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Project	NASA Center	Project Title	Project Description	Requirements
1	Ames Research Center Moffett Field, California	Shockwave Radiation Testing	The Electric Arc Shock Tube (EAST) Facility is NASA's only remaining shock tube capable of obtaining hyperorbital velocities (Mach 10-50, velocities up to ~15 km/s). The EAST data is the primary source of data for informing NASA's radiation modeling practices and associated uncertainties. The intern will participate in planning and conducting tests in the EAST facility, operating the diagnostics, performing calibrations, and analyzing data. The exact tests being performed in EAST will depend on the term of the intern's residency. Current plans for 2018 are to study radiation from expanding flows in the newly refurbished 20º expansion nozzle.	Experience with spectroscopic techniques and/or hypersonic testing facility, esp. shock tubes/tunnels desired. Graduate level (MS or PhD) strongly preferred.

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2	Ames Research Center Moffett Field, California	Genomics of Single Cell Mechanos-transduction in Mouse Embryonic Stem Cells	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 intern 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 intern 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.

FCT Fundação para a Ciência e a Tecnologia

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3	Ames Research Center Moffett Field, California	Deep Learning Binarization of Vascular images	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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4	Ames Research Center Moffett Field, California	Image analysis software based on neural nets and "deep learning"	Image analysis software based on neural nets and "deep learning" has been successfully used to find and classify objects in images. This project investigates whether such software can be used to determine the orientation of an object. For example, it is commonly claimed that image recognition software can use deep learning to recognize the presence of some feature, such as a cat, in an image or video. (http://www.nec.com/en/global/ad/insite/article/bigdata07.html) This is done by providing the software with a large training set of images in which a particular feature has been identified, and allowing the software to learn to recognize that feature in new images. The idea of this project is that if such software is trained with images of a wind tunnel model at different orientations, along with independent information about orientation of the model in each image, the software will be able to recognize the orientation of the model in new images. Currently, wind tunnel model orientation is found with a combination of onboard accelerometers to detect orientation with respect to the gravity vector, and encoders on the model support to detect rotations around the gravity vector (yaw). These methods are less accurate when the principle motion of the model is in yaw (e.g. wings-vertical orientation of the model in the wind tunnel) or the model is too small to accommodate an accelerometer package. Conventional photogrammetry can be used to measure model orientation but requires time-consuming setup and calibration, and is vulnerable to changes in illumination.	Computer science with a focus on data science/neural nets. Aerospace engineering with a strong background in software would also be acceptable. The project will consist of three parts: 1) Set up a simple test apparatus consisting of a rigid body resembling a wind tunnel model, a multi-axis accelerometer, and a yaw meter, on a multi-axis rotation stage. Set up a camera to view the model. Take images at a variety of model orientations while recording the orientation measurements. 2) Feed the images and orientation data into open source deep learning software such as Keras. 3) Compare the accuracy of the resulting software against conventional sensors for determining model orientation.

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5	Ames Research Center Moffett Field, California	Biosensor Development	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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6	Ames Research Center Moffett Field, California	Space Structure Assembly Robotics - The Automated Reconfigurable Mission Adaptive Digital Assembly System (ARMADAS) Project	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 for publication. Graduate students may consider more focused investigations leading to preparation of a technical journal article.

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7	Ames Research Center Moffett Field, California	Aerothermodynamics Modeling	The Aerothermodynamics Branch at NASA Ames Research Center focuses on advancing the understanding of the fundamental aspects of hypersonic flows for multiple planetary atmospheres including Mars, Venus, Titan, and Earth. Computational Fluid Dynamics solvers, coupled with non-equilibrium radiation codes, are employed for this purpose. Interns will collaborate with engineers and scientists to enhance the capabilities of the current software to better capture the fundamental aspects of the basic physical phenomena in hypersonic flows. They will have access to a world class HPC machine and will be using state-of-the-art physical models and numerical methods. Multiple openings are available in the following areas: - Develop an accurate and efficient radiation-flow solver coupling strategy. - Support the development of a robust and scalable adaptive mesh refinement algorithm. - Assess the performance of the shockwave radiation solver, NEQAIR, on hybrid nodes (CPU/GPU) and investigate optimization strategies.	Experience with Fortran and shell scripting. Experience with computational modeling and parallel simulations.

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8	Ames Research Center Moffett Field, California	Orbit Analysis for LEO CubeSats and Low Lunar Orbits	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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9	Ames Research Center Moffett Field, California	Experimental Visualization of Shock Structure in a Miniature Arc Jet	The Thermophysics Facilities Branch has recently upgraded its 30 kW miniature arc jet (mARC II). These upgrades have resulted in a high-speed, high-temperature jet with a new shock structure. The intern will be integral in implementing and analyzing experimental diagnostics aimed at characterizing the flow physics and operational health of the upgraded facility. This may include visualization of the shock structure within the jet, measurements of the magnetic field around the arc heater, spectroscopic studies of the plasma within the column, and both standard and non-intrusive methods of measuring jet quantities such as heat flux, stagnation pressure, or electron density. The intern will work closely with the team that operates and maintains the mARC. Student will give a final presentation and compile a final report documenting the work completed at ARC. If the results support it, the work will be considered for submission to a conference or journal publication.	Student should be a graduate student with a solid background in aerospace or mechanical engineering and familiarity with fluid flow, optical diagnostics, and experimental research. The student should be able to work as part of a team. Pursuing Masters Pursuing Doctorate Pursuing Post Doctorate Engineering - Aerospace Eng. Engineering - General Engineering - Instrumentation Eng. Engineering - Materials Eng. Engineering - Mechanical Eng. Engineering - Optical Eng.

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Project	NASA Center	Project Title	Project Description	Requirements
10	Ames Research Center Moffett Field, California	Novel Planetary Robotic Sensor Development	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

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Project	NASA Center	Project Title	Project Description	Requirements
11	Ames Research Center Moffett Field, California	Control Internship Position	Advances in material technologies have led to a new class of ultra-efficient transport aircraft that incorporate advanced high-aspect ratio flexible wing designs with novel control effectors. The NASA Performance Adaptive Aeroelastic Wing (PAAW) research element under the NASA Advanced Air Transport Technology (AATT) project seeks to develop control technologies and analysis capabilities to enable the implementation of these advanced future wing designs. Development of control systems for highly flexible wings is a critical component of this relevant and challenging field. This internship opportunity will support the NASA research team in developing disturbance estimation techniques for use in both adaptive and non-adaptive control designs for gust load alleviation. The intern will also help formulate design requirements for future hardware that facilitate successful estimation and control. Specific applications for the techniques developed include flight control, wing shaping, and load alleviation of flexible wing aircraft. Final deliverables for this internship include any research results such as report, presentation, or conference publication as well as simulations demonstrating operation of the disturbance observer in use with the control system.	The intern should have theoretical and practical knowledge of control and estimation including adaptive control, as well as extensive experience simulating dynamic models within MATLAB/Simulink.

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12	Ames Research Center Moffett Field, California	Experimental Aero-Physics Engineering Intern	The intern will help with a variety of experimental projects which investigate the fluid mechanic, aerodynamic, and/or aeroacoustic characteristics of manned and unmanned spacecraft, aircraft, rotorcraft, ground vehicles, ships, structures, sports balls, and other objects. The experimental projects will be conducted in conjunction with on-site research mentors, using NASA Ames wind tunnel, water channel, lab, and/or computer facilities. The intern will assist with many different phases of one or more test programs; these phases may include prior data review and test planning, test logistics, experimental design and setup, model construction and installation, instrumentation calibration, installation, and operation, test video/photo documentation, post-test data plotting and analysis, and report development. The intern may also assist with the development and execution of various computer programs used to analyze or simulate the results of experimental test programs. The main outcome of this internship will be experience with a variety of disciplines related to fluid mechanics, aerodynamics, and/or aeroacoustics.	Physics, Science, Math, Engineering backgrounds preferred

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13	Ames Research Center Moffett Field, California	Lunar Topographic Products from Orbital Images	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	3D Microscopy and Novel Optical Sensing for Planetary Exploration	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