JPL SIRI INTERNSHIP ANNOUNCEMENTS OF OPPORTUNITY (AO) – FALL 2024
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AO#: 15684
Internship Type: On-site at JPL
Preferred Major(s): Planetary Science
Number of Participants: 3

Project:
Mapping the Lunar Regolith Thickness using Young Craters

Desired Background:
All skills can be learned during internship

Project Description:
Use images from the Lunar Reconnaissance Orbiter Camera (LROC) to count boulders at young impact craters. Analyze differences in the number of rocks (or lack of rocks) around craters of different sizes and in different locations to constrain variations in the thickness of the regolith layer.

AO#: 15640
Internship Type: On-site at JPL
Number of Participants: 3
Preferred Major(s): Planetary Science, Astronomy/Astrophysics, Computer Science

Project:
Analysis and Archiving of Near- and Mid-Infrared Observations of Outer Planet Atmospheres

Desired Background:
The data reduction programs are written in the Interactive Data Language (IDL, which is close to Matlab in format, and ultimately not very different from Python). 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.

Project Description:
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 "ISIS3" 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 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 "rainbow" 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 "detached" 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 – 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. 5. There also may be opportunities to work on imaging or spectra of Uranus or Neptune from James Webb Space Telescope (JWST) and supporting observations from NASA's Infrared Telescope Facility and Palomar Observatory.

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AO#: 15638
Internship Type: On-site at JPL
Number of Participants: 1
Preferred Major(s): Computer Science, Computer Engineering, Aerospace Engineering, Electrical Engineering, Mechanical Engineering, Physics, Astronomy

Project:
Anomaly detection and algorithm development for Deep Space Network data

Desired Background:
Programming skills suggested: MATLAB. Optional: one or more general-purpose programming languages including C/C++, Java, JavaScript, Lisp, Python

Ability to work with other students and engineers; self-motivated; accountable.

Useful, but not required: previous knowledge or experience with MATLAB based machine learning techniques.

Project Description:
Building on the previous summers ML/AI work to more clearly typify the data collected by the DSN operational tracks. This work should build into the next ML/AI work to allow standard Data Analytical techniques to be pursued. In order to complete this task, the intern will require learning how DSN tracks are performed (as a minimum tracking and telemetry), and the real-time data artifacts that are produced. Since DSN tracks have several different types, creating a catalog of the data types and their normal and abnormal variations, may create pre-sorting programs to allow ML/AI to be used.