NASA International Internship Project List
Projects Eligible Under the
"Canadian Student Participation in the NASA International Internship (NASA I^2) Project (summer 2022, fall 2022 & spring 2023)"
Announcement of Opportunity

Project Number	NASA Center	Project Title	Mentor	Project Description	Requirements
1	Ames Research Center Moffett Field, California	Robotic Sample Transfer Automation	Brian Glass	The Atacama Rover Astrobiology Drilling Studies (ARADS) project is a Science Mission Directorate-sponsored project led at NASA-Ames. ARADS proposes a Mars rover analog mission as a field test of an integrated rover-drill system with prototype life-detection instruments that are flight mission candidates. The essential elements to ARADS are: 1) use of integrated drill and rover at sites in the Atacama Desert in Chile in unprepared "regolith"; 2) field use of instruments with the rover/drill that are flight prototypes comparable to those planned for ExoMars and Icebreaker; 3) acquire drilled cuttings and transfer to instruments onboard the rover; 4) on-board autonomy and monitoring to support drilling; mission and demonstrate science support (operations and control) for the rover/drill/instrument operations. This intern project will address the third element above: automated sample transfer between a drill (on one side of the KREX2 rover) and instrument intakes (on the other side of the rover). The ARADS sample transfer arm is mounted on a KREX2 rocker, which rotates relative to the central platform on which both the drill and instruments are mounted. Hence, as the rover moves, the trajectory between the drill and instruments will rotate relative to the sample arm's origin point. The arm is powered by servo motors which respond to pulse width modulation signals from the arm interface – two extra servo control channels support the testing of end effectors with up to two actuators. The intern will assist an existing ARADS staff member in developing a dynamic transformation for arm trajectories that will automatically compensate for rocker rotation and for vertical drill movements. This will be coded and tested with the actual arm, drill and rover mechanisms.	

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2	Ames Research Center Moffett Field, California	Rover-Instrument Automation and Data Integration	Brian Glass	The Atacama Rover Astrobiology Drilling Studies (ARADS) project is a Science Mission Directorate-sponsored project led at NASA-Ames. ARADS proposes a Mars rover analog mission as a field test of an integrated rover-drill system with prototype life-detection instruments that are flight mission candidates. The essential elements to ARADS are: 1) use of integrated drill and rover at sites in the Atacama Desert in Chile in unprepared "regolith"; 2) field use of instruments with the rover/drill that are flight prototypes comparable to those planned for ExoMars and Icebreaker; 3) acquire drilled cuttings and transfer to instruments onboard the rover; 4) on-board autonomy and monitoring to support drilling; mission and demonstrate science support (operations and control) for the rover/drill/instrument operations. This student project will address the fourth element above: integrated remote rover and instrument control in science operations. The current ARADS rover (KREX-2) hosts three instruments, plus a drill and robot arm. The drill and arm are already partially integrated and hosted on the rover CPU. The instruments are controlled and return their data to two auxiliary laptops strapped to the rover. These communicate by wifi and trunk network connections with instrument team members. Intern will assist ARADS developers in developing system operating procedures, drill and arm control software, drilling system diagnosis and executive controls. The student with work with both the KREX2 rover team and the instrument leads and existing ARADS team members (Thomas Stucky, Antoine Tardy) to define the internal interfaces for commands and data to be relayed from the rover. A “data suitcase” of instrument results and images will be defined and a mechanism developed with the rover team to capture the “suitcase” and then forward it intact to a remote science server for offline parallel analysis by the science team. Likewise, a command dictionary to each instrument will be defined.	

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3	Ames Research CenterMoffett Field, California	Genomics of Single Cell Mechanos-transduction in Mouse Embryonic Stem Cells	Eduardo Almeida, Cassandra Juran	Forces generated by gravity have a profound impact on the behavior of cells in tissues and can affect the course of the cell cycle and differentiation fate of progenitors in mammalian tissues, potentially impacting the course of normal tissue regenerative health and disease. In this context, to enable Human space exploration, it is increasingly important to understand the gene expression patterns associated with regenerative health and disease as they relate to space travel in microgravity. Until recently changes in gene expression of stem cell progenitors exposed to spaceflight factors have been difficult to interpret, primarily because cellular responses are often not homogeneous in tissue populations, and may occur only in a subset of those cells. In stem cells in particular, “cell decisions” made in response to stimulation may include proliferative self-renewal, progression to differentiation, or entry into a state of replicative quiescence, however the gene expression programs associated with each are not readily knowable in a mixed cell population. Recent developments however now allow us to isolate and separately barcode mRNAs from thousands of single cells and to sequence their expressomes, opening a new field of “quantum genomics” in which regulatory gene networks and stimulus responses are studied and understood with greater clarity at the single cell level. In this project the fellow will specifically culture mouse embryonic stem cells and model gravity by either mechanostimulating them with axial stretch and compression, or not, as they initiate development in vitro, then conduct single cell isolation and barcoding of mRNAs using the 10XGenomics Chromium Controller, followed by reverse transcription into cDNAs and preparation of sequencing libraries for Illumina NGS or Oxford Nanopore long read sequencing. The fellow will also utilize bioinformatic tools including Cell Ranger, Loupe, and GeneSpring to analyze results and attempt to identify common patterns of gravity mechanoresponses in stem cells. If conducted successfully, this research may enable the development of novel tissue regenerative approaches to tissue degeneration such as that induced by spaceflight in microgravity.	

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4	Ames Research Center Moffett Field, California	The Influence of Mechanical Unloading on Biological Function	Eduardo Almeida, Cassandra Juran	The spaceflight environment, including microgravity and space radiation, is known to negatively impact mammalian physiology, including somatic stem cell-based tissue regeneration. The degenerative effects of spaceflight that we understand best include rapid microgravity-adaptive bone and muscle loss, loss of cardiovascular capacity, defects in wound and bone fracture healing and impaired immune function. These implications pose a significant risk for long-term human space exploration. Our work focuses on the influence of mechanical unloading on stem cell proliferation, differentiation and regeneration and how alterations in stem cell function may be the cause of widespread tissue degeneration in space. In this opportunity, the selected candidate will work with research scientists to analyze the response of mouse bone and bone marrow stem cells to mechanical unloading using both spaceflight samples and mouse hindlimb unloading experiments. The intern will investigate stem cell responses to microgravity and mechanical unloading using gene expression and protein analysis and furthermore, will investigate the influence of stem cell function on whole bone tissue properties - including structural and molecular analysis. Furthermore, the intern will also work with scientists on optimizing conditions for an upcoming spaceflight experiment where we aim to identify key molecular mechanisms that cause degenerative effects in bone tissue through impaired differentiation of mesenchymal stem cells. The intern will conduct cell culture and gene expression/protein assays to characterize wildtype stem cells compared to the transgenic model. The intern will then work with research scientists to determine the optimal cell culture parameters to conduct the experiment in spaceflight hardware.	Laboratory experience is preferred.

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5	Ames Research CenterMoffett Field, California	Machine Learning classification of transit-like signals	Hamed Valizadegan	Kepler and TESS are critical missions to increase our understanding of how common earth-like planets (in habitable zone) are. These telescopes work based on transit photometry and their pipelines return a list of threshold crossing events (TCEs) whose light signature resemble a planet. However, not all TCEs are planet orbiting a star and they could be due instrument noise or other astrophysical phenomena. We have been exploring deep learning technology for automatic classification of TCEs and finding planets from non-TCEs. Using our in house tools, we have been able to identify new planets (subject to confirmation). We also have identified multiple ways to improve the existing classifiers and we are looking for interns who can explore these new ways. This internship opportunity is very rewarding because the result will lead to the discovery of new exo-planets. We will also publish the results in prestigious journals. This is a great opportunity to get some visibility. A potential interns needs to know how to program in python and write deep learning codes. The intern is expected to help us developing parts of this project in Python. Tools we use for this project are scikit-learn and Keras (and TensorFlow). Specific Tasks and Responsibilities: Python Coding, Research on appropriate deep learning architectures for time series classification.	AI General knowledge, Bachelor (Masters or PhD is preferred). Python programming.
6	Ames Research Center Moffett Field, California	Deep Learning Binarization of Vascular images	Hamed Valizadegan	The Space Bioscience Research Branch (SCR) of NASA Ames has developed VESGEN, a software package for analyses and study of vascular images. A bottleneck in efficient application of VESGEN is the fact that it needs binary images as input in order to analyze the vascular images and provides insight about them. Currently, a VESGEN user needs to semi-manually binarize a vascular image using CAD software packages such as Adobe Photoshop before giving the image as input to VESGEN for analysis. Binarization aims to categorize the pixels of a vascular image into two categories, foreground or Vessel pixels and background pixels. We are investigating deep learning technologies to automate the binarization of vascular image. Our results with deep learning have been very encouraging and we are looking to hire an intern to help us further improve the existing technology! Specific Tasks and Responsibilities: Python Coding, Research on appropriate deep learning architectures for image segmentation.	AI General knowledge. Bachelor (Masters or PhD is preferred). Python programming.

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7	Ames Research Center Moffett Field, California	Biosensor Development	Jessica Koehne	Development of biosensors is an active field due to a wide range of applications in lab-on-a-chip, diagnostics of infectious diseases, cancer diagnostics, environment monitoring, biodetection and others. One of the strategies used for selective identification of a target is to /preselect/ a probe that has a unique affinity for the target or can uniquely interact or hybridize with the target: sort of a "lock and key" approach. In this approach, one then needs a platform to support the probe and a recognizing element that can recognize the said interaction between the probe and the target. The interaction result can manifest optically (by using dyes, quantum dots for example) or electrically. The platform design and configuration may vary depending on whether optical or electrical readout is used and what environment the sensor will be utilized. Recently, printed biosensors on paper substrates have gained much attention for their low cost of manufacture. Within NASA, such printed devices are being investigated because of our potential ability to manufacture in an in-space environment. Such a biosensor would be a print-on-demand device. The current project involves fabricating and validating a printed, electrical biosensor for cardiac health monitoring from a whole blood sample. The intended NASA application is point of care diagnostics for astronaut health monitoring.	

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8	Ames Research CenterMoffett Field, California	Space Structure Assembly Robotics - The Automated Reconfigurable Mission Adaptive Digital Assembly System (ARMADAS) Project	Kenny Cheung/Christine Gregg	The Coded Structures Laboratory at NASA Ames Research Center conducts research across material science, robotics, and algorithms, for application to aeronautics and space systems. The lab's current primary project is titled Automated Reconfigurable Mission Adaptive Digital Assembly System (ARMADAS), and it incorporates a building-block based approach to automated assembly of ultralight lattice-based structures for space infrastructure. Expected activities for this position can be both theoretical and experimental in nature. Advanced research using multidisciplinary analyses seeks to understand the mechanics of new mechatronic and structural strategies and to develop predictive analytical models for the design of systems with novel behavior. Experimental work seeks to obtain accurate data to validate these analyses. * Expected opportunity outcome (i.e. research, final report, poster presentation, etc.): At the conclusion of the internship, the intern will prepare a final report and either make a final presentation or participate in a poster day. The results of the research, if appropriate, can be considered for abstract submittal to a conference in the appropriate subject area forpublication. Graduate students may consider more focused investigations leading to preparation of a technical journal article.	

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9	Ames Research Center Moffett Field, California	Orbit Analysis for LEO CubeSats and Low Lunar Orbits	Marcus Murbach	The intern will fulfill assignments as a member of the orbital dynamics team in the Mission Design Division at NASA Ames Research Center. The Mission Design Division conducts early-stage concept development and technology maturation supporting the Center's space and aircraft mission proposals. Personnel have experience in mission planning, small spacecraft design, and engineering analysis. The Mission Design Division, or MDD, supports the full mission life cycle in the areas of: • Early Concept Development • Mission Design • Rapid Prototyping • Mission Implementation The candidate will work closely with flight dynamics engineers to expand existing innovative approaches to low altitude orbit design. This work includes the effects of differential drag in Low Earth Orbit (LEO), as well as, the effects of mascon perturbations in low lunar orbits. SmallSat and CubeSat missions are a specialty of Ames Research Center and current research addresses practical issues with small spacecraft missions in a LEO and an interplanetary environment. Another orbital mechanics specialty of ARC is low, equatorial lunar orbits and design tools for addressing lunar gravitational perturbations. For lunar orbits, we plan to expand the research on equatorial frozen orbits and the visualization displays for characterizing gravitational perturbations. For LEO, the characterization of the effects of drag in relative satellite disposition is in the scope of this position. The goals of this assignment include documentation and display tools that will reside as part of the Mission Design Division's computational capability. Additional assignments as needed may involve CubeSat low thrust trajectory design, multiple CubeSat swarms, and CubeSat reentry calculations.	Candidate's Computer and/or special skills: GMAT or STK/Astrogator, Matlab or Visual Basic. Strong writing skills are expected, both for internal documentation of work accomplished and for publications resulting from this work.

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10	Ames Research CenterMoffett Field, California	Analyzing satellite and drone imagery from the Atacama Desert, a Mars analog environment in Chile	Mary Beth WilhelmKim Warren-Rhodes (SETI)	The project goal is to understand the impact of an extreme and rare rainfall event on the modification of soil and unltimately on the generation and preservation of molecular biosignatures from the largely inactive microbial community in the driest soils in the Atacama Desert, Chile. This work has implications for predicting if rapid shifts in water availability could impact a putative microbial population sufficiently to generate measurable biomarkers in modern Martian near-surface environments (e.g. RSL, gullies, northern plains ice-cemented soil), and inform where future missions should search for biomarkers that could have been preferentially preserved. More specifically, we would like to have a student (1) analyze nano-climate sensor data from hyperarid Atacama soils and map data onto regional gravimetric moisture data; (2) integrate and analyze historical satellite data, drone, and field imagery to understand the extant, patterns, and history of the water regime in the driest parts of the Atacama Desert; and (3) develop a fluvial map and construct a simple model of water transport and accumulation across surfaces and infiltration into the soil column at different spatial scales.	
11	Ames Research Center Moffett Field, California	Nanotechnology in electronics and sensor development	Meyya Meyyappan/Jin Woo Han	Nanomaterials such as carbon nanotubes (CNTs), graphene and a variety of inorganic nanowires offer tremendous potential for future nanoelectronics, nanosensors and related devices. We have active ongoing programs in these areas. Several examples are given below. Chemical sensors to detect trace amounts of gases and vapors are needed in planetary exploration, crew cabin air quality monitoring and leak detection; there are numerous societal applications as well. We have been working on CNT based sensors amenable for various platforms including smartphones. Flexible electronics on substrates such as textile and paper is of great deal of interest to us. We have fabricated gas/vapor sensors on cotton textile as well as cellulose paper. Other interests in paper electronics and flexible substrates include memory devices, energy storage devices, displays and detectors. Finally, we have also been revisiting vacuum tubes although in the nanoscale, using entirely silicon based technology. These radiation resistant devices offer exceptionally high frequency performance. Our interest here extends to exploring the nano vacuum tubes for THz electronics applications. In all the areas, the projects include material growth, characterization, device fabrication, device testing and evaluation, reliability and lifetime assessment.	For device related aspects, majoring in electrical engineering or physics is preferred. For the remaining aspects of the project, majors in material science, chemistry and other engineering disciplines are welcome. PhD candidates and talented undergraduates will get preference.

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12	Ames Research Center Moffett Field, California	Novel Planetary Robotic Sensor Development	Michael Dille	Long-term wide-area measurement of dynamic environmental surface-level phenomena in hard-to-reach areas is of growing interest for atmospheric research in both planetary exploration and Earth science contexts. These may include flows or variations in moisture, gas composition or concentration, particulate density, or even simply temperature. Improved knowledge of these processes delivers a deeper understanding of exotic geologies and distributions or correlating indicators of trapped water or biological activity. However, such measurements must frequently be taken in unsafe areas such as caves, lava tubes, or steep ravines where neither human field teams nor robotic vehicles can easily reach. To provide such a capability, we have developed small expendable sensors which may be hand-placed, lobbed from a robotic vehicle, or dropped from aircraft. Deployed sensors form a mesh network, communicating wirelessly during flight and once anchored, to provide radio or optical beacons and monitoring using cameras, environmental sensors, and miniature chemical detectors. We seek students interested in refining the existing prototype system, developing new sensor payloads, and evaluating new deployment mechanisms.	The ideal intern is a well-rounded student with interest in sensing instrument development. Depending on area of interest, relevant skills include electronics, mechanical design, embedded software development, RF, or optics. Opportunities in sensor data visualization and prediction of dynamic phenomena are also open. Project Area of Research: Sensors, embedded systems, electronics, mechanisms, RF, data visualization.
13	Ames Research CenterMoffett Field, California	Lunar Topographic Products from Orbital Images	Terry Fong	Digital terrain models are essential for cartography, science analysis, mission planning and operations. The NASA Ames Intelligent Robotics Group (IRG) has developed software to automatically generate high-quality topographic and albedo models from satellite images. Our software, the Ames Stereo Pipeline (ASP), uses stereo vision and photoclinometric techniques to produce 3D models of the Earth, Moon, and Mars with very high accuracy and resolution. The intern will assist IRG to improve the quality of topographic products from lunar orbital images. In particular, the intern will help develop multi-stage stereogrammetric methods to exploit the full potential of multiple, overlapping views of a planetary surface. The intern will work closely with NASA researchers and engineers throughout the internship. Very strong emphasis is placed on incorporating and integrating the intern's research into IRG's on-going projects. Research results may be published in one (or more) technical forums: as a NASA technical report, a conference paper, or journal article.	The intern must have a background in Computer Science or Mathematics. Practical experience with computer programming, Linux-based software development and open-source tools (gcc, git, etc) is required. Experience with C++ is strongly encouraged.

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14	Ames Research Center Moffett Field, California	SUPERball 2.0 Tensegrity Robot	Massimo Vespignani, Terry Fong	We are looking for a student intern to help with electronics design and integration for our SUPERball 2.0 tensegrity robot. The participant will conduct basic research in mobile robotics in the Intelligent Robotics Group (IRG) at the NASA Ames Research Center. Research will involve development of advanced mobile robots, including design and testing of novel mechatronic systems with SUPERball 2.0. Developing advanced mobile robots is critical to improving the performance and productivity of future NASA exploration missions. In particular, methods that enable dynamic tensegrity system to function robustly and autonomously under a wide range of environmental and operational conditions will enable robots to be used for a broader set of missions than is currently possible.	The applicant should be enrolled in a master level engineering program and have previous experience in electronics development. Good knowledge of C and Matlab and a Linux environment is preferred. Ability to work independently and effectively as part of a multidisciplinary team, prioritize tasks, coordinate tasks with others, and meet deadlines are a major plus.
15	Ames Research Center Moffett Field, California	Evaluation of Biomedical Devices for Exploration Missions	Tianna Shaw	The primary responsibility for this intern position is to support the development and testing of biosensor monitoring systems in support of the Human Research Program (HRP) Exploration Medical Capability (ExMC) Element. The Ames Research Center (ARC) team focuses on the integration of biomedical devices into a prototype medical data architecture (MDA), that will receive, store and display a wide variety of physiological parameters which include; electrocardiogram (ECG), heart rate, blood pressure, pulse oximetry, respiratory rate, and body temperature. The intern will work under the guidance of an ExMC project engineer and will also work with ExMC project system engineer. The intern will support human in the loop laboratory testing of biomedical devices and development of the medical data architecture system. The intern will also participate in data collection, processing and analysis of biosensor data and assist in report writing. He/She will support MDA operations in collaboration with CSA prototype wearable biosensor system and other systems.	

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16	Ames Research Center Moffett Field, California	Erosional Studies of Mars and Earth Using Digital Terrain Models	Virginia Gulick	Fluvial and hydrothermal studies using HiRISE images and Digital (Terrain) Elevation Models, combined with CTX, HRSC, CRISM, and other Mars or terrestrial data sets. These studies are focused mainly on the formation of gullies, channels, valleys and other fluvial landforms on Mars and Earth. Terrestrial analog sites or hydrologic or landform models will be used to illuminate the importance of various processes as well as understanding the implications for paleoclimatic change. Additional opportunities may also be available in assisting with HiRISE science planning and targeting support, submitting image requests, and analysing acquired image data. Geology, geography, or planetary science background is desired.	Experience working with ENVI, Matlab, Photoshop, USGS Integrated Software for Imagers and Spectrometers (ISIS), Geographic Information Systems GIS (e.g., ArcGIS, GRASS), SOCET SET, Ames Stereo Pipeline, and Python programming is helpful. Excellent communication and writing skills are desired. Enjoys working both individually and in teams, with creativity, positive energy, and determination.
17	Ames Research CenterMoffett Field, California	Deep Learning for Satellite Imagery (DELTA)	Brian Coltin/ Terry Fong	NASA Ames is partnering with the USGS and NGA to develop DELTA, an open source toolkit for deep learning on satellite imagery. DELTA will empower Earth scientists to achieve state of the art classification results with little to no knowledge of machine learning or computer programming. Initially, DELTA will be trained and evaluated on mapping floods for disaster response and recovery. Potential later uses include studying other natural disasters, changing land use patterns, climate change, and more.Specific Tasks and Responsibilities: The intern will contribute a feature to the DELTA toolkit which will ideally result in a research publication. Potential projects include: incorporating various metadata into the learning algorithm; experimenting with new neural network architectures or training methods; incorporating multi-satellite sensor fusion; and more, depending on student interest.	Experience with C++ and/or Python, Linux development, and machine learning are preferred.

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18	Ames Research Center Moffett Field, California	Robotic 3D Mapping of Lunar Skylights	Uland Wong	NASA is investigating new ways to explore Lunar skylights with robots. Skylights are giant, recently discovered sinkholes that may lead to intact lava tubes and other caves. Exploration of these skylights and caves is necessary for Lunar science, resource development, and understanding of natural infrastructure. We are developing a proposed mission to drive around the rim of a skylight using small, commercial rovers and to map the walls in 3D using a miniature optical payload. Our project seeks motivated interns who will assist with design, development and testing of a prototype mapping payload suitable for lightweight planetary rovers. Interns will also use computer vision approaches to process, stitch, and create 3D models from image data for scientific analysis.	Interns should have prior robotics and sensing experience. Exposure to 3D computer vision techniques such as image warping, stereo vision, structure from motion, and bundle adjustment is desired. We will be using libraries such as OpenCV and PCL. Ability to prototype mechatronic payloads using nVidia, PC104, Arduino, or Odroid-type embedded systems is a plus.
19	Ames Research Center Moffett Field, California	Thermal Mapping for River Measurement from a UAV	Uland Wong, Michael Dille	The Intelligent Robotics Group at Ames is designing a tightly-integrated UAV payload containing thermal and visible-light cameras to estimate flow rates in streams and rivers using novel optical techniques. In addition to cameras, onboard computing will perform real-time processing to provide live data streaming and vehicle path planning to deliver a complete survey across the water surface. The purpose of this payload is to automate and supplement a sparse and strained network of so-called stream gaging stations that provide the input dataset for US watershed monitoring. This data is critical to track water supplies, predict flood risks, preserve aquatic systems, and respond to natural disasters. This project is collaborative work with the United States Geological Survey (USGS) and presents a chance to engage in cross-cutting research and meet with a variety of scientists.	Interns should be familiar with Robot Operating System (ROS) and capable of developing functionality for a ROS system using C++ or Python programming. Familiarity with camera sensors and image processing (such as with OpenCV) is also desired. Skills for mechanism design (e.g. CAD), payload integration (e.g. electrical or shop skills), and testing are a plus.

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20	Ames Research CenterMoffett Field, California	3D Microscopy and Novel Optical Sensing for Planetary Exploration	Michael Dille, Uland Wong	We have recently developed a new type of miniaturized 3D microscope that uses just a single optical path (a single camera) and a solid-state means of controlling a moving aperture that allows imaging from multiple viewpoints. In conjunction with carefully controlled multi-directional illumination, this multi-view stereo imagery permits extraordinarily high fidelity 3D reconstruction at microscopic scale. This has incredible value in planetary exploration and terrestrial field applications to study surface composition and geometry, generating immersive graphical displays, detecting faint bio-signatures, and analyzing soil structure.Results with the device so far have been excellent, and we now seek to mature the design in either of two ways. First, we wish to further miniaturize and ruggedize the device, produce a compact fully self-contained version, and demonstrate its value for micro-rover or remote sensor pod applications. This includes work in optics design, CAD, and electronics. Second, we want to better characterize its performance under different conditions, extend and refine the 3D reconstruction algorithms, and implement new algorithmic techniques for material segmentation and bulk material property computation using reflectance modeling. This portion is primarily a software-side computer vision problem.We have unique access to a large array of planetary soil simulants to provide an immediately relevant dataset and a strong interest in publishing results in both the machine vision / optics and planetary applications communities.	Some combination of experience is needed with theoretical optics design and/or optical design software such as Zemax, image processing concepts and algorithms, and 3D reconstruction algorithms. Reasonable programming experience is expected to support the task (e.g. matlab, python, or C++). For the interested student, this could provide an excellent senior project, a substantial portion of a Master's thesis, or an interesting direction and application for PhD thesis work in a related area.Project Area of Research:Microscopy, computer vision, optics, sensors, planetary science.

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21	Ames Research Center Moffett Field, California	Novel Media Visualization	Michael Dille, Uland Wong	Robotic planetary exploration is rapidly moving beyond simply taking pictures and detecting basic chemicals, instead now providing ever-larger bodies of data. At the small scale, advanced detectors and imagers now capture fine details of the structure of rocks, soils, dust, while at the larger scale seismographs and climate-scale weather monitoring offer insight into complex wide-area geology and atmospheric processes. The sheer volume of this data and the translation of raw numerical values into representations intuitive for human scientists create great difficulty. Presenting such data to the public in interesting, easily-understood ways is an even greater challenge. Recently developed forms of media including immersive virtual or augmented reality, multi-material 3D printing, and holographic displays offer new and powerful means to meet these challenges by expressing raw and derived data for clear and rapid interpretation. They also provide promise for enabling physically disabled individuals to experience and appreciate environments they could not otherwise reach. We invite a student interested in any or all of these technologies to explore with us such presentation concepts, to produce interactive graphic displays and/or 3D printed artifacts from remotely collected data. We can provide the student with access to our existing array of 3D printers, a rare and extensive collection of planetary soil simulants, low cost 3D displays, and some of the leading experts in planetary robotic sensing and geology.	Some combination of experience in computer vision, computer graphics, display technologies, programming, human-computer interaction, or media arts is needed. Given the complex and high open-ended nature of this work, self-directed senior level students with strong algorithmic and linear algebra backgrounds are suggested. Project Area of Research: Data visualization, computer graphics, media arts, planetary science.

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22	Ames Research CenterMoffett Field, California	Mini Hyperspectral Camera for Planetary Surface Study	Michael Dille, Uland Wong	Determining material composition or biological presence is an important task in remote robotic planetary missions and Earth science field studies. Point spectrometers and filter imagers are popular instruments to collect such data, however they are often bulky devices that provide either poor spatial or spectral resolution. Future mission concepts demand small, inexpensive, and rugged sensors that can be applied to micro-rovers, small unmanned aircraft, and distributed mesh networks.The Intelligent Robotics Group at NASA Ames has developed a concept for a focal plane imager (camera) built upon Micro Electro Mechanical (MEMS) and Liquid Crystal Display (LCD) technologies that is effectively solid state but can produce multi-spectral images in a small device. Crucially, using concepts of compressive sensing theory, the effective resolution of the image can be varied with the number of samples taken, allowing a trade-off between sampling time, desired data quality, computational demand, and data volume. We now seek to build, characterize, and demonstrate a bench prototype of this camera and explore directions for further ruggedization, miniaturization, and increased science applicability.	Relevant research interest as a master's/PhD thesis or mature undergraduate thesis. Mainly, some combination of specific experience optics design theory and/or optical design software such as Zemax, and image processing in software. Electronics and/or mechanical experience would be helpful.Project Area of Research: Computer vision, optics, sensors, planetary exploration.
23	Goddard Space Flight Center, Greenbelt, Maryland	Lunar and Planetary Sample Science	Barbara Cohen	The history of each planet is told through its rocks - how the minerals are put together, what the minerals are made of, and when the rocks were formed. We use multiple analysis techniques to understand the formation, modification, and age of planetary materials to learn about their parent planets. We invite interns to participate in research projects using the Mid-Atlantic Noble Gas Research Laboratory (MNGRL.)	Geology, Chemistry, Planetary Science.

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24	Ames Research Center Moffett Field, California	Architecture Analysis tool for the Lunar Autonomous Positioning System	Kelley Hashemi	The Lunar Autonomous Positioning System (LAPS) concerns construction of an orbital and ground resource network that provides Position, Navigation, and Timing (PNT) services for lunar surface operations. While functionally similar to the Global Positioning System (GPS) for Earth, this system will instead build an automated PNT framework using a combination of participating lunar missions and supplementary PNT assets. The goal is to use distributed algorithms to autonomously achieve orbit determination and time synchronization of accuracy sufficient for lunar surface end-user localization. The focus of the intern's effort will be to enhance a simulation-based tool that facilitates exploration of the many LAPS architecture choices and relate them to user localization accuracy. Tasks could include a portion of the following: 1. Implement functionality to generate realistic measurements among PNT assets including considerations such as line of sight, satellite attitude, noise, signal variation due to selected hardware or operational mode. 2. Implement localization algorithms for an end user on the lunar surface using position and time estimates from visible PNT assets, gauge accuracy for variable system design choices. 3. Develop new or implement other existing automated, distributed orbit determination and time synchronization algorithms that are usable within the confines of the system architecture. 4. Execute localization accuracy trade study using the tool considering hardware selection and operational choices, asset locations, algorithm choice, access to ground truth measurements; separately consider the impact of asset failure.	Computer/Software Skills Required: MATLAB. Desired: GMAT or similar. Scientific and Technical Skills: Familiarity with topics such as Kalman filters, GPS, orbital dynamics, and numerical integration is desirable. Academic Level: College Seniors through PhD.

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25	Ames Research CenterMoffett Field, California	Top-Down Bioengineering Development	Diana Gentry	This is an opportunity for a bioengineering student to participate in the development of a proof-of-concept biofluidics system. Students may have either micro/molecular biology or mechanical/electrical/computer engineering backgrounds, though some cross-disciplinary experience is preferred.The student will have the opportunity to work on all aspects of the project, including validating experimental protocols, generating baseline data from bench top microbiology experiments, conducting hardware and software tests with the prototype, and analyzing data generated from all of the above. They will learn about microbial stress responses and adaptation, lab automation, bioreactors, and biogeochemistry. They will gain real-world experience in working on a multidisciplinary team, experimental design and documentation, developing and meeting science and engineering requirements, and statistics and data analysis.Students will have a chance to present their work at a poster symposium and/or instrumentation workshop. Depending on the breadth of work covered by the students, participation in writing a published research paper is a possibility.	

Project Number	NASA Center	Project Title	Mentor	Project Description	Requirements
26	Ames Research Center Moffett Field, California	VIPER rover, image processing pipeline design and optimization	Arno Rogg	NASA is sending a mobile robot to the South Pole of the Moon to get a close-up view of the location and concentration of water ice in the region and for the first time ever, actually sample the water ice at the same pole where the first woman and next man will land in 2024 under the Artemis program. About the size of a golf cart, the Volatiles Investigating Polar Exploration Rover, or VIPER, will roam several miles, using its four science instruments — including a 1-meter drill — to sample various soil environments. Planned for delivery to the lunar surface in December 2022, VIPER will collect about 100 days of data that will be used to inform the first global water resource maps of the Moon. VIPER is a collaboration within and beyond the agency. VIPER is part of the Lunar Discovery and Exploration Program managed by the Science Mission Directorate at NASA Headquarters. Ames is managing the rover project, leading the mission's science, systems engineering, real-time rover surface operations and software development. The hardware for the rover is being designed by the Johnson Space Center, while the instruments are provided by Ames, Kennedy, and commercial partner, Honeybee Robotics. The spacecraft lander and launch vehicle that will deliver VIPER to the surface of the Moon, will be provided through NASA's Commercial Lunar Payload Services (CLPS) contract, delivering science and technology payloads to and near the Moon. The student will support the rover systems engineer team in accomplishing its mission. More specifically, the focus will be on the imaging pipeline design and optimization. A key part of the mission is to safely teleoperate the rover on the lunar surface. In order to do so, the human operator relies on imagery taken and downlinked from the surface segment. The 3D processing and map generation will take place on the ground, while the image pre-processing and compression will happen on the rover. In the current state, this processing has a lot of variables such as the downlink speed, the compression quality, the different algorithms time. The role of the student will be to understand, and model the different processes. When the modeling is completed, an optimization of the overall image pipeline will be necessary in order for the rover operators to get the highest quality results in the shortest amount of time. The student needs a good understanding of systems engineer, optimization, software processes and demonstrate good skill to develop and model systems using common programming tools. Autonomy, pro-activity and team work is also high recommended.	