable systems. The group is also developing technologies for advanced passive EO/IR sensing techniques, associated signal processing and algorithms.

The Active Optical Systems Group is seeking a fall semester intern to assist in software and electrical engineering needs as well as system testing efforts for an ongoing program. The intern will be working with a sensor system currently under development and integration - adapting and expanding upon an existing codebase and interfacing with engineers actively building the system. Specific software needs will be to assist in implementing baseline functionality, expanding on to include new features and to streamline the operator interface. Further goals may include implementing and characterizing a closed loop optical scanner system as a subcomponent of the sensor.

Desired Skills: The candidate should have moderate to strong experience in LabVIEW software development and using serial communication protocol. **U.S. Citizenship Required**

Project: Reinforcement Learning for UAV Search and Rescue

Group 107: Advanced Capabilities and Systems

Req # 30625

Website: https://www.ll.mit.edu/r-d/tactical-systems/advanced-capabilities-and-systems

POC: Carlyn Dougherty; carlyn.dougherty@ll.mit.edu

Description: The Air Force AI Accelerator leverages the talent and resources available in the MIT and the Air Force communities to develop novel AI algorithms and systems that impact Air Force problems. This accelerator project aims to develop a multi-agent autonomous platform for unmanned aerial vehicles (UAV) to search complex environments. One example application is a search-and-rescue team of UAVs working together to identify victims in need of help during a natural disaster. This multi-disciplinary effort combines projects in reinforcement learning, real-time mapping, image processing, and several other disciplines. All algorithms are tested within a photorealistic simulation environment, after which they are deployed in hardware, requiring the team to carefully consider the efficacy of their model through that transfer.

In the proposed project, the student would develop, train, and test reinforcement learning flight models for specific search-and-rescue tasks in simulation. The project will be building upon current work and developing new strategies from research. On-site work permitting, the project will include integrating with hardware and testing. One key challenge will be how to properly structure and streamline the trained models to be deployed on small-footprint platforms. We will be attempting to achieve high-level performance of our models on an embedded system, which presents efficiency constraints.

Desired Skills: The ideal candidate would be pursuing a graduate degree in computer science, aerospace engineering, electrical engineering, or a related field. Rising senior undergraduates with significant relevant experience will also be considered. The candidate should have experience with reinforcement learning development and tools as well as proficiency in Python/Java/C++. The ideal candidate would also have some familiarity with flight vehicle dynamics and controls, small platform robotics and/or the Unity simulation engine. **U.S. Citizenship Required**.

Project: Cloud Classification in Visible Imagery

Group 108: Tactical Defense Systems

Req # 30586 and 30621

Website: https://www.ll.mit.edu/r-d/tactical-systems/tactical-defense-systems

POC: Vito Mecca; vito.mecca@ll.mit.edu

Description: The goal of this project is to research, develop, and assess learned methods for performing semantic segmentation of scenes in electro-optical (EO) imagery and video data for the purpose of ground-based meteorological cloud classification.

The ability to identify and characterize cloud coverage impacts a number of applications ranging from alerting communities to near-term hazardous weather, predicting the year-round performance of photovoltaic solar panels in a geographical region, and studying the impact of aircraft contrails on global warming. Active research in this area has gravitated towards computer vision algorithms that classify cloud content through the use of neural networks and machine learning algorithms. In this project, the student will investigate the use of neural networks to characterize the contents of visible imagery in terms of cloud types. The student will investigate features in EO imagery that contribute to successful classification and contribute to the building of labeled training imagery databases. This work will involve the use of real-world EO data in an offline processing environment.

Desired Skills: The candidate should be pursuing an undergraduate degree at MIT with a concentration in computer science, electrical engineering, or applied mathematics. Proficiency with Python, MATLAB or other similar programming language is required. Experience with deep learning frameworks (e.g. PyTorch or TensorFlow), GPU computing and demonstrated analysis skills are a plus. **U.S. Citizenship Required.**

Project: Environmental impact on Infrared sensors

Group 109: Systems and Analysis

Req # 30661

Website: https://www.ll.mit.edu/r-d/tactical-systems/systems-and-analysis

POC: Emily Lesser; emily.lesser@ll.mit.edu

Description: The goal of this project is to assess the impact of methane concentration on atmospheric transmission in the long-wave Infrared (LWIR) band. Unlike most other greenhouse gases, the methane absorption bands in the atmosphere are not saturated, so as the methane concentration increases there is potential for a significant increase in atmospheric absorption in specific bands. Significant increases in absorption have the potential to degrade infrared sensor performance and constrain future sensor designs. The student intern would be responsible for learning how to use the existing atmospheric modeling software with custom atmospheric profiles, developing analysis tools, and building a final report or presentation on the results.

Desired Skills: The candidate should be pursuing an undergraduate degree and have proficiency with Matlab, Python, or a similar programming language. A background in Physics, Chemistry, or Atmospheric Science is preferred but not required. Demonstrated analysis skills are a plus. **U.S. Citizenship Required**.