JPL SIRI INTERNSHIP ANNOUNCEMENTS OF OPPORTUNITY - SPRING 2023
(Subject to change without notice)

AO#: 14002
Project: Spacecraft Microbial Isolate Identification
Internship Type: On-site
Preferred Major(s): Biology, Chemistry

Desired Background/Skills: Introductory Microbiology and general Chemistry Courses. Knowledge of Microsoft Excel and familiarization with scientific graphical presentation.

Description: The Mars Program Office support a long-term project that is called Planetary Protection Archiving. The purpose of this archive is to preserve and identify new organisms arising from PP Bioassays done in support of Planetary Exploration Missions from the 1970 through the present time. This archive is intended to provide greater understanding of biological contamination related to spacecraft, assembly areas and assembly procedures. This new understanding aids in procedures implemented to lower bioburden on spacecraft. The identification of these specimens is accomplished by comparing sequences of the 16SrRNA gene to known gene sequences. A second method for identification is matching the Mass Spectra of bacterial specimens to libraries of known organisms. These two methods of identification are the subject of this student opportunity.

On-site lab work for this internship will include processing spacecraft microbial isolates and generating mass spectra with a MALDI-TOF instrument. The spectra will be processed and identifications of the microbes will be obtained. The samples will also be used for identification based on 16SrRNA gene sequence. Once identification of the microbial isolate is obtained, that information is to be added to a cloud-hosted database called Airtable.
A set of microbial isolates from the M2020 mission will be assigned to the intern. The intern will revive and subculture the isolates, prepare and run mass spec identifications. The results will be added to the database. The results will be examined for correlations to sample collection parameters. Summary reports and a final oral and written presentation will be required.

AO#: 13997
Project: Software Lifecycle Improvement and Modernization (SLIM)
Internship Type: Remote
Preferred Major(s): Computer Science

Desired Background/Skills: Knowledge/familiarity of the software development lifecycle (i.e. creating issue tickets, writing code, reviewing code, integrating / packaging software, deploying software, etc.). Programming knowledge in Python or equivalent modern scripting language. Excellent written and oral communication skills. Knowledge of the GitHub ecosystem.

Description: Software Lifecycle Improvement & Modernization (SLIM) is an open source community effort focused on collecting, developing, and disseminating best practices and process improvement strategies in NASA multi-mission software development lifecycle ecosystems. SLIM represents both a community of contributors as well as a continually evolving open source repository for best practices documentation. The candidate will assist in producing best practice automation solutions and written guides for our stakeholder project community that meet existing process improvement needs. The candidate will make a real-world impact on multiple ongoing NASA funded software projects at JPL.

The candidate will be onboarded as a contributor to the SLIM project, and help resolve open issue tickets relating to process improvement needs for our stakeholder community, which can be viewed on our open source ticketing system: https://github.com/NASA-AMMOS/slim/issues. These tickets range from process improvement needs such as guidance on open source best practices, continuous integration / testing / delivery, dependency management, security scanning, to other topics such as governance and software metrics. The candidate will create generic software automation solutions and written guides to satisfy a particular process improvement need for our stakeholder community of projects. In addition to producing, the candidate will work to advocate for and help infuse the best practice solutions within our stakeholder projects and missions.

AO#: 13996
Project: dataSPACE Controller Interface
Internship Type: On-site
Preferred Major(s): Computer Science, Electrical Engineering, Information Systems

Desired Background/Skills: Understanding of HD, UHD, 8K video and audio signal formats, compressions, file formats; Understanding of TCP/IP interface protocols RS-232 serial interface protocols; Bluetooth connection interface protocols; Programming device control class libraries in Python; Programming video file conversion and transfer class libraries in Python Programming device control class libraries using equipment vendor's SDK, Building iPad / Mac GUI using Xcode; Running Python under anaconda; Unix shell programming; Source code version control using git; Experience in video editing/compositing software such as Shake, FinalCut; Experience in digital circuit design; Able to diagnose software and hardware problems

Description: dataSPACE is a visualization facility at JPL which contains audiovisual equipment supporting science data visualization endeavors for science, research and public outreach. A partial list of hardware within dataSPACE includes the following:

-A seamless 16 foot by 9 foot ultra-high definition (UHD) video display wall
-8K / UHD large format video monitors
-HDMI and SDI video switchers
-HDMI signal extenders through CAT-6 cables
-Multi-screen video combiner
-8K / UHD / HD video servers
-Multi-format video / audio converters
-UHD / HD Fiber optic video transmitter / receiver
-UHD video capture / playback card attached to Mac servers
-iPad, Mac, and PCs
-Augmented/virtual reality (AR/VR) goggles and workstations

Intern will integrate the data, visual, and audio equipment in dataSPACE through the following software development tasks:

-Design & write Python API libraries to control each device from a Mac workstation via RS-232, bluetooth, or TCP/IP
-Design & implement a graphical user interface (GUI) to control the devices via an iPad using the above API
-Design & build a Bluetooth to RS-232 interface converter using System-on-Chip (SoC) device

AO#: 13992
Project: Software Lifecycle Improvement and Modernization (SLIM)
Internship Type: On-site
Preferred Major(s): Computer Science

Desired Background/Skills: Knowledge/background of the full software development lifecycle. Programming knowledge in Python or HTML/JS. Excellent written and oral communication skills.

Description: Software Lifecycle Improvement & Modernization (SLIM) is a project focused on collecting, developing, and disseminating best practices and process improvement strategies in NASA multi-mission software development lifecycle ecosystems. SLIM represents both a community of contributors as well as a continually evolving repository for best practices documentation. The candidate will assist in producing best practice written recommendations / automation solutions for our stakeholder project community.

The candidate will be onboarded as a contributor to the SLIM project, and help resolve open issue tickets for our stakeholder community: https://github.com/NASA-AMMOS/slim/issues. Additionally, the candidate will work with stakeholder projects and missions to help them infuse new best practices into their respective projects.

AO#: 13990
Project: Climate model simulations to support weather forecasting
Internship Type: On-site
Preferred Major(s): Computer Science, Mathematics, Deep Learning/Machine Learning

Desired Background/Skills: Required: Strong background deep learning concepts and optimization, GAN architectures, metrics, and training failure modes. Familiarity with atmospheric data and related file structures, as well as remote/cloud based computing infrastructure. Fluency with Python, SKLearn, TensorFlow and/or PyTorch, Docker, Anaconda. Strong communication and writing skills.

Description: Precipitation forecasting is a key decision support application for many agencies. Dynamical methods compute climate models starting from some initial conditions, while empirical models aim to leverage existing observational data to train machine learning algorithms. For climate models aiming to capture atmospheric processes, manual calibration often results in high uncertainties due to the probabilistic computations involved. This project aims to test generative machine learning models as an alternative manual calibration of forward models.

This project will focus on development and optimization of generative-adversarial networks (GAN) to learn the evolution of climate models. The student intern will become familiar with atmospheric data and learn optimization methods, developing, implementing, and testing GAN architectures on GPU clusters.

AO#: 13988
Project: NISAR Operations training and tools
Internship Type: On-site
Preferred Major(s): Computer Science, Information Systems/Technology

Desired Background/Skills: Unix/Linux Command line, bash shell scripting, Python, Confluence, Amazon Web Services HySDS operates in Amazon Web Services and uses Elasticsearch, Kibana, Logstash, Redis, Celery, RabbitMQ, Flask. Strong written communication, ability to research new technologies, ability to read code to troubleshoot failures

Description: The NASA-ISRO Synthetic Aperture Radar, or NISAR, satellite is designed to observe and take measurements of some of the planet's most complex processes. These include ecosystem disturbances, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides. Data collected from NISAR will reveal information about the evolution and state of Earth's crust, help scientists better understand our planet's processes and changing climate, and aid future resource and hazard management. The mission is a partnership between NASA and the Indian Space Research Organization. It is scheduled to launch in 2023.

This internship will support the Operations Team on NISAR in building automation tools and reports and dashboards to smoothly operate the science data system. The science data system is an automated system that takes the data from the satellite instruments and processes it through a pipeline of software to generate usable products for the individual teams as well as the science data users. NISAR uses the HySDS framework for its science data processing system. HySDS was developed at JPL and open sourced in 2017. It is under active development with many new features designed to support upcoming NASA missions like SWOT and NISAR. HySDS scalably powers the ingestion, metadata extraction, cataloging, high-volume data processing, provenance management, and publication of data products for various projects at JPL.

In some cases, we will be able to leverage work done by other interns on SWOT and SMAP. Candidates would work on one or more of the following tasks:

1) Develop and document resolution procedures for NISAR data system failures.

2) Create cheat sheet and command line tools to interface with Amazon Web Services. Services used include S3, EC2, ASG, CloudWatch, lambdas, SQS, SNS.

3) Develop dashboards and visualizations to help monitor infrastructure, jobs, and products within HySDS

4) Adapt tools to query ElasticSearch and generate text or web-based reports

AO#: 13985
Project: Orbiting Carbon Observatory 2 (OCO-2) and (OCO-3)
Internship Type: On-site
Preferred Major(s): Computer Science, Information Systems/Technology

Desired Background/Skills: Python scripting, web reporting tools, linux and shell scripting, good communication skills, experience with customer focused use. Desired: familiarity with AWS, documenting programs and systems with flow charts & written descriptions.

Description: The Orbiting Carbon Observatory 2 (OCO2) is an Earth Observing, Earth orbiting satellite mission measuring the levels of carbon dioxide (CO2) in the atmosphere, the leading human-made driver of climate change. OCO-3 is the same instrument, installed on the International Space Station (ISS) instead of on a dedicated satellite. The Science Data Operations System (SDOS) is a key part the data return process, serving both missions. The SDOS extracts science data from the returned data stream and prepares higher-level products for the public. With a million observations coming in each day, the SDOS operations has three different venues used for reprocessing the entire data record - the reprocessing can't be finished in a timely fashion without use of all three, due to the resource intensive nature of the level 2 data processing. These three are a JPL local computing cluster, the NASA AMES super computing cluster (Pleiades), used by various institutions for high performance computing and simulations, and the Hybrid Cloud Science Data System (HySDS) on Amazon Web Services (AWS).

This project will document the Pleiades and HySDS systems, with an emphasis on usability and learning the system. Next, this project will focus on updating the underlying code from Python 2 to Python 3, and recommendations on refactoring the code for ease of upkeep and use. Customers are the SDOS System operators, who manage and troubleshoot the systems while reprocessing years of data. The student will modernize & improve web reporting tools which communicate quality checks to operators, as well as codify some of these checks and automate other processes in order to triage the daily products generated by the SDOS. The student will work with programmers, testers and systems engineers in order to learn the workflows of the data system and the processes of the operators. The task will involve reading bash scripts, reading and writing Python scripts, and interacting with AWS, elastic-search, and Kibana.

AO#: 13983
Project: Miniaturize SHS Spectrometer - electronic design
Internship Type: On-site
Preferred Major(s): Computer Engineering, Computer Science, and/or Electrical Engineering

Desired Background/Skills: Electrical engineering and analysis, Programming, Electronics design and coding, Machine learning

Description: The majority of the NASA missions are looking for water and ocean worlds inside and outside our Solar System. Studying the creation of water and its transfer in the Solar System contains information about the evolution of Solar System and how did water end up on the Earth. One of the approaches to study where the water on Earth came from is by studying spectral signatures from water such as Lyman-alpha, OH, and OD/OH ratio on various objects in the Solar System. However, these spectral signatures are very faint and a very difficult measurement to make, often require in situ bulky spectrometers to be sent to the astronomical bodies with spacecraft. In our lab at JPL, we develop a new generation of technologies that has the capability to make such measurements remotely using small aperture telescopes from ultra-compact instruments. These spectrometers are in the size of a shoebox or a sneaker bar (!00) but have the sensitivity of a 5-meter telescope for observing a targeted spectral signature.

We have multiple ongoing instrument development projects that require electrical engineering/computer science/computer engineering. We have a project to fly our breadboard spectrometer on a Blue Origin Rocket in summer 2021 and test our instrument by making measurements from Earth's atmosphere as the rocket goes up to +80 km altitude and returns to Earth. We also have a few mission concept studies for studying planetary and astrophysics targets from SmallSats and CubeSats as well as onboard of large spacecrafts. Under this announcement of opportunity, the student(s) will develop the electrical breadboard and data handling software package for the spectrometer given a set of requirements and work on the vibration and thermal analysis to ensure the instrument's survival and performance after launch and in flight. Depending on the background of the student (s) they can also be involved in reviewing the electrical interfaces and system requirements and system integration strategy and process. The student(s) will also take notes and document the progress of the project.

AO#: 13978
Project: SMAP Operations scripts and documentation
Internship Type: On-site
Preferred Major(s): Computer Science, Information Systems/Technology

Desired Background/Skills: Unix/Linux Command line, bash shell scripting, Python, Confluence, Amazon Web Services, HySDS operates in Amazon Web Services and uses Elasticsearch, Kibana, Logstash, Redis, Celery, RabbitMQ, Flask; Strong written communication, ability to research new technologies, ability to read code to troubleshoot failures.

Description: The SMAP (Soil Moisture Active Passive) mission measures soil moisture over a three-year period, every 2-3 days. This permits changes, around the world, to be observed over time scales ranging from major storms to repeated measurements of changes over the seasons. The Science Data System is responsible for producing archive quality Science Data Products used by science teams and researchers.

This internship will support the Operations Team on SMAP in building automation tools and reports and dashboards to smoothly operate the science data system. The science data system is an automated system that takes the data from the satellite instruments and processes it through a pipeline of software to generate usable products for the individual teams as well as the science data users.

SMAP is in the unique position that it is transitioning from a legacy system to a new system. New tools will need to be built to interface with the new system, while providing the previous functionality. In some cases, we will be able to leverage work done by other interns on NISAR and SWOT. However, SMAP is operating in a true hybrid manner with some resources in Amazon Web Services and some resources on a Linux cluster at JPL. Consequently, we will encounter additional challenges that will require pathfinding and troubleshooting.

Candidates would work on one or more of the following tasks:

1) Document and develop resolution procedures for SMAP data system failures.
2) Create cheat sheet and command line tools to interface with Amazon Web Services. Services used include S3, EC2, ASG, CloudWatch, lambdas, SQS, SNS.
3) Improve robustness and operability of shell scripts and Python scripts that download data from data providers and distribute the data to various destinations. Develop user guide for these tools.
4) Develop dashboards and visualizations to help monitor infrastructure, jobs, and products within HySDS.
5) Adapt tools to query ElasticSearch and generate text or web-based reports.

AO#: 13977
Project: Additively Manufactured Heat Pipe Evaporators
Internship Type: On-site
Preferred Major(s): Mechanical Engineering, Aerospace Engineering, Materials science

Desired Background/Skills: Thermal analysis, CAD (solidworks, NX), basic laboratory skills

Description: Heat pipes are a crucial component of thermal management technologies for spacecraft. Due to the lack of an atmosphere, spacecraft rely entirely upon conduction or pumped fluid loops in order to move heat throughout their chassis. One method to greatly increase the rate of conduction is to bond heat pipes into the structure. These work well, but tend to offer a significant integration challenge, involve bond lines which decrease performance, and rely on suppliers delivering custom, flight critical parts in a timely manner. JPL has developed techniques to 3d print heat pipes fully integrated into structures as they are printed. This project will focus on designing more efficient evaporators to pull heat out of critical components.

The intern(s) will create a series of different evaporator geometries to help us better understand the tradeoff between size, weight, and surface area. They will perform thermal testing and interpret data from the tests. Intern(s) will provide recommendations on the most promising geometries, and what should be done to further refine their geometries.

AO#: 13975
Project: Mechanical Design of Integrated Oscillating Heat Pipes
Internship Type: On-site
Preferred Major(s): Mechanical Engineering, Thermodynamics, Fluid Mechanics, Materials Science

Desired Background/Skills: Computer Aided Design (CAD), Finite Element Analysis (FEA), Solid Mechanics, Solidworks, NX

Description: Heat pipes are devices capable of effective thermal conductivities orders of magnitude higher than traditional conductive materials. They achieve this by using a constrained volume of working fluid, which is controlled to be able to transition between the liquid and vapor states. By allowing the fluid to transform from a liquid at the hot end, flow migrate to the cold end as a vapor, and then condense, the latent heat of vaporization can be used to transfer heat. Once the vapor has condensed, it needs to be transported back to the hot end as a liquid; this is where much of the difficulty in designing, manufacturing, and optimizing heat pipes lies. Traditional heat pipe technologies use a porous wick to provide capillary forces to pump the liquid back towards the hot end. Oscillating heat pipes (OHPs) are a relatively new variant of heat pipes, having only first been created a few decades ago. Instead of utilizing a wick to pump the liquid phase, they consist of alternating slugs of liquid and vapor in a long, serpentine channel. Localized heating creates more vapor at the liquid/vapor interface, creating high pressure, which then pushes on the liquid creating flow. Similarly, when the vapor loses heat some vapor will condense, depositing a large amount of energy, creating a low pressure region, and pulling the fluid in the tubing. They are traditionally created by manual bending & welding of a hypodermic tube into a long serpentine structure, and then brazed, epoxied, or otherwise fastened to the structure. This technique is difficult, laborious, and inefficient both thermally and for effective uses of mass. JPL has developed a method to integrate these heat pipes directly into additively manufactured structures, enabling all sorts of conformal geometries never before achievable. Systems have been tested with thermal conductivities in excess of 40,000 W/m-K.

Current computational models for OHPs have resulted in some surprising results for various non-traditional geometries. The project will entail designing, printing, and testing of new oscillating heat pipe geometries at JPL's two-phase technology lab.

AO#: 13970
Project: SMAP Operations scripts and documentation
Internship Type: On-site
Preferred Major(s): Computer Science, Information Systems/Technology

Desired Background/Skills: Unix/Linux Command line, bash shell scripting, Python, Confluence, Amazon Web Services; HySDS operates in Amazon Web Services and uses Elasticsearch, Kibana, Logstash, Redis, Celery, RabbitMQ, Flask

Strong written communication, ability to research new technologies, ability to read code to troubleshoot failures

Description: The SMAP (Soil Moisture Active Passive) mission measures soil moisture over a three-year period, every 2-3 days. This permits changes, around the world, to be observed over time scales ranging from major storms to repeated measurements of changes over the seasons. The Science Data System is responsible for producing archive quality Science Data Products used by science teams and researchers.

This internship will support the Operations Team on SMAP in building automation tools and reports and dashboards to smoothly operate the science data system. The science data system is an automated system that takes the data from the satellite instruments and processes it through a pipeline of software to generate usable products for the individual teams as well as the science data users.

SMAP is in the unique position that it is transitioning from a legacy system to a new system. New tools will need to be built to interface with the new system, while providing the previous functionality. In some cases, we will be able to leverage work done by other interns on NISAR and SWOT. However, SMAP is operating in a true hybrid manner with some resources in Amazon Web Services and some resources on a Linux cluster at JPL. Consequently, we will encounter additional challenges that will require pathfinding and troubleshooting.

Candidates would work on one or more of the following tasks:

1) Document and develop resolution procedures for SMAP data system failures.
2) Create cheat sheet and command line tools to interface with Amazon Web Services. Services used include S3, EC2, ASG, CloudWatch, lambdas, SQS, SNS.
3) Improve robustness and operability of shell scripts and Python scripts that download data from data providers and distribute the data to various destinations. Develop user guide for these tools
4) Develop dashboards and visualizations to help monitor infrastructure, jobs, and products within HySDS
5) Adapt tools to query ElasticSearch and generate text or web-based reports

AO#: 13967
Project: Developing simple photometric models for observations of Europa
Internship Type: On-site
Preferred Major(s): Astronomy/Astrophysics, Physics/Applied Physics, and/or Computer Science

Desired Background/Skills: Some basic knowledge of astronomy or geology; basic computer skills. A bonus would be previous experience fitting polynomials or other simple equations to data.

Description: The Europa Clipper Project will be NASA's first in-depth exploration of an Ocean World, which are bodies in the Solar System containing possible habitable environments in their subsurface oceans. There is a suite of nine instruments on the spacecraft, including cameras and spectrometers. A challenging task of the science team is to describe the effects of how measurements are affected by the viewing geometry of the spacecraft.

This project is to work with the Deputy Project Scientist to gather published data from previous Europa missions and fit simple empirical equations to this data that describe how the intensity of Europa's surface varies with the spacecraft's position and the position of the sun

AO#: 13966
Project: NASA JPL Virtual Voice Interface (NAVVI)
Internship Type: On-site
Preferred Major(s): Computer Science, Computer Engineering, Computational Linguistics

Desired Background/Skills: Software Engineering, System Design, User Experience Research, Python, Resource Description Framework (RDF), SPARQL query language for RDF

Description: JPL employees want to get simple, timely answers to questions like ‚ÄúWhen does Europa Clipper launch?‚Äù or ‚ÄúWho do I contact about using a lab in a given building?‚Äù or ‚ÄúWhat projects did the Navy sponsor last year?‚Äù. Currently, there is no way to get answers to sometimes non-trivial interdisciplinary questions other than by asking someone or by querying the JPL Institutional Knowledge Graph (IKG). The truth is that the answers to these questions are ready to be served by the IKG; the obstacle is in the barrier to entry for using SPARQL query language. Even though SPARQL is an a W3C international standard semantic language and protocol for RDF graph databases, the overwhelming majority of JPL developers either lack the competency or are simply ‚Äòturned off‚Äô by the thought of manually writing a SPARQL query. Having an ability to query a database using natural language (NL), asking questions as a human being would ask them, would eliminate this barrier.

This project will revisit existing proof-of-concept software coiuned the NASA JPL Virtual Voice Interface a.k.a NAVVI. NAVVI is an intelligent virtual voice assistant able to perform tasks or services based on verbal commands or questions. NAVVI addresses fundamental barriers to JPL, interacting with knowledge bases (e.g., JPL's flagship Institutional Knowledge Graph (IKG)). The NAVVI framework enhances existing JPL IT to a commercially usable level for NASA and other Government agencies. NAVVI will meet the widespread Google + Alexa search and discovery user expectation and is positioned as JPL's next Killer IT App. NAVVI is NOT a generic ChatBot, it addresses a clear market opportunity, providing a framework and trainable standards-based virtual assistant capability. The desired outcome is for NAVVI to be deployed in a non-production setting for a beta stakeholder group to use and provide feedback on.

AO#: 13955
Project: Improved time series analysis using geodetic measurements
Internship Type: On-site
Preferred Major(s): Earth Science, Remote Sensing, and/or Geological/ Geophysical Engineering

Desired Background/Skills: Skills in python/matlab/C/C++/Linux. Background in earth sciences/remote sensing/math/physics/computer sciences/engineering are encouraged.

Description: Airborne and space geodetic measurements from Interferometric Synthetic Aperture Radar (InSAR) and Global Navigation Satellite System (GNSS) provide capability to image surface deformation at various spatiotemporal scales. The growing observations and data volume also call for advancement in techniques for rapid and reliable data processing, noise correction, time series analysis and modeling.

The student will work with mentors to adopt/improve state-of-the-art techniques for noise correction and transient detection using airborne and space geodetic measurement, and incorporate them in the analysis for geophysical applications such as fault creep and groundwater deformation.

AO#: 13951
Project: Open Source Rover Innovative Development
Internship Type: On-site
Preferred Major(s): Mechanical Engineering, Electrical Engineering and Computer Science

Description: The 174 Division is responsible for AI, Analytics, and Innovative Development within JPL's IT Directorate. A few years ago we developed and mobilized an Open Source Rover (OSR) community. Our home page is https://opensourcerover.jpl.nasa.gov/#!/home

We are looking for a dynamic and entrepreneurial undergrad interns to join our team and push the boundaries of the OSR further. Specific scope for fall activities will be tailored to each interns skillsets, experiences, and interests. However, the main thrust of their internship will be focused on developing a familiarity with the OSR platform (mechanical, electrical, and software) and finding a unique and innovative capability to develop and ultimately publish to the OSR community. Example activities have been but are not limited to - Design and 3D print your own components, swap out compute or other hardware to support a more complex function, infuse 174 developed or other Open Source AI/software into the rover to improve autonomy or performance, etc. You will have access to and become familiar with our team, our tools, and so much more as you help ideate and deliver the next iteration of new capabilities to the OSR.

AO#: 13950
Project: Mars Data Analysis
Internship Type: On-site
Preferred Major(s): Planetary Science, Earth Science, and/or Planetary Geology

Description: JPL is seeking highly motivated undergraduate students to participate in Mars data analysis focused on information returned by the Mars Global Surveyor, Mars Odyssey, the Mars Reconnaissance Orbiter spacecraft, the Mars Exploration Rovers, the InSight lander and the Mars 2020 rover and helicopter. Data to be studied will be from the Mars Orbiter Camera (MOC), Mars Orbiter Laser Altimeter (MOLA), Thermal Emission Spectrometer (TES), Thermal Emission Imaging System (THEMIS), High Resolution Imaging Science Experiment (HiRISE), the Context Imager (CTX), and instruments of the Mars Exploration Rover Athena Science Payload, the InSight lander, the Mars 2020 rover and helicopter, and earth analogs.

Work will be directed at characterizing the geology and safety of candidate landing sites for future Mars missions, including the Mars Sample Return. Safety issues focus on quantification of slopes of concern for landing safely in potential landing sites and traverses using MOLA data and digital elevation models from stereo images. Work will also be related to measuring rocks on the surface of Mars from orbit, in flight and on the surface and understanding their context. This will include analyzing rocks visible in high-resolution HiRISE images and quantifying their size-frequency distribution to better understand landing safety. InSight work will involve mapping geological features observed in the surface images such as craters, eolian bedforms, rocks, and soils. HiRISE and CTX images will also be georeferenced to lower resolution images (CTX, THEMIS) and topographic maps (MOLA). Additional work may include analyzing craters on Mars to investigate rock distributions in their ejecta, how they change with time and their morphologic state as well as the geomorphology as a clue to the subsurface geology. Terrains, rock abundance, slopes and trafficability of notional traverses between Jezero crater and northeast Syrtis to assist Mars Sample Return landing and sample retrieval may also be studied as well as possible earth analogs.

Most of the work will be done on personal computers utilizing mixed operating systems (mostly Windows), so experience with them is important. The ability to measure and tabulate rocks, place the data into standard spreadsheets, and plot the results is required for the work on rock distributions. Experience with ArcGIS mapping software, especially georeferencing imagery, is preferred as our landing site data is specifically formatted to work with this GIS package. Additional knowledge of Integrated Software for Imagers and Spectrometers (ISIS 3.x), SOCET SET, or Matlab software would be a plus. Preference will be given to students with backgrounds in geology or planetary science and other related disciplines such as geographic information science, physics, chemistry, astronomy, engineering, and computer sciences. They may be supervised by one or two research scientists and may also work alongside other researchers and students.

AO#: 13948
Project: Materials Test Laboratory Support
Internship Type: On-site
Preferred Major(s): Materials Engineering, Material Science, and/or Mechanical Engineering

Desired Background/Skills: Proficient in Microsoft Office products; Experience with best practices for laboratory safety and cleanliness; Suggested experience with optical and electron microscopy

Description: To support the materials and process laboratory in flight fabrication, surface preparation of materials for adhesive bonding, materials characterization, and materials testing tasks.

Participant will be responsible for aiding in fabrication, as well as collaborating on characterization tasks and writing memos and reports.

AO#: 13947
Project: Streamlining Satellite Oceanographic Data Aquisition
Internship Type: On-site
Preferred Major(s): Computer Science, Earth Science

Desired Background/Skills: Python 3 including the "numpy" package. Some familiarity with the 'xarray' package would be useful.

Description: "Estimating the Circulation and Climate of the Ocean" (ECCO) http://ecco.jpl.nasa.gov is a NASA-funded ocean climate modelling effort that uses satellite oceanographic data to reconstruct Earth's changing ocean. This internship will focus on streamlining the process by which we acquire and process these satellite data so that they can be 1) effeciently assimilated into our ocean climate model and 2) easily compared with our ocean climate model.

The project will require writing Python code to acquire and process satellite oceanographic and sea-ice data from NASA data centers. Processing NASA data entails preparing the data for use in an ocean climate model.

AO#: 13945
Project: Advanced Low SWaP Avionics Technology for Small SHS Payload
Internship Type: On-site
Preferred Major(s): Electrical Engineering and Computer Science, Computer Engineering, and/or Computer Vision and IoT, Aerospace Engineering, IT, Avionics

Desired Background/Skills: Good communication skills, self-motivation. Circuit analysis using PSpice. Hands-on familiarity with instruments such as oscilloscopes, logic analysrs, etc. Python, C/C++ programming will be a plus. Embedded software development. Coursework: Standard coursework in EE/CE majors with the following emphasis: Circuit Analysis, Digital System Design, Programming Languages, Operating systems, Embedded system, Signals and Systems, Digital Signal Processing, Computer Networks, Machine Learning, etc.

Description: JPL has developed a new generation of instrument technologies capable of remotely measuring spectral signatures from water such as Lyman-alpha, OH, and OD/OH ratio on various objects in the Solar System based on small aperture telescopes from ultra-compact instruments. These kind of SHS spectrometers are in the size of a shoebox or a sneaker bar but have the sensitivity of a 5-meter telescope for observing a targeted spectral signature. It is enabled by both the advanced optical system and the low-SWaP rad-hardened capable avionics technology called Sphinx for deep space mission.

The students will work with the mentor and other team members to build multiple Sphinx-based instrument electronics subsystem that will be flown in Blue Origin, NASA Tech Demo Challenge , and other lunar and planetary missions. The internship will include hardware board schematic design, layout, and analysis; FPGA firmware development, embedded software development, machine-learning based science data processing, platform benchmarking, application software development, and integration, test software enhancement, and the system integration and document.

AO#: 13944
Project: Miniaturize Spectrometer - electronic design
Internship Type: On-site
Preferred Major(s): Electrical Engineering, Computer Science, and/or Software

Desired Background/Skills: Electrical engineering and analysis; Programming; Electronics design and coding; Machine learning

Description: The majority of the NASA missions are looking for water and ocean worlds inside and outside our Solar System. Studying the creation of water and its transfer in the Solar System contains information about the evolution of Solar System and how did water end up on the Earth. One of the approaches to study where the water on Earth came from is by studying spectral signatures from water such as Lyman-alpha, OH, and OD/OH ratio on various objects in the Solar System. However, these spectral signatures are very faint and a very difficult measurement to make, often require in situ bulky spectrometers to be sent to the astronomical bodies with spacecraft. In our lab at JPL, we develop a new generation of technologies that has the capability to make such measurements remotely using small aperture telescopes from ultra-compact instruments. These spectrometers are in the size of a shoebox or a sneaker bar (!00) but have the sensitivity of a 5-meter telescope for observing a targeted spectral signature.

We have multiple ongoing instrument development projects that require electrical engineering/computer science/computer engineering. We have a project to fly our breadboard spectrometer on a Blue Origin Rocket in summer 2021 and test our instrument by making measurements from Earth's atmosphere as the rocket goes up to +80 km altitude and returns to Earth. We also have a few mission concept studies for studying planetary and astrophysics targets from SmallSats and CubeSats as well as onboard of large spacecrafts. Under this announcement of opportunity, the student(s) will develop the electrical breadboard and data handling software package for the spectrometer given a set of requirements and work on the vibration and thermal analysis to ensure the instrument's survival and performance after launch and in flight. Depending on the background of the student (s) they can also be involved in reviewing the electrical interfaces and system requirements and system integration strategy and process.

The student will be responsible for taking notes and documenting the work and progress between groups at JPL and other companies.

AO#: 13943
Project: Raman Spatial Heterodyne Spectroscopy - astrobiology applications
Internship Type: On-site
Preferred Major(s): Planetary Science, Physics/Applied Physics

Desired Background/Skills: Raman Spectroscopy, Optomechanical engineering, Chemistry, Biology

Description: Raman spectroscopy is a valuable technique for planetary exploration because it is sensitive to organic and inorganic compounds and able to unambiguously identify key spectral markers in a mixture of biological and geological components. Sample manipulation is not required in Raman spectroscopy and any size of a sample can be studied without chemical or mechanical pretreatment. NASA and ESA are considering the adoption of miniaturized Raman spectrometers for inclusion in suites of analytical instrumentation to be placed on robotic landers on Mars in the near future to search for extinct or extant life signals. There are many reviews about the advantages and limitations of Raman spectroscopy for the analysis of complex specimens with relevance to the detection of bio- and geo-markers in extremophilic organisms which are considered to be terrestrial analogs of possible extraterrestial life that could have developed on planetary surfaces.

We have developed a miniature spectrometer, Spatial Heterodyne Spectrometry, that can achieve high spectral resolution at high throughput in compact formats. The student would investigate Raman biosignatures suitable to be studied with our Raman Spatial Heterodyne Spectrometer onboard small robots in future astrobiology applications.

AO#: 13942
Project: Europa Clipper - Payload V&V
Internship Type: Remote
Preferred Major(s): Aerospace Engineering, Computer Science, and/or Systems Engineering

Description: NASA's Europa Clipper spacecraft will conduct a detailed survey of Jupiter's moon Europa to determine whether the icy moon could harbor conditions suitable for life. The spacecraft, in orbit around Jupiter, will make about 40 to 50 close passes over Europa, shifting its flight path for each flyby to soar over a different location so that it eventually scans nearly the entire moon.

We are looking for an enthusiastic systems-thinker who would enjoy working with our science and instrument teams to help gather evidence that the Europa Clipper payload is meeting its requirements as a Payload Verification and Validation Intern. This project may involve supporting tests performed in the system testbed (writing test plans, developing test cases, running tests, analyzing test data, and supporting data reviews), resolving problems that are identified during testing (helping to track down problem failure report closures, supporting engineering change requests or waivers necessary to close gaps), and developing code/tools to help track progress, identify errors or gaps, and improve efficiencies for our verification leads.

AO#: 13928
Project: Validating active crop areas using satellite optical and radar data
Internship Type: Remote
Preferred Major(s): Computing, and Physics, Environmental Science

Desired Background/Skills: Programming skills (python), Statistics

Description: This task contributes to the upcoming NISAR (NASA ISRO Synthetic Aperture Radar) satellite, due for launch in 2024. Specifically the NISAR mission's Ecosystems Science would like to validate the algorithms that seasonally identify globally active cropland with 80% accuracy at the one hectare scale. This product is expected to represent a diverse range of crop types and agricultural practices. Accurate and reliable products will improve the global and regional managements of food security and availability.

The goal is to validate the algorithm's capability to identify active staple 1 ha crop area every 3 months. The mentor's team already developed the algorithm that will automatically estimate the active crop area using European Space Agency's radar data. The participant will execute the algorithm in python environment. The participant will prepare a validation data set using very-high-resolution optical data by hand, QGIS, or any other methods at selected locations in the world. The algorithm output and the validation data will be compared to produce the statistics that quantify the accuracy of the algorithm.

AO#: 13923
Project: Analysis and Archiving of Near- & Mid-Infrared Observations of Jupiter and Saturn
Internship Type: On-site
Preferred Major(s): Planetary Science, Astronomy/Astrophysics, and/or Computer Science

Desired Background/Skills: The data reduction programs are written in the Interactive Data Language (IDL, which is close to Matlab in format). The analysis code is written in FORTRAN. At least rudimentary knowledge of these (or willingness to learn before the beginning of the research) is highly recommended. Some programming experience is required. With a significant level of contribution, students are welcomed as co-authors on papers emerging from this research.

Description: Images and spectra of Jupiter and Saturn from visible, near- and mid-infrared instruments are sensitive to temperatures, abundances of a major condensate (ammonia) opacity of clouds and the variability of the molecular para vs. ortho-H2 ratio. These define the fundamental state of the atmosphere and constrain its dynamics. This research will focus on observations obtained from a variety of instruments used at large professional telescopes: NASA's Infrared Telescope Facility, Gemini North and South Telescopes, ESO's Very Large Telescope, and the Subaru Telescope, and the Juno mission images of Jupiter in reflected sunlight from the JunoCam instrument. The general objective of the specific tasks below will be to create fully reduced data from unreduced or partially reduced sets. In some cases, our objective is to format the data for input into an atmospheric retrieval code from which atmospheric properties will be derived.

Several specific topics are available: 1. Analyze images made by the JunoCam imaging instrument on the Juno mission. To some extent, each of these tasks may require work with a transformation of the images to a latitude-longitude map using ,ÄúISIS3,Äù software supplied by the US Geological Survey. A task associated with any of the following science goals could be automating this process. 1a. Understanding the dynamics of Jupiter's high northern latitudes. Search for sequential JunoCam observations near the north polar region with time dependence in order to determine the wind field of this region and the degree to which Jupiter's winds flow east-west to something different, possibly chaotic, but with a component of east-west prevalent winds. 1b. Search for and measure hazes in Jupiter's atmosphere, i.e. particles lying above Jupiter's main cloud deck. This will include the following, each of which could be a separate research task: (i) Identify clouds near Jupiter's dusk region that appear to have different shapes or positions that are wavelength dependent, creating a ,Äúrainbow,Äù appearance. (ii) Identify persistent hazes, their level of transparency and changes in their morphology between successive Juno orbits to determine a velocity. Where possible, verify their appearance in a special filter that is sensitive to high-altitude particles. (iii). Survey JunoCam images of Jupiter's horizons to detect and measure haze layers. 1c. Continue previous work in the first 20 orbits of the Juno mission to detect and measure small-scale waves in Jupiter's atmosphere to increase statistical evidence for their latitudinal distribution and

association with larger features. 2. Archive images of Jupiter made in support of the Juno mission. To fulfill contractual obligations to NASA, we need to archive our infrared imaging of Jupiter from various instruments from the last four years of mid-infrared images and two decades of near-infrared images with NASA's Planetary Data System (PDS). These data must be accompanied by required ancillary files in a specific PDS format. The goal of this work is to collect copies of the images and related files into a single location with a specific nomenclature and submit these to review by the PDS. Aspects of this work could be done concurrently with other student work on the long-term variability of Jupiter. 3. Reduce near-infrared images of Jupiter. We will be acquiring a large volume of observations of Jupiter that are designed to support observations from instruments on the Juno spacecraft. We want to reduce the data and, to the extent possible, analyze the results. There are several objectives in this broad category. 3a. Develop quasi-automated software for reducing near-infrared imaging observations. The basis of this software exists in the Interactive Data Language (IDL), but the order of operations must be reversed at one stage and a subtracted pair of images must be reversed at another stage. 3b. Develop software for combining Mercator maps derived from images taken at different times as the planet rotates; use these to create full maps of Jupiter over all longitudes, as well as to polar project those maps ,Äì for example - to investigate correlations between different phenomena in the neutral atmosphere and the aurora. 3c. Create an absolute calibration of the reflectivity of these images by referencing the flux from measured standards stars. Compare this with a calibration scaled to spacecraft observations of the near-infrared spectrum. 3d. Measure the distribution of cloud properties in the atmosphere with near-infrared reflectivity, including high-resolution adaptive-optics stabilized images. Use these data to characterize the chemistry and dynamics of the atmosphere, associated with specific atmospheric features e.g. polar hazes, the Great Red Spot and its environment, their evolution and their relationship with temperatures and winds. 3e. Reduce scanned spectral observations of Jupiter that create a hypercube of data (two dimensions of imaging and one of wavelength), deriving spectra at each pixel of the slit. Analyze these for properties of clouds and hazes, comparing them with models. 4. Examine the long-term variability of longitudinally averaged temperatures and other properties in Jupiter to create accurate and self-consistent calibrations of all data from a variety of telescopes. Extend a current program to input longitudinally averaged data over Jupiter's full disk to include observations at facilities where only a northern or a southern hemisphere of Jupiter could be captured. Format these data to be an input to an atmospheric retrieval program. Organize the output of this program to enable rapid plotting and correlation with previous studies and between different retrieved atmospheric properties.

AO#: 13917
Project: Fast Texture Segmentation using Deep Learning
Internship Type: On-site
Preferred Major(s): Computer Science, Mathematics, and/or Deep Learning/ Machine Learning

Desired Background/Skills: Strong background in statistics, optimization, deep learning, compute clusters, machine learning concepts. Working understanding in image processing and computer vision algorithms. Fluency with Python, SKLearn, SKImage, TensorFlow and/or PyTorch, Docker, Anaconda. Strong communication and writing skills.

Description: One of the key drivers of the Mars Exploration Program is the search for evidence of life. The relevant Martian environments to study are those that are associated with liquid water. The process of finding such features on Martian terrain requires development of robust segmentation methods that can evaluate very large number of images and identify those with the features of interest. To automatically locate these features on Mars surface we use deep learning models on HiRISE image set. HiRISE is a large data set (>40TB) covering about 5% of Mars surface.

This project will focus on development and optimization of deep learning models to process the full HiRISE image data. The student intern will learn optimization methods, deep learning based segmentation, and implement solutions on GPU-based computing clusters.

AO#: 5741
Project: Indoor Air Quality (IAQ) and Ventilation Baseline Assessment in JPL Offices and Laboratories.
Internship Type: On-site
Preferred Major(s): Occupational Health and Safety

Desired Background/Skills: Proficient in Microsoft Excel. Participants will be managing spreadsheets and collecting data being measured.

Description: Ventilation is one of the most important engineering controls available to industrial hygiene for improving and maintaining air quality in the occupational work environment. To ensure workers are protected from potential hazardous contaminants in the work area, chemical assessments are conducted using theoretical formulas for anticipating or estimating potential exposure. Currently, conservative estimates for room and laboratory ventilation rates are used, following ASHRAE 62.1 requirements for occupancy exhaust rates.

To move toward a more realistic modeling formula, and therefore obtain more accurate worker exposure to workplace contaminants estimates, realtime measurements of ventilation rates is required. Additionally, collection of baseline IAQ data will assist the IH process in characterizing HVAC characteristics and allow the IH team to examine relationships of (future) symptom complaints, if any.

The goal of the research project is for the JPL Intern to 1) perform a study to characterize ventilation and exhaust rates in offices and laboratories in various select locations and 2) develop baseline Indoor Air Quality (IAQ) assessment data of select buildings. To do this, the intern will:

1. Measure air supply and exhaust ventilation rates in various room locations.
2. Collect temperature, humidity, CO, CO2, ozone and TVOC readings in selected buildings.

All of the aforementioned will be performed under the guidance of a JPL mentor and JPL equipment.

All building and room locations to be inspected and evaluated will be determined prior to the start of this project. We anticipate approximately 40 locations within 4800 Oak Grove Drive in Pasadena, CA.

Deliverables include one comprehensive written report that summarizes the tasks and findings, an excel spreadsheet with the data collected, an e-copy of the report, and a face-to-face meeting describing findings and recommendations.