NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA

VIRTUAL INTERN SYMPOSIUM

SUMMER 2021

Goddard Space Flight Center

Main Campus
IV&V
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WFF

Overview

Welcome to the OSTEM GSFC Intern Exit Presentation Symposium schedule for Summer 2021! Interns at GSFC are excited to present on their projects this Summer. Each day of the symposium is listed in the table of contents. See the Index Each presentation includes a short description of the project presentation, as well as a link. We hope you enjoy these presentations! A big THANK YOU to all interns for their participation and their mentors for their continued support.

If viewing this on a word document, either download a PDF version so that when you click on the current day in the Table of Contents, or select the "shift" button and click to navigate to the correct page.

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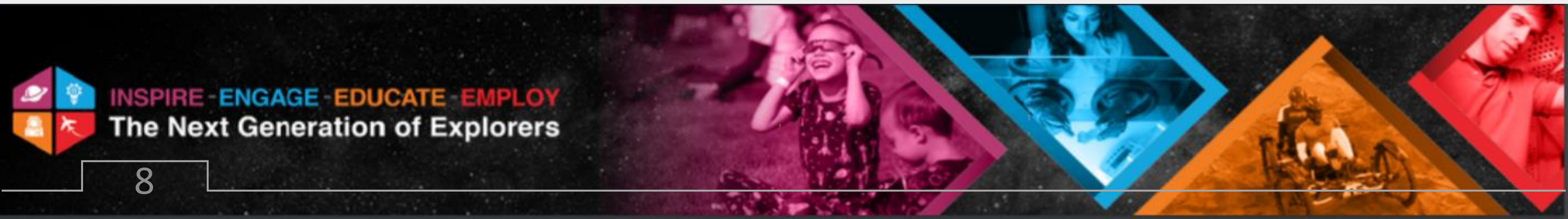
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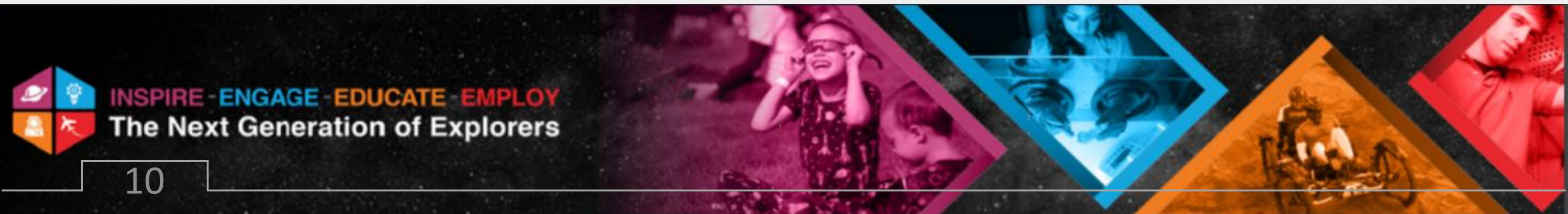
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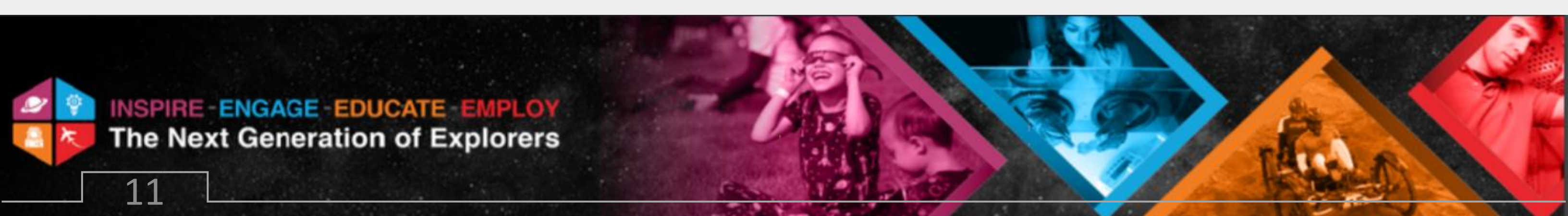
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Virtual Intern Symposium – Room A	Virtual Intern Symposium – Room B	Virtual Intern Symposium – Room C	Virtual Intern Symposium – Room D
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August 4

August 4 – Room 0

Code 130 Interns [Room Link]

Spanish Language Science Project

1030a Misael Pagán Chárriez

1040a Omarys Santiago Torres

Mentored By: Pedro Cota and Maria-Jose Vinas Garcia

Audio Storytelling Project

1050a Kate Steiner

Mentored By: Katie Atkinson

Code 130 Interns [Room Link]

Earth Science News Project

320p Emily Fischer

Mentored by: Ellen Gray

Live Team News Interview Project

330p Fiona Flaherty

Mentored By: Michelle Handleman

Planetary News Project

340p Brooke Hess

Mentored By: Bill Steigerwald

Earth Science, Climate Projects

350p Jordan Hickey

Mentored By: Peter Jacobs

August 5, 2021

August 5 - Room A

10am-11amEST / 9am-10amCST / 7am-8amPST

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High-Fidelity Simulations of EXCLAIM Mission Data

Gina M. Pantano | OSTEM Intern | GSFC – Code 665

Mentored By: Dr. Eric Switzer

Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

The EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM) is a balloon-borne mission designed to investigate why the star formation rate declined around redshift z ~ 2, despite the continued clustering of dark matter. EXCLAIM will use a relatively new observational technique, known as line intensity mapping, to measure the integrated sky emission of carbon monoxide and singly-ionized carbon line transitions at different redshifts. EXCLAIM will analyze the evolution of these tracers by integrating these snapshots and cross-correlating our observations with galactic surveys, which will allow us to provide a more detailed reconstruction of star formation patterns. During my presentation, I will show high-fidelity simulations of these three dimensional intensity maps based on current EXCLAIM models and mission data.

Instrument Design and Implementation for Cryogenic Balloon Borne Telescope

Joseph Watson | OSTEM Intern | GSFC – Code 665

Mentored By: Eric Switzer

Science Mission Directorate (SMD)

I have been working at NASA Goddard Space Flight Center on the EXCLAIM team. EXCLAIM's mission is to use a cryogenic balloon borne telescope to record a three-dimensional intensity map in the microwave electromagnetic range corresponding to carbon monoxide and carbon ion emission to study galaxy evolution and star formation. My work focused on the spectrometer package and readout, taking a preliminary design meeting mission requirements to a complete mechanical design that has been sent to machine shops for fabrication. These tasks have involved challenging special, thermal, magnetic, and electrical constrains. After everything was verified, drawings of highly complex parts were produced and sent to machine shops for quotes and future purchase

1pm-2pmEST / 12pm-1pmCST / 10am-11amPST

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CDSA Data in Action Stories

Nia Asemota | OSTEM Intern | GSFC – Code 5860 – SPEID

Mentored By: Alfreda Hall

The NASA Commercial Smallsat Data Acquisition (CSDA) Program evaluates and acquires data that complements NASA Earth science research and application goals. The CSDA team has been established to manage acquired data and make this data available to the science community. To make this data more broadly discoverable, the team has developed the Data in Action stories as a means to provide online resources demonstrating how the community can use the data. The stories also include shared dataset examples with basic code for the public to get involved. After identifying the DIA users and conducting use case interviews, we encoded the content as Markdown files. Further, using Next.js as a static site generator in conjunction with the TinaCMS toolkit, we deployed a functional site via Github Pages. Doing so, we seek to lower the barrier of entry for current and prospective scientists to access and interpret the data available.

August 9, 2021

August 9 – Room 0

Code 130 Interns Room Link

Heliophysics Project

1200p Ali Gold

Mentored By: Miles Hatfield

Hubble Communications Team

1210p Lauren Lambert

Mentored By: Tracey Vogel and Claire Andreoli

1220p Anisha Engineer

Mentored By: Elizabeth Tammi

Hubble Video Series

1230p Grace Weikert

Mentored By: Paul Morris

August 9 - Room A

8/9 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Interfacing a Spectrometer ASIC with cFS on an FPGA Soft Processor

Christian Bitzas | OSTEM Intern | GSFC – Code 5870
Mentored By: Alessandro Geist
Space Technology Mission Directorate (STMD)

This project consists of interfacing a Spectrometer application specific integrated circuit with Core Flight System software on an FPGA. The Core Flight System software is run on an FPGA equipped with a Microblaze soft processor. The Microblaze soft processor is connected to LVDS, SPI, and memory intellectual property cores. Interfacing between the ASIC and the Core Flight System software is completed through both LVDS and SPI communications. The LVDS communication provides high-speed data transmission while the SPI communication provides ASIC control and another method of data transmission.

Development of MIPI Camera Interface Prototype Adapter Board

Haruka Kido | OSTEM Intern | GSFC – Code 587
Mentored By: Alessandro Geist, Cody Brewer
Space Technology Mission Directorate (STMD)

This project is the development of the prototype FPGA-Compatible MIPI CSI-2 (Camera Serial Interface) D-PHY adapter board. The FPGA used on the SpaceCube processor card does not have I/O that natively supports the D-PHY standard, and thus requires additional external components to adapt the interface to the FPGAs I/O. The goal of this project is to develop a prototype board with this external circuitry. The project tasks include preliminary research and analysis of the adapter circuit requirements involving waveform comparisons, signal processing chain tests for voltage measurements, and calculations from I/O channel system simulations in TI-TINA, components' values and circuit configuration verifications, protoboard schematic entry, PCB footprint builds, and PCB layout in Altium Designer, and lastly, PCB manufacturing. This adapter board is useful in data conversion and transmission from the MIPI camera module to the FPGA, a D-PHY circuit arrangement used in NASA'S SpaceCube Mini's VADIR (Versatile Analog/Digital Interface) between the MIPI Camera module and the Backplane Connector.

SSolve

Elias Reed | OSTEM Intern | GSFC – Code 587
Mentored By: Dr. Christopher Wilson
Science Mission Directorate (SMD)

This project is developing a graphical user interface (GUI) and flight software for the SSolve spectrometer instrument. If approved, SSolve will detect water ice on the Lunar surface and possibly be deployed in more distant regimes like in the orbit of Venus. We developed the flight software component using the Core Flight System runtime and its APIs and libraries, and we utilized COSMOS and its APIs to design and implement the GUI. The COSMOS GUI exposes an interface with the cFS application that allows us to send commands and receive telemetry from a version of the instrument operating on the ground.

8/9 1pm-2pmEST / 12pm-1pmCST / 10am-11amPST

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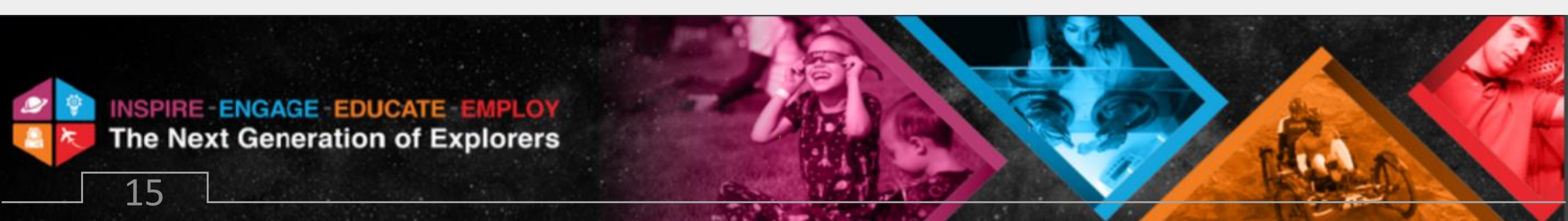
SSOLVE

Lucas Shea | OSTEM Intern | GSFC – Code 587
Mentored By: Dr. Christopher Wilson
Space Technology Mission Directorate (STMD)



During the internship I developed flight software to support Earth science missions. With SSOLVE I worked to build software that would read data from a spectrometer, process that data and then downlink it to the ground. I also worked on the ground systems to be able to interact with the flight software by issuing commands, and displaying the data received.

RAISR: AI Autoencoders for Satellite Fault Diagnosis

Gabriel Rasskin | OSTEM Intern | GSFC – Code 587

Mentored By: Evana Gizzi

Space Technology Mission Directorate (STMD)

Satellites create large amounts of unlabeled data; using this data for meaningful purposes creates a challenge. In this work, unsupervised Autoencoders are used to understand satellite telemetry, and diagnose the causes behind faults.

Fault Reasoning in Spacecraft Telemetry

Hayley Jeanette Owens | OSTEM Intern | GSFC – Code 587

Mentored By: Evana Gizzi

Using constructs such as the partially observable Markov decision process (POMDP), Kalman filter, and proximal policy optimization (PPO), this project aims to provide fault detection while providing a line of reasoning for diagnosis purposes. In the RAISR system, data streams in from the spacecraft frame by frame, and these artificial intelligence and machine learning techniques are used to provide reasoning on faulting data frames. This is beneficial for the diagnosis process, pointing to specific causes for the faulting mnemonics. Overall, the system should run onboard spacecrafts detecting crucial and catastrophic faults in real-time. This system can help save time and money, and be used in scenarios when communicating with scientists on the ground is not feasible.

[RAISR]: Explainable Diagnosis of SmallSat Faults using Artificial Intelligence

Nicholas William Pellegrino | OSTEM Intern | GSFC – Code 587

Mentored By: Evana Gizzi

Space Technology Mission Directorate (STMD)

The RAISR Project (Research in Artificial Intelligence for Spacecraft Resilience) aims to use artificial intelligence methods to diagnose faults on-board satellites. While previous work simply detects faults by looking at symptoms, RAISR goes beyond this, looking at the cause of faults instead of just the symptoms. RAISR also aims to be fully explainable - giving scientists the "why" behind each diagnosis. Explainability is an important problem in A.I., as many "black box" machine learning methods simply yield answers without humanly interpretable reasoning behind the result.
I worked on the RAISR project last summer, and have returned to work on it again this summer. My work this year involves an explainable reinforcement learning agent to diagnose satellite faults. Additionally, I worked on data generation and acquisition for the project.

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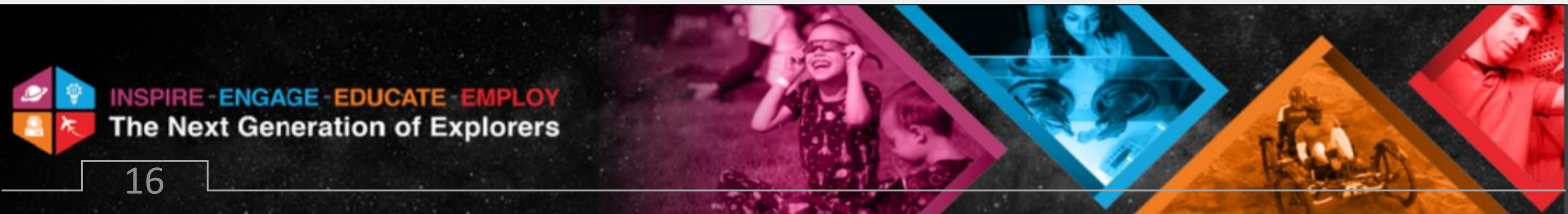
STP-H9-SCENIC Backplane Interface Design

Noah Edward Perryman | OSTEM Intern | GSFC – Code 5870

Mentored By: Christopher Wilson



Space Technology Mission Directorate (STMD)

This project is centered around the architecture and PCB design of a backplane interface for the Space Test Program - Houston 9 (STP-H9) SpaceCube Edge Node Intelligent Collaboration (SCENIC) experiment. The SCENIC experiment is intended to be an ISS-based testbed to develop, demonstrate, and evaluate both innovative commercial technologies and next-generation NASA space technologies, for space artificial intelligence, machine learning, and deep learning applications. The SCENIC backplane interface implements the main interconnect and power distribution network for the flight electronics. The design of the backplane focuses on incorporating design requirements for the flight electronics as well as layout, routing, signal integrity, and power integrity considerations.

Scientific Visualization Studio

Devika Elakara, Lucas Zurbuchen | OSTEM Intern | GSFC – Code 587

Mentored By: Lori Perkins

Science Mission Directorate (SMD)

This summer was about exploring new softwares for visualization. First we focused on creating a visual of SVS visualizations using the online platform Observable, D3, and Javascript. These visuals categorized SVS history by popular keywords and shows insight into what the breadth and depth of NASA science. Next, we looked at using Google Earth Engine to create a time-lapse visualization of Las Vegas and Lake Mead. Data was read from Landsat files and coded using Javascript. The data was then rendered into a 4K movie.

8/9 3pm-4pmEST / 2pm-3pmCST / 12pm-1pmPST

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AR/VR for Science and Engineering

Caitlin E. Lian | OSTEM Intern | GSFC – Code 587 - NCSCP

Mentored By: Thomas Grubb

Space Technology Mission Directorate (STMD)

This project involves developing augmented and virtual reality applications for science and engineering. The main application, Mixed Reality Exploration Toolkit (MRET), is an XR toolkit that's primary purpose is to efficiently simulate and render scientific problems, models, and situations. MRET is a robust visualization tool for the scientists and engineers at NASA and it takes in user interactions to create a more realistic experience. Its versatility is due to its ability to successfully encapsulate all NASA science domains by incorporating existing scientific models, LiDAR data, and more. The main feature I have developed is the ability for the user to use virtual reality controls in order to realistically climb walls and ladders at designated grab points. As it implements into the existing locomotion system, this feature can additionally be toggled on and off efficiently through the user interface. By working on the development of the application, I am improving the usability and adaptability of the toolkit, ultimately contributing to the wide range of research done at NASA.

AR/VR for Science and Engineering - Adding Motion Constraints to MRET

Dev Chheda | OSTEM Intern | GSFC – Code 587 - NCSCP

Mentored By: Thomas Grubb

Space Technology Mission Directorate (STMD)

This project adds motion constraint functionality to the Mixed Reality Exploration Toolkit (MRET). MRET helps scientists and engineers build VR environments that can utilize scientific data, CAD-based models, and a powerful built-in toolset. Previously, users could interact with objects in MRET by moving them freely in all three dimensions. This project develops a new method for interacting with objects within MRET, in which object motion is constrained to specified surfaces. The new Constrained Motion mode restricts objects to move strictly along floors and ramps, allowing for more realistic simulation of moving large equipment and hardware. The Constrained Motion mode is built with support for transitioning smoothly between floors and ramps, changing the direction of gravity (e.g. on space stations, asteroids, etc.), and preventing objects from clipping into floors.

AR/VR for Science and Engineering
Devesh Bhor | OSTEM Intern | GSFC – Code 580 - NCSCP
Mentored By: Thomas Grubb

Development of Features and Collaboration in the Mixed Reality Exploration Toolkit (MRET)
Don Balanzat | OSTEM Intern | GSFC – Code 5870
Mentored By: Thomas Grubb
Science Mission Directorate (SMD)
The Mixed Reality Exploration Toolkit (MRET) is an extended reality tool for integrating scientific and engineering design and visualization over multiple NASA domains and missions. Using the Unity Engine's C# scripting API and Shader Graph package, functionality was implemented into MRET to visually indicate the status of parts including active monitoring, selection, and part limits. Additionally, a shader was created to take in color coded vertex data for future use with structural engineering software such as Femap and Nastran. Lastly, an update to the user interface was added to toggle the user avatar, voice commands, and part alignment. The internship culminated in a demonstration of the collaborative functionality of MRET where interns from multiple centers participated in a joint session to demonstrate a harness routing use case for the planning of the Roman Space Telescope.

8/9 4pm-5pmEST / 3pm-4pmCST / 1pm-2pmPST

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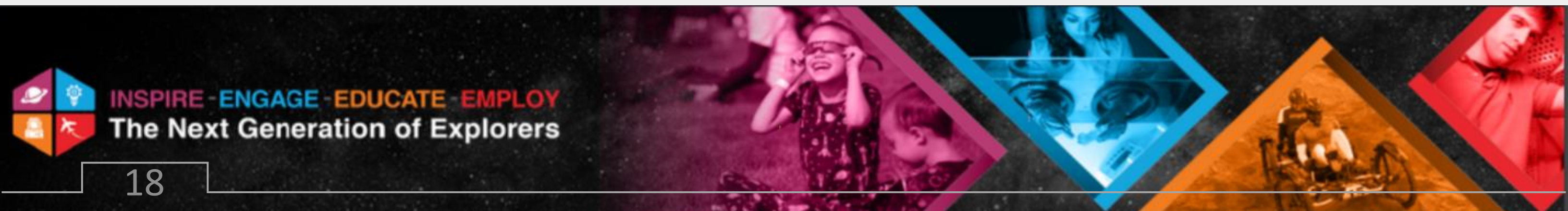
AR/VR for Science and Engineering
Henry Chen | OSTEM Intern | GSFC – Code 587 - NCSCP
Mentored By: Thomas Grubb
Space Technology Mission Directorate (STMD)
In this project, titled AR/VR for Science and Engineering, I am working with NASA's Mixed Reality Engineering Toolkit (MRET). Specifically, I am implementing features found in the virtual reality (VR) version of MRET into the new desktop version to make MRET more accessible for scientists/engineers who do not have easy access to VR headsets. MRET's primary goals are to help scientists and engineers throughout all of NASA's science domains more efficient by allowing them access to augmented reality, virtual reality, and desktop tools to model and test different features in their work. Some of the tools I successfully incorporated into Desktop mode include rotation on the X, Y, and Z planes and scaling the objects within a scene. Additionally, I helped improve the overall user experience of MRET.

Mixed Reality Exploration Toolkit
Noah Egan | OSTEM Intern | GSFC – Code 5870
Mentored By: Thomas Grubb
Space Technology Mission Directorate (STMD)
This project consisted of developing features and working on product demos for the Mixed Reality Exploration Toolkit (MRET), a software toolkit that allows engineers and scientists to do work within virtual reality. Features developed



include the ability to lock parts so that they cannot be moved, importing cables from CAD models and converting them to MRET cables so that they can be used within MRET, the ability to resize parts, and various bug fixes. I also helped organize and develop features for a product demo with a non-destructive evaluation group at Langley Research Center. I developed a file reader to read their data files, a converter to convert the their data into point cloud meshes, and an interface with an existing point cloud package to render their data. I also developed the ability to scale and rotate point clouds based on feedback from the team.

Low Cost Optical Terminal (LCOT)

Eric Yang | OSTEM Intern | GSFC – Code 450

Mentored By: Victoria Wu

Human Exploration and Operations (HEO)

This summer, I am working on the monitor and control of a low-cost optical ground terminal (LCOT) that will use laser communications to help relay information to and from spacecraft in Low Earth Orbit to Lunar orbit. Our terminal will utilize a custom 70cm aperture telescope built by Planewave Instruments. To successfully track a satellite during a pass, the telescope is mounted on a gimbal that must be carefully monitored and controlled. My work is supporting the implementation of this gimbal monitor and control system, which will provide appropriate telemetry while receiving operator and system commands. In addition, I'll be supporting LCOT on other software tasks, such as image data set processing for Factory/Site Acceptance testing analysis and data test preparation for field testing.

Requirements to Verification Detailed Analysis

Taylor Courtney | OSTEM Intern | GSFC – Code 581

Mentored By: Mark Walters

Space Technology Mission Directorate (STMD)

The OSAM-1 Mission, set to launch in 2025, is in development with the goal of servicing the spacecraft Landsat 7, currently residing in the Low Earth Orbit (LEO). Landsat 7, a satellite launched approximately 25 years ago is primarily used for imaging. OSAM-1 shall perform tele-operated servicing tasks on Landsat 7 to enhance mission lifetime. Assisting the Lead Flight Software Systems Engineer, a plan outlining the requirements to test traceability verification was developed for the OSAM-1 Payload Flight Software. The primary focus lying with identifying a plan for verifying all the software that runs through the servicing payload. Broken into five categories, the verification plan includes: an operations overview, system test personnel, system test approach, a system test scenario overview, and system test configuration.

August 9 - Room B

8/9 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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The X-Ray Spectral Energy Distribution of the Nearby Giant Elliptical Galaxy Maffei 1

Andrew Ferrell | OSTEM Intern | GSFC – Code 662

Mentored By: Ann Hornschemeier Cardiff, Neven Vulic

Science Mission Directorate (SMD)

Using the combined power of the X-ray telescopes Chandra (soft X-ray) and NuSTAR (hard X-ray), this project determined the 1-25 keV spectral energy distribution (SED) of the early-type galaxy (ETG) Maffei 1. Most ETGs are too distant to be studied in hard X-ray, but Maffei 1 is special due to its proximity, at only 3.4 Mpc it is the closest ETG. We first modeled the background spectra in a source free region. Then we used that model to constrain the background component within the region of the source. Source spectra were then modeled, informing us to the nature of the X-ray emitters found in ETGs (such as X-ray binaries, active galactic nuclei, active binaries and cataclysmic variables). Allowing us, for the first time, to compare the hard X-ray emitters of ETGs to those of other galaxy types.

Searching for variability in archival far ultraviolet spectra of massive stars

Sarina Martinez de Osaba| OSTEM Intern | GSFC – Code 662
Mentored By: Ann Hornschemeier Cardiff and Alexandre David-Uraz
Science Mission Directorate

This project uses archival far ultraviolet (FUV) spectra of massive stars obtained both with the International Ultraviolet Explorer (IUE) space mission and the Hubble Space Telescope (HST). The goal of the project is to search for variability between spectra obtained at different epochs to identify candidates of interest for follow-up studies. Various phenomena can cause the strong resonant lines of massive stars to vary with time: magnetic fields can lead to the rotational modulation of their profiles, while long-term changes in the bulk wind properties of these stars (as proposed in a recent study) should also affect the shapes of these lines. Detecting variability due to either of these (relatively rare) phenomena would enable future studies, while non-detection (particularly of the latter) within a large sample would help constrain their occurrence statistics.

Cross-Calibration of X-ray Satellites with 3C273

Corin Marasco | OSTEM Intern | GSFC – Code 662
Mentored By: Kristin Madsen

Over the past decade, the bright quasar 3C273 has been observed yearly by the X-ray satellites NuSTAR, Swift, Chandra, and XMM-Newton to collect data necessary to cross-calibrate the satellites. This project focuses on the 3C273 data collected from 2015–2021 by those X-ray observatories, and the goal is to compare the spectra of 3C273 between the observatories to quantify their cross-calibration inconsistencies. This was done by reducing the data and producing a spectra for each observation of 3C273, fitting the spectra to determine the flux detected by each instrument, and comparing the measured fluxes to find a cross-normalization constant for each instrument pair. By identifying these inconsistencies between satellite observations, we can better ensure the accuracy of scientific results obtained by the observatories studied in this project.

ALMA Observations of Dense Molecular Gas in the N113 Star-Forming Region of the Large Magellanic Cloud

Jonathon Nosowitz | OSTEM Intern | GSFC – Code 667
Mentored By: Marta Sewilo
Science Mission Directorate (SMD)

Star formation studies in the Large Magellanic Cloud (LMC) provide a stepping stone to understanding star formation and complex chemistry at earlier epochs of the universe where these processes cannot be directly observed. Utilizing ALMA molecular line data of the N113 star forming region of the LMC, the impact of low metallicity and overall environment on star formation can be studied using dense gas tracers: HCN, H13CN, HCO+, H13CO+, and CS. The python package astrodendro is used to identify dense gas clumps and provide information on their physical properties, of which a catalog is created. A statistical analysis can then be performed. The positions of the clumps are compared to those of known young stellar objects or those previously identified. The results are compared to other star forming regions in the LMC and other galactic regions of star formation to determine environmental impacts on star formation.

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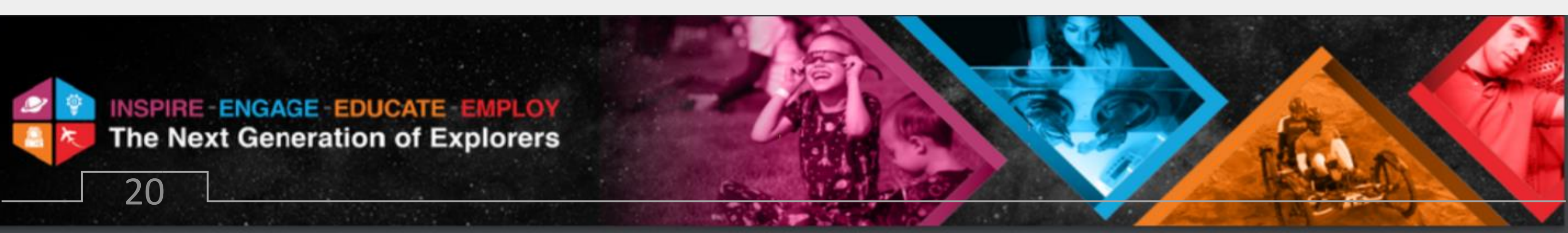

Measurement of Titan's Winds Using SMA

Siobhan Light | OSTEM Intern | GSFC – Code 693
Mentored By: Conor Nixon
Science Mission Directorate (SMD)

Titan is one of the most dynamic worlds in our solar system. As a result, understanding how its processes change over time is key to better understanding this moon. To provide insight into this, data was collected by the Submillimeter Array (SMA) in 2009 and 2010, around the time of Titan's last equinox. In this project, that data was analyzed to understand the distribution of the molecule acetonitrile (CH_3CN) during that time period. Doppler line shift measurement techniques were then employed to measure mesospheric wind speeds, and these speeds are compared to previous work in order to paint a fuller picture of how Titan's winds change with its seasons.

Search for new chemical species in Titan's atmosphere

Brendan Steffens | OSTEM Intern | GSFC – Code 600
Mentored By: Conor Nixon
Science Mission Directorate (SMD)

We have continued our search for C_4 hydrocarbons in Titan's atmosphere. During this summer, we were awarded upcoming observing time at NASA IRTF, and we submitted a manuscript to Planetary Science Journal with our work using Cassini CIRS data.

Remote sensing of Titan in the infrared with Cassini CIRS

Brian Murphy| OSTEM Intern | GSFC – Code 693
Mentored By: Conor Nixon and Gordon Bjoraker
Science Mission Directorate (SMD)

We have focused our search for latitudinal and temporal variation of water vapor on Titan in the 120-260 cm^{-1} range, using Cassini's Composite Infrared Spectrometer (CIRS) instrument. We chose nadir spectra to cover all latitudes over Titan's disk during the operational lifetime of Cassini and split the spectra into 30 latitude-dependent bins over the 12.5-year data set (2005-2017). We modeled the data set using the Non-linear Optimal Estimator for MultivariatE Spectral AnalySIS (NEMESIS) planetary atmosphere radiative transfer and retrieval tool. Temperature profiles, aerosol, trace gas, and water vapor scaling factors were retrieved from a set of modeled a priori estimates. Our contribution functions, which denote the sensitivity of our water retrievals, peaked in the lower stratosphere (90-180km). We derived stratospheric mixing ratios for water in each of the modeled bins, and here we can provide new stratospheric mixing ratios that record Titan's spatial and temporal dispersion of water vapor.

Distribution of ethyl cyanide in Titan's atmosphere from 2013 to 2016 with ALMA

Hypatia Barry | OSTEM Intern | GSFC – Code 693
Mentored By: Dr. Conor Nixon
Science Mission Directorate (SMD)

The Atacama Large Millimeter/submillimeter Telescope provides useful observations for analysis of the atmosphere of the moon Titan, from its dynamics to its chemical makeup, particularly in its Bands 6 and 7 (211 – 373 GHz). Observations of Titan available in the ALMA Science Archive -- both flux calibration observations and dedicated observations -- can be mapped with the Common Astronomy Software Applications (CASA) to understand the latitudinal distribution of molecules over time. Here we present maps of C_2H_5CN (ethyl cyanide) from 2013 to 2016 in the context of the existing collection of molecular maps of Titan. We discuss implications for current models of C_2H_5CN dynamics and formation.

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Using Machine Learning to Detect Chaos Terrain on Europa

Kathryn Gansler | OSTEM Intern | GSFC – Code 693

Mentored By: Conor Nixon

Science Mission Directorate (SMD)

In this project, a U-net neural network architecture was applied to images of the surface of Jupiter's moon Europa taken by the Galileo spacecraft to detect ice floes in the moon's Chaos Terrains. These regions are illustrative of the massive disruption, reorientation, and refreezing experienced on Europa's surface as Jupiter's gravity imparts immense tidal forces that heat the moon. Creating software to automatically detect these jigsaw-like ice floes will accelerate scientific analysis of such terrains once higher resolution images of the moon arrive in the fall of 2022 from the Juno spacecraft and later from the forthcoming Europa Clipper mission.

Dynamical Atmospheres of the Outer Solar System

Sarah K. Howard | OSTEM Intern | GSFC – Code 693

Mentored By: Conor Nixon

Science Mission Directorate (SMD)

Neptune exhibits some of the fastest winds in the solar system. The ice giant has only been visited by Voyager 2 in 1989, meaning that we are dependent on ground based instruments to observe Neptune's atmosphere. In this project, observations from the Atacama Large Millimeter/submillimeter Array (ALMA) are used to directly measure Neptune's stratospheric winds through the Doppler shifts of Carbon Monoxide (CO) molecular transition spectra. These speeds can be compared to previous studies that used different measurement methods, such as cloud tracking.

Greenland Atmospheric Data Investigations

Sara Delawalla | OSTEM Intern | GSFC – Code 6150

Mentored By: Tom Neumann

Science Mission Directorate (SMD)

This project assesses the accuracy of ATL09 measurements from NASA's ICESat-2 using data and observations from Summit Station in Greenland. ICESat-2 is a space-based mission to measure the height of the earth using green laser light. In addition to surface topography, ICESat-2 also measures atmospheric properties. ATL09 contains data about cloud and atmospheric properties as well as lidar backscatter. We compared cloud layer and blowing snow heights from specific cases between ATL09 and Summit. These comparisons can be used to affirm the accuracy of ATL09 or identify possible problems.

ICESAT-2 and Indigenous Connections

Shawnell McFarlane | OSTEM Intern | GSFC – Code 615 – SPEID

Mentored By: Valerie Casasanto

Science Mission Directorate (SMD)

My project will briefly go over what the ICESAT-2 satellite is and its mission as well as its importance. This project mainly focuses on outreach for younger indigenous students interested in STEM so throughout this project we will have small but relevant ICESAT-2 activities to connect both westernized and indigenous science. I wanted to find a way to tie in our salmon, because the ICESAT-2 satellite can help in a variety of ways in monitoring the salmons habitat and how the water heights, water temps, and reservoirs have changed in our estuaries. Our salmon migrate from Alaska an area where the ICESAT-2 satellite/team has connected with already. I just hosted a motion in the ocean activity with my tribal youth thankfully in person but now we have to go virtual so we were thinking of hosting virtual workshops for not only my tribe but surrounding tribes as well. We have been brainstorming to come up with a new innovative activity that ties in both westernized and indigenous science because for missions like ICESAT-2 it is nice to bring awareness, not everyone is familiar with certain NASA missions and how they may positively impact tribal communities, my goal is to bring awareness through a variety of activities and maybe even monthly article or social media post through tribal newspapers.

8/9 3pm-4pmEST / 2pm-3pmCST / 12pm-1pmPST

Virtual Intern Symposium – Room B

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Snow Volume Change from Radar Layer Tracking

Alejandra Vega Gonzalez | OSTEM Intern | GSFC – Code 615

Mentored By: Thomas Overly

Science Mission Directorate (SMD)

My project consisted on tracing layers of past annual snow accumulation across the Greenland ice sheet. This data was measured using ground penetrating radars on Operation Icebridge. By tracing these layers, the goal was to identify how climate change has impacted the ice sheet. In addition, the project seeked to utilize the CreSIS toolbox to further improve and enhace its features as a layer tracing tool

Modeling dust aerosol optical depth with machine learning

Alan Chen | OSTEM Intern | GSFC – Code 613 - NCSCP

Mentored By: Yaping Zhou

Science Mission Directorate (SMD)

The Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) is a powerful instrument onboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite that uses active Lidar to retrieve vital information such as cloud and aerosol optical depth in the atmosphere. However, its spatial coverage is incredibly limited compared to other passive instruments such as the Moderate Resolution Imaging Spectroradiometer (MODIS), requiring multiple weeks to achieve quasi-global measurements and can miss many important atmospheric events such as dust storms. This project aims to address this limitation by combining the CALIOP and MODIS instruments utilizing machine learning to retrieve AOD with the coverage of MODIS and accuracy of CALIOP. Main steps include preparing the training dataset for machine learn-ing from collocated CALIOP and MODIS level-2 products, screening out pixels with cloud/snow/ice interferences, training and testing the model, optimizing parameters, and then evaluating the retrieval.

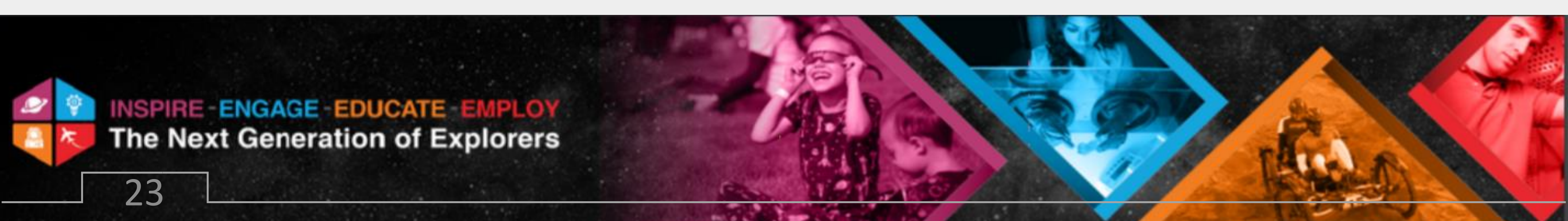
Extreme Precipitation Frequency Analysis with IMERG Data

Jerry Xiong | OSTEM Intern | GSFC – Code 613- NCSCP

Mentored By: Yaping Zhou, George Huffman

Science Mission Directorate (SMD)

The Integrated Multi-satellitE Retrievals for GPM (IMERG) product provides precipitation estimates over the majority of the Earth's surface. By modeling precipitation accumulations that exceed some threshold using the generalized Pareto extreme value distribution, estimates can be created for the magnitude and frequency of future extreme events (presented as average reccurence intervals). Existing modeling systems increase the quality of the results by utilizing a



regional modeling approach in which data from similar locations are pooled in order to compensate for the short data record. In this project, the pooling process is modified to (1) use a region-of-influence approach and (2) weight the site characteristics based on their correlations with distribution homogeneity. This approach increases the overall homogeneity of the resulting clusters, which reduces the error of the model estimates.

Improve automation of phytoplankton pigment HPLC peak identification using recurrent neural networks

Rohan Mittu | OSTEM Intern | GSFC – Code 616- NCSCP
Mentored By: Crystal Thomas, Joaquin Chaves
Science Mission Directorate (SMD)

The Ocean Ecology Laboratory’s (OEL) Field Support Group (FSG) measures local in- and above-water variables for algorithm development and the vicarious calibration of ocean color satellite sensors. Samples are analyzed with High Performance Liquid Chromatography (HPLC), and the goal of this project is to use a recurrent neural network (RNN) to identify for each peak either the pigments that matches the peak or if the peak is interference based on previous decisions. Automating the identification of the peaks in the HPLC chromatogram makes the HPLC analyst’s workflow more efficient and supports improved quality of NASA satellite data for ocean ecological research.

8/9 4pm-5pmEST / 3pm-4pmCST / 1pm-2pmPST

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On the Binary Black Hole Shadow Hierarchy

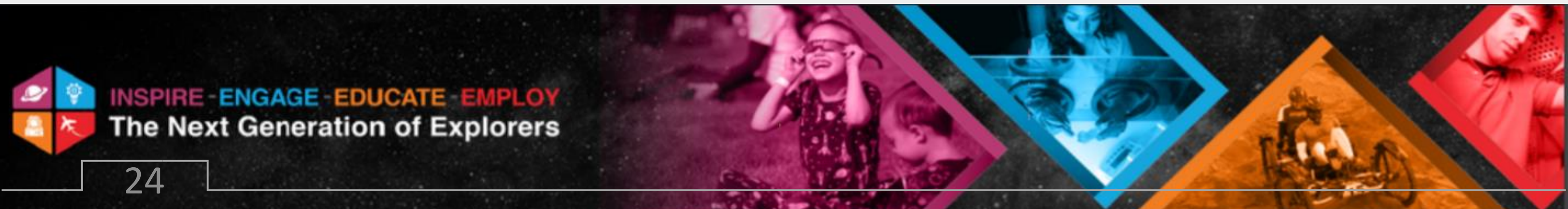
Ajeet Gary | OSTEM Intern | GSFC – Code 663
Mentored By: Scott Noble
Science Mission Directorate (SMD)

General Relativity tells us that in a binary black hole system light rays should experience extreme gravitational lensing as they pass through the system. We analyze the paths that these null geodesics take on their way to either black hole to discern a hierarchy of shadows in the image plane corresponding to ever more complicated paths that geodesics may take before disappearing behind an event horizon.

The Steady State of a Circumbinary Black Hole Accretion Disk

Sasha Gladkova | OSTEM Intern | GSFC – Code 663
Mentored By: Dr. Scott C. Noble
Science Mission Directorate (SMD)

If left to evolve, a binary black hole system’s accretion disk will likely reach a steady state. This project determines the equilibrium period of a circumbinary accretion disk in an equal mass ratio binary black hole system. In similar studies, magnetohydrodynamics laws and a Newtonian frame were used, but this simulation set is the first to use a post-Newtonian approach instead. We are analyzing data from a recent simulation by Dr. Scott Noble et al. in which a black hole system with initial conditions involving the accreting gas is allowed to evolve over time, while the black holes remain a fixed distance apart. With the goal of determining when the disk of matter surrounding the black holes reaches a steady state, we are analyzing the figures generated with Python code to help us understand the disk. The graphs we are interpreting are the accretion rate over time, averaged accretion rate over radius, mass enclosed within a radius, and the specific Maxwell stress. We’ve found the best time for the steady state epoch to begin is after the black holes orbit each other about 290 times, about half way through the simulation. These figures and findings can be compared to



similar works that have been published in order to glean the most accurate conclusion. Our results can be useful for identifying multi messenger sources and serve as a progression towards future, less restrictive simulations.

Landsat's Long History: Cousteau and the Origins of Satellite Derived Bathymetry

Evangeline Koonce | OSTEM Intern | GSFC – Code 600
Mentored By: Ginger Butcher
Science Mission Directorate (SMD)

Landsat is the longest running, continuous record of Earth observations from space. As we approach the launch of the ninth Landsat satellite, we take a look back at the long history of this mission, a mission that has impacted so many different fields. In the summer of 1975, Jacques Cousteau and NASA teamed up with Landsat 1 and 2 to test the satellites' ability to measure shallow water depth from space. Using the photography of David Lychenheim, the onboard communications engineer, and the published work of Laura Rocchio, a Landsat science writer, a short documentary video was created to tell the story of how this experiment gave birth to the field of satellite derived bathymetry.

Landsat: Animation and Interactives

Ross Walter | OSTEM Intern | GSFC – Code 600
Mentored By: Ginger Butcher
Science Mission Directorate (SMD)

The projects I worked on this semester comprised of 3d animation, Motion graphics, and interactive development inspired by the features of science of Landsat. My work dealt with animating a low-poly model of Landsat 9 and creating an Landsat band combination interactive.

August 9 - Room C

8/9 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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The Role of Financial Tracking and Reporting in SRB Life Cycle Reviews

Nelymar Font Valcarcel | OSTEM Intern | GSFC – Code 159
Mentored By: Dwight Norwood and Julie A. Rivera Perez
Center Operations

During this summer, I supported the SRO Senior Resources Analyst (SRA), who serves as the financial liaison between SRO and the Program/Project Offices. I had the unique opportunity of performing cost analyses to assess SRB funding needs for the Civil Servants and contractor SRB board members. I assisted with creating/modifying SRB tasks by reviewing statements of work (SOWs) and producing in-house cost estimates (IHCEs) to include cost/schedule changes and no-cost extensions (NCEs) for the SRB tasks. I have also assisted with the creation of IHCE for various Projects and their SRB boards, updating SRB schedules, and running financial data through GSFC financial systems. Tracking and reporting financial data for the SRB Life Cycle Reviews helps SRO and the Review Managers make the proper decisions when deciding on how to proceed with tasks and the funding necessary to support the SRBs.

Financial Report (Workbook) Guide for Scientists (Codes 660/670/690)

Daisy Navarro | OSTEM Intern | GSFC – Code 150 - NCSCP
Mentored By: Cheryl-Ann Barrington, Ricardo Martinez Serrano, Joan Rodriguez Rivera, and Shawn Taylor
Science Mission Directorate (SMD)

This project creates a guide to help scientists interpret the monthly financial reports that are prepared by the space science resources analysts (RAs) on a monthly basis. It will enhance the current financial report to add a guide that explains each tab of the report and how to utilize this information for the decision-making process; define the different components of the budget; and explain financial terminologies to better respond to actions throughout the year.

Contract COVID-19 Function Code Correction Process

Beryl Ndofor | OSTEM Intern | GSFC – Code 157
Mentored By: Christine Baxley, Ryan Fiora, Thomas Wolking, Robin Neukam
Science Mission Directorate (SMD)

Covid-19 gave the government covid related costs due to contractors not being able to come onto site to do their work but still needing to be paid. In order to group all of these costs there is a covid specific function code that must be used. Financial mangers and many different people working on contracts were unaware of this code and were using the regular function code for tasks. This means they must now go back on previous contracts and determine the covid costs and then attach them with the correct function code. This issue is spread over various tasks in various projects and thus takes a lot of time and collaboration between different offices such as procurement.

Exploration into Quality Assurance and Policy Standards

Mariam Sheikh | OSTEM Intern | GSFC – Code 152
Mentored By: LeeAnn Murphy
Center Operations

My project will focus on various aspects of the work within code 152 - The Office of Quality Assurance, Policy & Standards, such as topics relating to internal control/audit of Contractor Held Property, NF533 Contracts and the processes used to validate them, and the stages of Planning, Reporting, and Fieldwork in the audit process.

8/9 1pm-2pmEST / 12pm-1pmCST / 10am-11amPST

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Office of the CFO - Business Support to CCRS

Joel Krznaric | OSTEM Intern | GSFC – Code 155
Mentored By: Robert Montgomery
Science Mission Directorate (SMD)

This project establishes more efficient and reliable reporting processes for the CCRS resource and scheduling teams through the use of Microsoft Power BI. We leveraged new application techniques to transform, analyze and clean up and visualize data for plan-vs-actual, travel log and schedule health check reports. This process included light coding in the transformation steps and the calculation of visualization measures with the DAX language. Several of the reports existed in Excel but were enhanced through the data management and visualization capabilities of Power BI. During the latter half of the project, I trained the resources team on how to manage and update the Power BI files that I created and shared.

Visualizing Project Performance Data with Power BI

Angelica N. Martinez Miro | OSTEM Intern | GSFC – Code 153
Mentored By: Ron Warczynski
Center Operations

This project creates a series of dashboards using Power BI, a Microsoft business analytics tool, to visualize GSFC Flight Project performance data. Project data is uploaded monthly into the repository using metrics and datasets submitted by the projects. Through interactive graphs and visualizations, the Power BI dashboards will provide users with the ability to easily view and analyze Project performance data. It will also allow users to compare actuals against requirements, analyze trends, and view multiple projects simultaneously for a Center-level assessment of the health and performance of projects at GSFC.

IPAC Monthly Statistics for Intra-governmental Payment & Collections (IPAC) transactions

Brendan Didier | OSTEM Intern | GSFC – Code 151

Mentored By: Shirley Royal and Wanda Brown

Center Operations

For my project, I decided to look into Intra Governmental Purchases and Collections transactions (IPAC's) and the statement of differences that are associated with them. I gathered all the IPAC transactions from all three centers and then organized and visualized the data. The number of IPAC's per center were compared along with the number of statement of differences. The value of these transactions were also compared along with the percentage of statement of differences that were needed. Using this data, I attempted to find any correlations or answers as to why some of the numbers varied so much between the three centers.

Reconciliation of Explorer's Financial Data

Michael Chartier | OSTEM Intern | GSFC – Code 155

Mentored By: Carla Connor

Science Mission Directorate (SMD)

Provided data validation/reconciliation to the Explorers program office financial data to ensure categorization was appropriately labeled. Created BOBJ Reports using the BERPT2 report function which included participating in several courses related to BOBJ and SAP programs. The project included understanding the data and pulling in current year and past year data that was merged into a total table. Also, revising formula's on data collection and verifying the formula's are returning the correct data and moving "Unknown" data to the exceptions list. Provided more effective practices with the file while creating multiple versions of it needed to build upon each step during the verification process of the data.

8/9 2pm-3pmEST / 1pm-2pmCST / 11am-12pmPST

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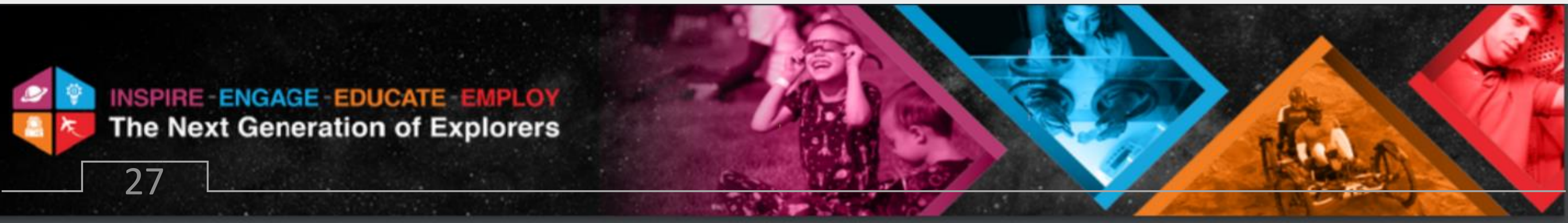
Archives Internship

Maia Huddleston | OSTEM Intern | GSFC – Code 200

Mentored By: Holly McIntyre

Center Operations

The scientists and engineers at Goddard Space Flight Center work hard to construct new technology and find solutions to unsolved mysteries. That work leads to important knowledge that needs to be preserved for future reference, and the archives make sure that happens. The Goddard archives are working on making thousands of photos from the late 1990s accessible to Goddard researchers and scientists. The photos span a variety of subjects from astronauts and celebrities to operational wiring. In order to prepare the photos for publication on the archives website, the files must first be transformed, organized, renamed, and keyworded. This work will ensure that the photos are easy for researchers to find when they need to search for photos from specific missions or events.



Covariate Software Defect Changepoint Analysis

Joshua Steakelum | OSTEM Intern | GSFC – Code 372

Mentored By: Ying Shi

Science Mission Directorate (SMD)

This project expands on previous research done with Dr. Ying Shi improving software reliability modeling by implementing recent testing activity-based metrics over traditional reliability prediction models. In software reliability, mathematical models are typically used given defect data found from testing in order to predict the occurrence times and counts of potential future software defects. However, existing models are limited as they do not consider the underlying reasons as to why defects may be detected in testing, and, more specifically, causes of a spike in defect counts. A covariate reliability model is employed using the Cox proportional-hazards model tracking a number of testing activities to (1) better fit models to defect data, and (2) determine which activities optimally detect defects. The novelty of this technique additionally required the development of tools for example dataset generation and aims to provide more accurate reliability modeling using simple metrics such as code coverage.

A Review of Burn-in Testing Performed on Hybrid Microcircuits

Diana Gutierrez | OSTEM Intern | GSFC – Code 370

Mentored By: Bhanu Sood

Space Technology Mission Directorate (STMD)

Burn-in is a stress test performed on all hybrid microcircuits to identify defects that may result in infant mortality and is a key resource in ensuring that the devices used in space missions and can grant long-term use reliability. This presentation discusses burn-in testing and its potential role in the additional degradation of hybrid microcircuits due to over-stressing. This work seeks to understand what conditions result in the high degradation of “healthy” devices through a detailed critiquing of the screening tests in MIL-PRF-38534L, a standard that provides guidelines on burn-in testing and more for hybrid microcircuits. Additionally, researchers have discussed that burn-in testing may be excessive for some parts and lenient on others which calls for a revision of the current life stresses hybrid microcircuits are tested under. This presentation addresses degradation in burn-in testing and the review of conditions to help mitigate an additional loss of remaining useful life.

GMIP's efficiency and effectiveness

Marc Minor | OSTEM Intern | GSFC – Code 300- NCSCP

Mentored By: (Mentor: Chanel Duncan) (Co-Mentor: Bo Yang)

Center Operations

My project will go over how we can accurately capture the efficiency and effectiveness of GMIP's across Nasa missions and projects. During my presentation I will explain the methods and approach towards in-house built and out- house built methods in terms of GMIP's data inputs. While also giving in insight to what I have learned during my internship process and how I effectively collected and analyzed the data put into my project and research.

8/9 3pm-4pmEST / 2pm-3pmCST / 12pm-1pmPST

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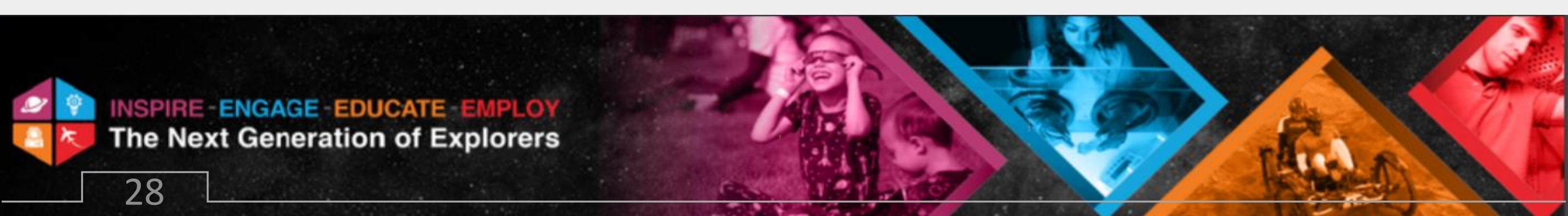
Documentation and Improvements to a Flight Safety Risk Assessment Tool

Brandon Gardner | OSTEM Intern | GSFC – GSFC – WFF – Code 392

Mentored By: Adam J. Mullins



Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

The Wallops Flight Facility flight safety division has an inherent need to take information about flight parameters and develop risk assessment models from said data through data manipulation and executable programs. A portion of that process is completed through the use of an excel spreadsheet. This template is filled out by a flight safety analyst and through the use of VBA code, the data is turned into XML code which can be used with RiskCalc or DragSim. These programs help in calculating the probability of certain risk criterion which the flight safety analyst uses to determine safety of a mission. A portion of the internship was spent documenting this process, and a portion of this internship was spent analyzing the VBA code for inefficiencies, and errors, while generating a process to reverse from XML back to the raw template entries.

Conversion of Wind File Formats

Elizabeth Weidl | OSTEM Intern | GSFC – WFF – Code 392

Mentored By: Randall Strom; Christian Strom

Center Operations

The project had the goal of reformatting two North American Mesoscale (NAM) atmospheric data files to Range Risk Analysis Tool (RRAT) specific formats. The program RRAT uses a specific format when uploading wind and air density files. This format was provided in the RRAT help file, along with an example. The first of the original NAMS data files contained altitude, pressure, temperature, and dew point. A conversion had to be made to ensure correct units. The second of the original NAMS data files contained altitude, wind direction, and wind velocity. Reformatting had to be completed to ensure compatibility with RRAT. This conversion process was performed using Microsoft Excel.

Flexible Harness Thermal Vacuum Cryo-Fatigue Test

Nolan Inman Kowitt | OSTEM Intern | GSFC – Code 448

Mentored By: Dino Rossetti

Science Mission Directorate (SMD)

The purpose of this test is to measure continuity of a flexible harness in motion under space-like conditions. This harness will connect from the optical array to the readout electronics within the Nancy Grace Roman Space Telescope. The optical array sits on a hexapod, which enables the array to change directions and focus, but requires the flexible harness to move. We use motors to simulate three axis motion on one end of the harness and measure electrical resistance on all of the channels as the harness moves inside a cryo-vac chamber. The different temperatures of liquid and gaseous N2 allow us to create a temperature differential across the harness simulating telescope conditions. This test represents the worst case scenario and if successful, will prove that the flexible harness can safely be moved when in operation within the telescope.

Implementing Strategic Public Communications with Social Media Performance Insights: @NASAHubble Data Analysis

Joshua D. Ingram | OSTEM Intern | GSFC – Code 441

Mentored By: James F. Jeletic

Science Mission Directorate (SMD), Center Operations

A strong social media presence is a necessity for any organization to successfully grow an audience. Since their emergence, social media platforms have enabled NASA to better communicate scientific discoveries and engage with the public. However, determining the best way to expand reach to the public through these outlets is difficult without tracking and analyzing performance data. Using follower and post-feature data from the @NASAHubble Twitter, Instagram, and Facebook accounts, we conduct categorical data analysis to discover any relationships between post performance and characteristics of the content. Specifically, we investigate the effects of post type, time, hashtags, subject, and other characteristics on user reach, engagement, and follower growth. These insights provide strategies that the Hubble and NASA communications teams can immediately implement to increase their presence on social media platforms.

8/9 4pm-5pmEST / 3pm-4pmCST / 1pm-2pmPST

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On-Orbit Robotics in VR using MRET

Nathaniel Rose | OSTEM Intern | GSFC – Code 480

Mentored By: Billy Gallagher

Space Technology Mission Directorate (STMD)

Over the summer I have been working with OSAM-1 and the MRET development team in the development of their mixed reality toolkit. MRET is used by scientist, engineers, and more to build scenarios to teach, learn, and discover. I have been working on tasks that help witht the user interface and interaction of the scenarios, such as displaying distance, solving inverse kinematics, and scaling projects/objects

Mentorship Development

Gabrielle Gaudet | OSTEM Intern | GSFC – Code 480

Mentored By: Zakiya Tomlinson

Space Technology Mission Directorate (STMD)

Throughout the summer I've been documenting the duties and processes for internship coordinators, creating promotional and training materials for future mentors and collecting feedback from mentors and other interns

August 9 - Room D

8/9 3pm-4pmEST / 2pm-3pmCST / 12pm-1pmPST

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Earth Observation Applications for Resliency

Skye Lam and Sonia Aronson | OSTEM Intern | GSFC – Code 6110 CCRI

Mentored By: Dr. Christian Braneon

Science Mission Directorate (SMD)

We use remote sensing data to investigate extreme heat and susceptibility to flooding in historically redlined areas of New York City. In the 1930s, the Home Owners Loan Corporation (HOLC) created color-coded maps of residential neighborhoods to help lenders evaluate risk. Recent studies show elevated land surface temperature in redlined areas for cities throughout the United States. Our project uses Landsat and Sentinel imagery from 1990 to 2021 to examine the relationship between vegetation cover, summer land surface temperature, and inundation during flood events from heavy precipitation in each HOLC graded area. We find that redlined neighborhoods, or "D" graded areas, are more likely to experience higher summer temperatures, have less vegetation cover, and experience greater chronic street flooding than "A" graded areas.

CCRI: Atmospheric Rivers in a Changing Climate

Taylor Miranda and Prachi Ingle | OSTEM Intern | GSFC – GISS – Code 600 CCRI

Mentored By: Allegra LeGrande

Science Mission Directorate (SMD)

Recent melting events in the cryosphere raise concerns about polar areas in the future, particularly around Greenland and West Antarctica. Atmospheric Rivers cause poleward heat and moisture transport which can affect the melt patterns in these areas. Using climate data from the GISS ModelE2.1, Atmospheric River models from Guan and Walliser 2019, and climate oscillation data from NOAA, we created a mechanism to calculate the Surface Mass Balance and Surface Energy Balance for both Greenland and Western Antarctica. Upon synthesizing surface balance calculations with Atmospheric River (AR) Data, we applied and evaluated various modeling techniques to predict surface balances from AR events and climate oscillations. We found non-linear models proved a better tool in simulating the effect of AR and climate oscillation data on surface balances in the cryosphere.

8/9 4pm-5pmEST / 3pm-4pmCST / 1pm-2pmPST

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The Urban Heat Island Effect in Brooklyn, New York: Assessing Variations in Vegetation and Land Surface Temperature at Multiple Scales Using Data from Multiple Sources

Erin Foley and Matthew Zhang | OSTEM Intern | GSFC – GISS – Code 1600 - CCRI

Mentored By: Dr. Reginald Blake and Dr. Hamidreza Norouzi

Science Mission Directorate (SMD)

This project takes a closer look at the urban heat island (UHI) effect in Brooklyn, New York, and how it varies over space and time. We utilized remote sensing data observations from multiple satellites to construct an in-depth analysis of how land surface temperatures correlate to Naturalized Difference Vegetation Index values. Moreover, an analysis of how historic redlining policies may play a role in how various Brooklyn zip codes experience the UHI effect differently. Finally, in order to make all data for UHI analysis more readily available at a higher temporal and spatial resolution, we used a downscaling process to combine MODIS and Landsat observations and projected this downscaled data to a website in order to aid both researchers and citizens in finding accurate climate data.

August 9 - Room E

8/9 9:45am-5pmEST / 8:45am-4pmCST / 6:45am-2pmPST

WebEx meeting: **415-527-5035, Access code: 199 429 0539**

Time	Topic	Speaker
09:45	**Ray Tracing for Radio Propagation Modeling** *Telecommunications Engineering, Data Modeling*	**Thomas Montano**, Pathways intern Telecommunication Networks & Technology Branch *Mentor: George Bussey, code 566*
10:00	**Link Analysis for a NASA Ka-band Ground Station** *Telecommunications Engineering*	**Darius Dale – OSTEM Intern – NSCSP** Near Space Network *Mentor: Eric Harris, code 457*

10:15	**S-Band Network Analysis and Strategies for Low- Earth Orbit CubeSat Science Missions** *Telecommunications Engineering, Electrical Engineering*	**Ethan Abele – OSTEM Intern** Near Space Network *Mentor: Dr. Serhat Altunc, code 566*
10:30	**Mission Visualization Toolkit for Outreach and Customer Engagement** *Telecommunications Engineering, Data Modeling*	**Vicki Carrica, Zoe Schoeneman-Frye - OSTEM Interns, Aman Garg, Arya Kazemnia, & Leo Wang** Near Space Network *Mentor: George Bussey, code 566*
11:10	**Network Emulation within a Software-Defined Laboratory** *Testing & Tools, Software Engineering, Network Engineering*	**Nicholas Reichert – OSTEM Intern** Near Space Network *Mentor: Mark Sinkiat, code 581*
11:25	**Faster, Easier Radio-Frequency Testing: Centralized Control and Data Logging System** *Testing & Tools, Software Engineering, Electrical Engineering*	**Alan Chen & Colin Petherbridge - OSTEM Interns** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentors: Jake Barnes, code 566, & Andrew Robinson, code 459*
11:45	**Making Noise: Simulating Radio Frequency Interference for Cell Phone Towers** *Testing & Tools, Software Engineering, Electrical Engineering*	**Nick Wood** Near Space Network *Mentor: Jake Barnes, code 566*
1:05	**Novel Optical Demodulation Algorithm Implementation and Testing** *Electrical Engineering, Software Engineering*	**Lindsay White**, Pathways intern Telecommunication Networks & Technology Branch *Mentor: Rafael Garcia, code 566*
1:20	**All-Sky Infrared Cloud Imager for Optical Communications** *Electrical Engineering, Optics, Computer Vision*	**Brandon Byford – OSTEM Intern** Advanced Communications Capabilities for Exploration and Science Systems / New Mexico State University SCaN Grant *Mentors: Armen Caroglanian, code 566 & Dr. Steven Stochaj, New Mexico State University*
1:35	**Building a Laser Terminal for the International Space Station: Mechanical Integration and Testing** *Mechanical Engineering, Integration & Testing*	**Micah Temenak** Integrated LCRD Low-Earth Orbit User Modem and Amplifier Terminal (ILLUMA-T) *Mentor: Ted Goodhue, code 540*
1:50	**Development of Business Tools for Data Management** *Testing & Tools, Network Engineering*	**Austin Ryan** Exploration and Space Communications *Mentors: Tara Dulaney & Mike Zeydelis, code 450*
2:05	**Connecting the Goddard Community Through Upcoming Launch Engagement** *Outreach, Public Engagement, Optical Communications*	**Katrina Lee** Policy & Strategic Communications *Mentor: Mariah Pulver, code 450*

2:30	**Cloud Status System Development** *Software Engineering*	**Elizabeth Smith,** Pathways intern Computing Environments and Collaborative Technologies Branch *Mentors: Risha George, code 459 & Eve Rothenberg, code 583*
2:45	**Spacecraft Design for Lunar Communications and Navigation** *Mechanical Engineering, Mission Design*	**Kimberly Stringer – OSTEM Intern** Technology Enterprise and Mission Pathfinder Office *Mentor: Dr. Jaime Esper, code 450.2*
3:00	**SCaN Educational Resources for Lunar Missions and Laser Communications** *Outreach, Optical Communications, Artemis*	**Alicia August-Furhman & Jen Ushe** Policy & Strategic Communications *Mentor: Julie Hoover, code 450.1*
3:15	**Lunar Navigation Using the Global Navigation Satellite System** *Navigation, Software Engineering*	**Anna Zhong – OSTEM Intern** Positioning, Navigation, & Timing *Mentor: Lauren Schlenker, code 595*
3:35	**Trajectory Optimization Software for Autonomous Spacecraft Maneuver Planning** *Navigation, Software Engineering*	**Spencer Boone – OSTEM Intern** Positioning, Navigation, & Timing *Mentors: Dr. Sun Hur-Diaz & Dr. Noble Hatten, code 595*
3:50	**Orbit Simulation for Autonomous Spacecraft Landing** *Navigation, Software Engineering*	**Jeffrey Greer IV – OSTEM Intern - SPEID** Positioning, Navigation, & Timing *Mentors: Dr. Sun Hur-Diaz & Dr. Noble Hatten, code 595*
4:15	**Waveform Database for ACCESS Modem Testbed** *Software Engineering, Testing & Tools*	**Sander Cochran** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentor: David Schuchman, code 459*
4:30	**Engineering Interfaces: Results Database for Modem Testbed Software** *Software Engineering, Testing & Tools*	**Connor Moon** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentor: David Schuchman, code 459*

August 10, 2021

August 10 - Room A

8/10 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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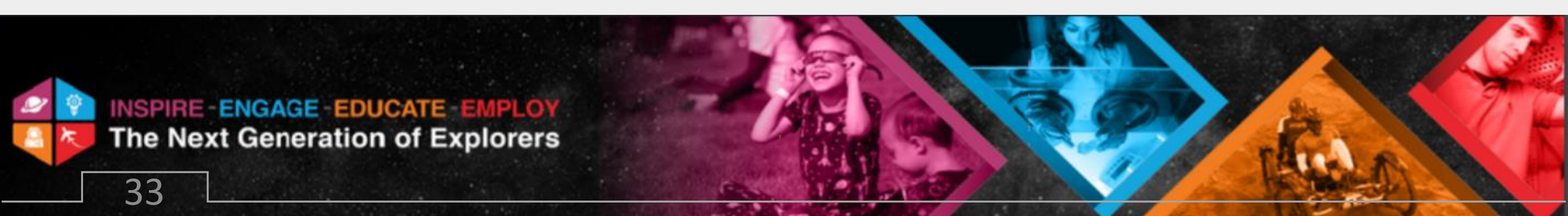

MUREP: MISTC2 CubeSat, FlatSat, and GN&C Systems Dev and Analysis

Amari Harrington, Christian Jordan, David Toler II, and Gloria Johnson | OSTEM Interns | GSFC – Code 596 – SPEID - NCSCP

Mentored By: Dr. Sean Semper, Dr. Chantale Damas, Mr. Milton Davis, and Dr. Aprille Ericsson

Space Technology Mission Directorate (STMD)

Our project is to design and integrate FlatSats with 1U CubeSats for the purpose of investigating the changes of climate change. Our mission, Salus, will monitor the greenhouse effect on the earth recording the amount of energy received from the sun’s visible wavelengths, and the atmospheric circumstances that allow the greenhouse effect to exist. Our team, Amari Harrington, Christian Jordan, David Toler II, and Gloria Johnson, have designed four Cubesats to achieve this by monitoring the amount of energy put into the earth's greenhouse effect, receiving data from the other CubeSats and sending the data to a ground station receiver, observing and measuring greenhouse gas (GHG) concentration in the upper atmosphere, and monitoring atmospheric pressure and magnetic field to deduce the correlation between the atmospheric thickness and magnetic strength. The goal’s to make accurate models that could help environmental scientists protect our current ecosystems.

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CubeSat, FlatSat, and GN&C Development & Analysis

Jalen Geason, Makiah Lee| OSTEM Interns | Simul Deb Nath & Hiroshi Wang | Visiting Researchers | GSFC – Code 596 – SPEID - NCSCP

Mentored By: Dr. Sean Semper, Milton Davis, Dr. Aprille Ericsson, Dr. Chantale Damas

Space Technology Mission Directorate (STMD)

In this project, we researched, designed, fabricated, and integrated our own FlatSat and learned about CubeSat technology. We used commercial off-the-shelf (COTS) components and software to make the FlatSat. With the powerful and multi-faceted Berry-IMU as our payload, we brainstormed many applications this CubeSat could have on Earth and in space. Our CubeSat's mission is to measure sea levels over time, which have been steadily rising due to climate change. The barometer/pressure sensor on the Berry-IMU allowes the CubeSat to do this. We hope this CubeSat will help to monitor rising sea levels and enable scientists to solve the problem. This project was done in collaboration with students from Queensborough Community College.

Facilitating Heliophysics Data Discovery with Cloud Collaboration: Development for the HSO Connect Program

Amr Alshatnawi | OSTEM Intern | GSFC – Code 671

Mentored By: Dr. Barbara J. Thompson

Science Mission Directorate (SMD)

The HSO Connect project aims to link the Heliophysics community together and establish a connection for collaboration and data sharing. Through the development and use of different collaboration tools, data sharing will be more efficient. It is often not easy to search and find data, which sometimes limits the kind of data that scientists and researchers use, the goal is to develop a portal that allows scientists to reach different datasets more easily. We were also able to test different collaboration tools, for example JupyterHub was used for code development. It allowed us to collaborate on the development of different Jupyter notebooks that targeted different data and model products from different missions.

Predicting radiation in low earth orbit from ground based indices using machine learning methods.

Benjamin Johnson | OSTEM Intern | GSFC – Code 590
Mentored By: Sean Semper and Alexa Halford
Science Mission Directorate (SMD)

The use of machine learning (ML) methods in the prediction of space weather conditions has recently exploded, and one such application is predicting the Polar Operational Environmental Satellite (POES) index. The daily POES index quantifies the radiation hazard due to the radiation belts, and is calculated using particle detector data from the NOAA POES satellites. It is designed to provide information to low Earth orbit satellite operators on space weather conditions. Importantly, prediction of the POES index would provide advanced warning on space weather hazards to satellites. We present several ML models to nowcast and forecast the POES index. To improve and make the models more explainable, we performed correlation and feature importance analysis. This analysis indicates a correlation between DST and the POES index, and the models proved capable of both nowcasting and forecasting the POES index, especially storm periods which are of specific importance to satellite operators.

FiRESAT-O

Jaimie Zhao, Hunter Saylor, Elizabeth Akinyemi, Bryson Ellington | OSTEM Interns | Omar Shalaby | Visiting Researcher | GSFC – Code 596 – SPEID
Mentored By: Sean Semper, Davis Milton
Space Technology Mission Directorate (STMD)

The project is to design, build, and test a 6U CubeSat using COTS (Commercially-off-the-shelf) components and incorporate two science payloads and two technology demonstrations. The FiRESAT-O is a terrestrial 6U Cubesat containing a variety of sensors (CO2, Temperature, Humidity, Air Quality, and Soil Moisture) that can forecast the conditions of a rapidly developing fire and quickly send out alerts to first responders. The FireSat will also communicate with two 1U CubeSats, creating a network of CubeSats that will cover more ground and ideally warn people of possible fires before they have the chance to spread. The FireSat can be adapted for space by upgrading the flight hardware, structural integrity, and sensors.

Firesat

Germaine Gray, Kimora Oliver, Gabriela Bernales | OSTEM Interns | Comfort Nadjiwa| Visiting Researcher | GSFC – Code 596 – SPEID
Mentored By: DR. Sean semper
Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD), Aeronautics Research (AERO)

The goal of this mission is to build a 6-U CubeSat using readily available COTS (commercial off-the-shelf) components to record and predict the probability of rapidly spreading fires in Central Park of New York City. The team will use a suite of sensors to collect the following data: temperature, humidity, and CO2 levels. The team is also constructing two 1-U CubeSats, one carrying a soil sensor to measure the ground's moisture, and the other carrying an air quality sensor to measure the density of smoke in the air. The CubeSat will function as an early warning system capable of sending out alerts to first responders and the general public. The CubeSat will also include a collision detection system as the first technology demonstration. Using a LIDAR (Laser Detection and Ranging) system that continuously revolves scanning for objects in a 12m radius around the CubeSat, it would then detect rapidly approaching objects and give alerts. As a second technology demonstration, the CubeSat will include a Liquid Lens Guidance, navigation and control (GN&C)

Optical Sensor (e-NTR# 1624037344) for rapid depth of field (DOF) changes while sensing the environment or for absolute navigation with varied celestial objects, i.e. the stars, planets, etc.

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Visualization and Communication of Solar Wind Forecasts

Jaime Landeros | OSTEM Intern | GSFC – Code 673

Mentored By: Daniel Da Silva, Michael Kirk

Science Mission Directorate (SMD)

The Wang-Sheeley-Arge Model makes geomagnetic activity predictions, but it currently lacks an adjustable visualization to compare observations and the model's predictions. This void was filled with my project of creating a graphical user interface for forecasters to easily reference and absorb information from. The project included learning the historical desktop based Qt5 package for the Python coding language in the model's existing user interface. This was followed by studying the Dash platform for Python and determining that it was more appropriate for building the desired forecasting tool in a browser based setting which fits into the contemporary software development environment more melodiously. The code was developed in the PyCharm integrated development environment and the Git workflow was used to upload code for peer review. As a result, the Wang-Sheeley Arge Model now has an updated and effective tool for visualizing coronal and solar wind model predictions

Heliophysics Knowledge Graphing: Helio2050 White Papers and Beyond

Jennifer Mulvey | OSTEM Intern | GSFC – Code 670

Mentored By: Brian Thomas, Ryan Mcgranaghan

Science Mission Directorate (SMD)

This project has been a series of experiments in natural language processing, coding Python filtering programs, and developing graphs to represent connections in Heliophysics literature. The current NASA Concept Tagging API was used to process one hundred and thirty papers from May 2021's Heliophysics 2050 Workshop. Ngrams for each paper were collected from the output of the tagging algorithm and were filtered by a rough heliophysics glossary consisting of fifty terms. The resulting terms were used to find connections between all of the Helio2050 papers, which allowed for data visualization through chord and network diagrams; calculations of paper connectivity, key term frequency, and network measures; additions to a more complete Heliophysics glossary; and observations about trends in Heliophysics literature, both over time and across subdomains of the field. This work is being used to analyze and graph Heliophysics journals from various years, and can be expanded on for future research.

Understanding the Internal Magnetic Structure of Interplanetary Coronal Mass Ejections Observed by MESSENGER, Helios 1, and Helios 2

Jose H. Lozano | OSTEM Intern | GSFC – Code 590

Mentored By: Dr. Luiz Fernando Guedes dos Santos and Dr. Teresa Nieves-Chinchilla

Science Mission Directorate (SMD)

This project aims to classify internal magnetic structures of ICMEs observed by the MESSENGER and Helios spacecraft from 2007-2015 and 1975-1980, respectively. We used catalogs of previously identified ICMEs in conjunction with plasma and magnetic field data from these spacecraft to produce visualizations so classification of the internal structures could be conducted. The classification is inspired by a previous catalog for the Wind spacecraft and is based on flux rope signatures observed within each ICME. The catalogs produced by this project will provide additional data for current efforts in modeling these internal structures. This classification is a newer approach to further understand the nature and evolution of ICMEs and can be expanded with observations from current spacecraft such as the Parker Solar Probe (PSP) and Solar Orbiter (SolO).

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IT Helpdesk Support

Normandy Carter and Lisa Marie Furtado | OSTEM Intern | GSFC – Code 480- NCSCP

Mentored By: Linda Pattison

Space Technology Mission Directorate (STMD)

Our project will be centered around end users and their feelings towards having to change software platforms, including reasons why they may have not immediately updated. In this case, upgrading from Time Machine backups to Druva. The users we will be evaluating are NASA employees working under code 480. We plan on creating a survey with a question then three options to choose from. The question will be along the lines of, “With the technological world vastly improving there has been a need for new and better services. For example, in the past few weeks NASA has been trying to transition users from a local backup, such as Time Machine, to an enterprise-based backup called Druva. How are your feelings about this specific change in software platforms? Do You… A) Want to fully transition to Druva, B) Use both of the backup systems (Time Machine and Druva), or C) Feel indifferent. If you choose A or B I please ask that you add your reasoning of why.” Once we gather that information, we will focus on why users don’t want to fully upgrade and try to configure a solution that will make them feel more comfortable when it comes to upgrades in the future. The results we gather can help to streamline a more effective and productive work environment in future scenarios.

Modernizing Spacecraft Software Patches using NASA's core Flight System (cFS)

Niall Mullane | OSTEM Intern | GSFC – Code 582

Mentored By: Gerardo Cruz-Ortiz

Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD), Human Exploration and Operations (HEO)

This project supports a DARPA challenge attempting to modernize the process of patching deployed software. This project develops a faulty core Flight System (cFS) environment to simulate the requirements of patching flight software on a spacecraft. An error was introduced into the flight software running in this cFS environment which needs to be patched by the DARPA challenge teams. The tools and processes developed by these teams can be applied to patch software on future NASA missions.

Local workflows for NASA's core Flight System and Natural language processing for FSSE

Frank L. Gonzalez Soto | OSTEM Interns | GSFC – Code 582

Mentored By: Gerardo E. Cruz-Ortiz

Space Technology Mission Directorate (STMD)

The internship consisted of two main objectives. Find a way to test the GitHub action workflows locally with CFS so that the main CFS repository is not cluttered with test commit of the workflow. The other part of the project will consist of applying machine learning to FSSE CCR Systems database. Using Natural language processing (NLP) it will be possible to finds patterns in what the engineers are focusing on and the way they are documenting their work. By obtaining this data it may improve effectiveness for future missions.

Using Natural Language Processing and Machine Learning to Identify Trends in Flight Software Patch History

Devin Robert Wright | OSTEM Intern | GSFC – Code 500

Mentored By: Gerardo E. Cruz-Ortiz

Flight Software Sustaining Engineering has collected a variety of data for each flight software patch performed during various NASA missions. While much is included in their database, the data is not currently organized in a way that facilitates easy analysis. This project aimed to: 1) Collect the FSSE data. 2) Organize and clean the data. 3) Use machine learning and natural language processing to uncover any overarching development trends. This analysis specifically focused on patch status comment history from the On Orbit Configuration Change Requests (CCR) left by engineers. This includes CCR patches dating back as early as 1996 and spans to present-day. The analysis focused to find which processes consumed the most time or resources and to then identify author contribution rates. By identifying possible bottlenecks or resource-draining processes in the development history, it would be possible to improve development patterns in the future

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Virtual Telescope for X-ray Observation: Phase Fresnel Lens Development

Daniel Smith | OSTEM Intern | GSFC – Code 661

Mentored By: John Krizmanic

Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

Refining computer design programs to generate 3D models of Phase Fresnel Lenses (PFLS) so that they can be fabricated using precision 3D printers. I am also working on testing out the 3D printer in order to get the structures to check the index of refraction of the fabricated materials as well as quantify the resolution of the printer, which should be sufficient to produce X-ray imaging PFLs.

Soft error upsets and SRAM-based FPGAs

Harrell Tolentino | OSTEM Intern | GSFC – Code 660

Mentored By: John Krizmanic

Space Technology Mission Directorate (STMD)

This project studies the Space Radiation Environment on the ISS and how it affects FPGA operations. SPENVIS modeling tool was used examine different space environment natures such as shielding against radiation. I investigate different types of soft error effects (SEE) and their effects on commercial off the shelf SRAM-based FPGAs. Single event upsets (SEU), multiple bit upsets (MEU) , and total ionizing dose (TID) are separately looked into towards different FPGAs. This project also researched into mitigating techniques and preventative measures against SEE such as memory scrubbing, triple modular redundancy, and register/combinational logic. Cost benefit analysis on the different FPGAs is to be done.

GPS Based Relative Navigation Development for the Virtual Telescope for X-ray Observations

Kyle Rankin | OSTEM Intern | GSFC – Code 661

Mentored By: John Krizmanic

Science Mission Directorate (SMD)

The Virtual Telescope for X-ray Observations (VTXO) is a space-based telescope using two SmallSats separated by 1 km and utilizes a new X-ray optic known as the Phase Fresnel Lens (PFL). PFLs promise to provide near diffraction limited imaging in the x-ray spectrum. To accommodate the PFL's 1 km focal length, the VTXO mission proposes to fly the PFLs, and an X-ray camera on two spacecraft flying formation in a highly elliptical orbit which approximates a rigid telescope structure. Formation flying in highly eccentric orbits above the GPS constellation creates significant constraints for navigation systems due to the limited GPS signal available at these high altitudes. Missions such as MMS have demonstrated techniques that permit a GPS solution while above the constellation. This project seeks to combine these techniques with the relative navigation problem to achieve navigation solutions with sufficient accuracy to align high-precision relative navigation systems currently under development.

3D Modeling and Rendering of Early Spacecrafts

Aaron Vigil | OSTEM Intern | GSFC – Code 690

Mentored By: Dr. David Williams, Jay Friedlander

Science Mission Directorate (SMD)

Many of the first spacecrafts to leave Earth's orbit did so nearly a century ago. As time has passed, new technologies and ways of archiving information have been created. This has led to the unique opportunity to bring these early spacecrafts into the realm of digital files, as 3D models. Looking specifically at the Soviet era Mars 2 and 3 landers, this project aimed to document the Soviet spacecrafts as 3D models. Using information obtained through research, a historically accurate model of the Mars 2 and 3 landers was created in the 3D modeling software Blender. Once completed, an image was rendered, from the model, that could be place in one of NASA's online databases for archival and educational usage.

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Geologic Mapping of Resurfacing Features on Europa

Kierra Wilk | OSTEM Intern | GSFC – Code 698

Mentored By: Lynnae Quick

Science Mission Directorate (SMD)

There is ample evidence to suggest that Jupiter's moon Europa is geologically active, with previous investigations suggesting that a subset of domical features on the icy moon may be cryovolcanic in origin. Although several of these features have been classified as extrusive cryovolcanic domes, they have not been extensively investigated, warranting the re-examination of cryolava domes on Europa. Here we mapped domical features interpreted to form through the axisymmetric flow of viscous fluids onto Europa's surface and compiled the location, area, and geological context for each identified feature. Pinpointing the spatial distribution of these domes and their geologic context will provide insights into locations that were recently geologically active and into Europa's cryovolcanic evolution.

Characterization of Cryogenic Muds on Ceres - Virtual - 20073

Wilson Jean-Baptiste | OSTEM Intern | GSFC – Code 698

Mentored By: Lynnae C Quick, Caitlin Ahrens

Here we categorize cryogenic muds on dwarf planet Ceres in order to predict surface features on its surface. In order to characterize these muds (viscous mixtures of materials), it was necessary to find and record the density of materials that have been identified on Ceres' surface, including hydrates, which play a substantial role in cryovolcanic processes on the icy dwarf planet. Applying mathematical modeling, based on the work of in the Quick et al. (2019) and Ahrens et al. (2020), potential cryovolcanic structural heights were determined from a variety of different cryogenic mud compositions and surface materials using a range of mud depths and subsurface mud column radii. This modeling includes obtaining cryolava eruption rates on Ceres surface with consideration of the radius of conduits through which cryogenic muds ascend to the surface, viscosities of these cryogenic materials, and their original source depth in Ceres' subsurface. Modeling results illustrate that low-density, low viscosity ice hydrates can form larger structures than the high-density and high viscosity hydrates.

DSMC modeling of thermal escape in multi-species atmospheres

Ryan Ifill | OSTEM Intern | GSFC – Code 6950 – SPEID

Mentored By: Orenthal J. Tucker

This project involves the analysis of thermal escape and the re-evaluation of planetary atmospheres using the direct simulation Monte Carlo (DSMC) model. Particularly, we are analyzing thermal escape as a function of temperature and gas density for multiple major and minor atmospheric species. We use the DSMC model to calculate escape from several parameters such as Jeans parameter, Knudsen number, and mixing fraction. After collecting the necessary amount of data, we plot the simulation results to examine important parameter regions for escape. This approach and the results would later be compared to several regions of Jeans escape and diffusion limited escape.

Millimeter-Wave Observational Studies in Astrochemistry

Timothy Proudkii | OSTEM Intern | GSFC – Code 691

Mentored By: Nathan Roth

Science Mission Directorate (SMD)

This project involves analyzing the outflow properties and photochemistry of various volatiles in comets. During the era of planet formation, comets were assembled in the cold disk midplane and then scattered into their present day major dynamical reservoirs. As comets enter the inner solar system, they release volatiles due to sublimation initiated by the increased solar insolation. Through remote sensing of these gases, the composition of the comet's nucleus can be revealed. Having remained relatively unaltered since their formation, understanding the composition of the comet's nucleus may provide a record of the chemistry and thermodynamic processes present in the protoplanetary disk at the time and location of the comet's formation. Ultimately, characterizing the composition of comets may provide invaluable insights into nascent solar system conditions.

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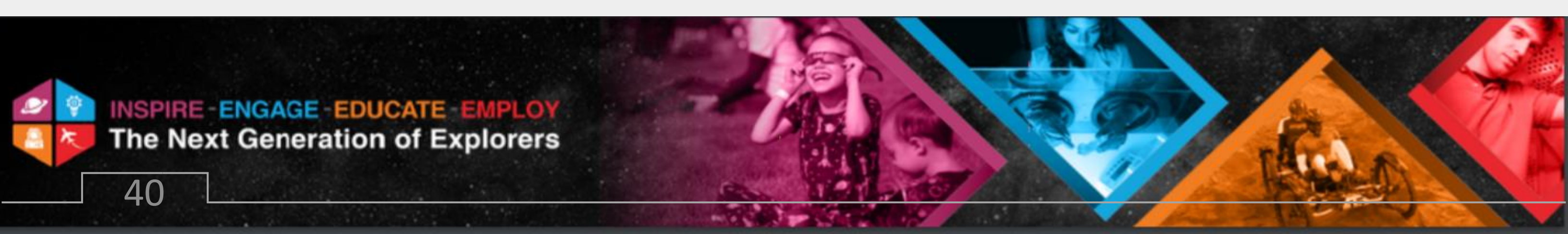
AI Atmospheric Parameters Retrieval Using ArcGAN

Thomas Monahan | OSTEM Intern | GSFC – Code 6930

Mentored By: Aslam Shahid

Science Mission Directorate (SMD)

This project continues the development of the ArcGAN atmospheric retrieval tool developed by Thanh Nguyen and Nicolas Gorius. ArcGAN is a deep learning architecture that improves on previous retrieval architectures, namely the ExoGAN for Exoplanets. We demonstrate the efficacy of artificial intelligence to quickly and reliably predict atmospheric parameters and present it as a viable alternative to slow and computationally heavy Bayesian methods. This work is directly applicable to the development and deployment of a machine learning algorithm to reduce the downlinked data volume from the Compact Ultraviolet to Visible Imaging Spectrometer (CUVIS) onboard the DAVINCI mission to Venus.



Laser Detection & Ranging (Lidar) from Airborne and Spaceborne Platforms

Damian Hackett | OSTEM Intern | GSFC – Code 698 - NCSCP

Mentored By: Dr. Xiaoli Sun

Space Technology Mission Directorate (STMD)

Investigation of the long-term behavior of the Lunar Orbiter Laser Altimeter (LOLA) aboard the Lunar Reconnaissance Orbiter (LRO) through trending, calibration, and analysis of dark noise counts, including against CRaTER radiation data. Of particular interest is the impact of space weather, both short-term events and long-duration exposure, to silicon avalanche photodiode (APD) detectors aboard LOLA. Additional project goals include development of data extraction and analysis tools for other instrument parameters and vital signs, as well as contributions to ongoing space lidar research in broader areas of instrument operation, science gathering, and data processing, with particular emphasis on the impact of radiation on space hardware.

Laser Detection and Ranging from Airborne and Spaceborne Platforms

John Rich | OSTEM Intern | GSFC – Code 698

Mentored By: Xiaoli Sun, Daniel Cremons

Science Mission Directorate (SMD), Human Exploration and Operations (HEO)

This project aims to create a model in MATLAB to simulate the performance of the Small All-range Lidar (SALi), a Lidar system designed specifically for missions to small planetary bodies such as asteroids and comet cores. The comprehensive performance model of the SALi instrument is used to simulate on orbit measurement precision, taking into account factors such as range, blur from out of focus optics, surface roughness and slope, and associated errors. Modeling the performance of SALi using a realistic surface gives valuable insight to the capabilities of this instrument and validates its relevance for future missions to small bodies in space.

Laser Detection and Ranging and Communication in Space – Analyzing Atmospheric Backscattering Data from an Airborne CO2 Laser Sounder

Paul Kolbeck | OSTEM Intern | GSFC – Code 690

Mentored By: Xiaoli Sun

Science Mission Directorate

The atmospheric backscattering data from the 2017 ASCENDS airborne campaigns have been used to determine column CO2 mixing ratios, and an algorithm was developed last summer to calculate the altitude-dependent backscattering cross-section. Effective correction for environmental and instrumental conditions affecting the raw data allows for the identification of atmospheric phenomenon, such as clouds, the atmospheric boundary layer, and plumes from wildfires, which further informs analysis of the CO2 mixing ratio during the airborne campaigns. These algorithms have been updated and streamlined for more efficient and informative processing and testing, and the data products generated have been used in several conference publications.

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Break 3-3:45pm

Investigating seasonal ENSO forecast amplitude correction for GEOS-S2S-2

Maria Geogdzhayeva | OSTEM Intern | GSFC – Code 610

Mentored By: Anna Borovikov

Science Mission Directorate (SMD)

The GEOS-S2S-2 is a coupled model and assimilation system, encompassing many aspects of the Earth system. This project focused on exploring and validating a forecast amplitude correction technique used by the North American Multi-Model Ensemble (NMME) for Nino 3.4 sea-surface temperature (SST) anomaly predictions. The algorithm relies on deriving a set of correction factors based on the standard deviations of hindcast and observed SST anomalies. The algorithm was implemented at the Global Modeling and Assimilation Office (GMAO) and applied to the GEOS-S2S-2 Nino 3.4 hindcasts, using a climatology baseline of 1982 to 2020. For most initialization months and forecast leads, the correction reduces the forecast amplitude. The correction reduces average RMSE when retroactively applied to historical forecasts. The correction has a larger impact on seasons with strong El Nino-Southern Oscillation (ENSO) events than neutral seasons. The outcome of this project is a tool that can be used to explore error attribution in forecasts.

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Active and Passive Microwave Remote Sensing of Snow

Dylan Boyd | OSTEM Intern | GSFC – Code 6180

Mentored By: Batuhan Osmanoglu

Science Mission Directorate (SMD)

This presentation showcases an analysis of publicly available SWESARR data provided by NASA GSFC. Two measurements took place over Grand Mesa, CO, during 2019 and 2020. Grand Mesa was a site featured during the 2020 SnowEx campaign wherein many in-situ observations were taken. These measurements are used in a study of SWESARR's sensitivity to changes in snow cover. SWESARR measurements show sensitivity to temporal and spatial variations in snow cover, and an exploration of snow modeling capabilities using the Snow Microwave Radiative Transfer model (SMRT) is performed in order to explore physical signatures and inversion potential for this dataset.

Improvements of a EO data driven Winter Wheat Yield prediction model

Patrick Chitic Patapievici | OSTEM Intern | GSFC – Code 610- NCSCP

Mentored By: Eric Vermote

Falling Snow Estimate from Ground-based Instruments

Katheryn Pecht | OSTEM Intern | GSFC – Code 612

Mentored By: Ali Tokay, Stephen Joe Munchak

Science Mission Directorate (SMD)

This project conducts validation of the Precipitation Imaging Package (PIP) and Multi-Rain Radar (MRR). These are used by the GPM mission to estimate equivalent snowfall rates. We used the PIP and MRR to compare currently used operational Z-S relationships to Z-S relationships generated by calculating the habit, density, echo-top, and event specific relationships for 30 snow events during the 2017-2018 winter in Marquette, Michigan. The resulting Z-S relationships are then compared to determine which Z-S relationship is the best overall estimation of snowfall, or if there is no particular relationship that can fundamentally describe the majority of events. This project continues and builds on the research done by previous interns, as the ground validation network of the GPM mission is tested for its adeptness and accuracy. The combined approach of operational and research-based Z-S relationships being tested ensures that the best method for estimating snow-water accumulate is produced and used.

Communications and Outreach for NASA's Exploration and In-space Services (NExIS)

Bryana Quintana | OSTEM Intern | GSFC – Code 480

Mentored By: Vanessa Lloyd, Katy Cawdrey

Space Technology Mission Directorate (STMD)

My project consists of writing articles distilling highly technical topics into engaging features for a general audience, creating social media posts, working on videos promoting our division and technologies, and strategizing engagement approaches for informing the public on NExIS missions. For the articles I write, I interview subject matter experts and conduct my own research to gather more information. I both design the graphics for the social media posts and write social copy to accompany them. My video work involves writing scripts as well as using editing software to produce the videos. Finally, I also lead a team of fellow interns to implement a new social media engagement activity I pitched and helped develop for Goddard's Instagram.

August 10 - Room C

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NCAS Programmatic Support WFF

Brian Ribas | OSTEM Intern | GSFC – WFF – Code 800

Mentored By: Victoria Danna

Science Mission Directorate (SMD)

The student will virtually support NASA Goddard Space Flight Center's Wallops Flight Facility's (WFF) Suborbital & Special Orbital Projects Directorate (SSOPD) Education Team with the preparation, organization, and execution of the NASA Community College Aerospace Scholars (NCAS) program.

The intern will conduct extensive research on student rideshare opportunities and access the feasibility of incorporating a hands-on student launch challenge as part of a Tier II advanced NCAS workshop experience at WFF. At the conclusion of the internship experience, we should have a greater understanding of what our Tier II challenge will look like and the next steps required to making this challenge a reality.

Throughout the summer, the student will support the virtual NCAS workshops and serve on the Intern Panel, or a comparable experience. In addition, the student will support other Directorate Education summer programs as needed.

Sounding Rocket Office Process Improvements

Jacqueline Resto | OSTEM Intern | GSFC – WFF – Code 810

Mentored By: Giovanni Rosanova

Science Mission Directorate (SMD)

During my summer internship, the expectations accomplished were identifying issues, analyzing information, and providing solutions in developing process enhancements for various tasks. The multiple projects assigned brought the Sounding Rocket Program Office closer to its most modern techniques using computer technology in conducting business within an office environment. The seven projects include the Sounding Rocket Working Group, which engage NASA's customer scientist. I created a "non-public" searchable database allowing quick access to specific classified documents dated back to 1994. Principal Investigators Orientation Plan, I made a more concise plan based on the Sounding Rocket Program Handbook; Converting the Technology Roadmap into a Living Document using hyperlinks to be accessed by members of the NASA Sounding Rocket Program science community on recent updates with the current technological developments. Additionally, Principal Investigator Feedback Memo Actions Database; Anomaly Review Action/Finding/Observation Database; Meta Usage and Training; and File Structure and Configuration Management projects.

Balloon Flight Data Analysis

Kijjiketchme Southern-Fox | OSTEM Intern | GSFC – WFF – Code 820

Mentored By: Sarah Roth, Chris Yoder

Science Mission Directorate (SMD)

The Balloon Program Office has been supporting the scientific community with the launch of scientific balloons since the 1980s, and over the course of that time has kept data about each balloon and flight in several databases. Last semester (Spring 2021), my project involved consolidating these databases into a master database, as well as developing Python tools to expand it further. This Summer, I have been developing a database-like tool from the master database which will enable comparisons of predicted vs. actual quantities for parameters such as air temperature, radiation, latitude/longitude/altitude versus time, and many others., for any balloon flight.

Small Satellites and Special Projects CubeSat

Drue Hairston | OSTEM Intern | GSFC – WFF – Code 800 - SPEID

Mentored By: Roland Wescott

Space Technology Mission Directorate (STMD), Aeronautics Research (AERO)

My project centers in on CubeSat, where the goal is to ultimately allow small satellite payloads that were made by schools and non-profits to be incorporated with future launches. The goal is to build a small satellite. While executing this, there is criteria that must be met, and some problems may arise such as delivery delays. It is a tedious process with many design specifications, standards, and requirements. Therefore, it takes an extended period for everything to fall into place before a launch occurs. There are many technical issues in this process and risks that are involved which is why this task is so prolonged. Using small satellites allows for greater access of scientific data, along with completing tasks bigger satellites cannot.

8/10 1pm-2pmEST / 12pm-1pmCST / 10am-11amPST

Virtual Intern Symposium – Room C

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Advancing retrievals of ocean properties with satellite imagery

Baleigh Doyle | OSTEM Intern | GSFC – GISS – Code 610

Mentored By: Brian Cairns and Matteo Ottaviani

Science Mission Directorate (SMD)

Retrieving ocean properties and their evolution from satellite data provides near-real-time information on ocean conditions, a fundamental aspect to consider for climate application studies. We are developing a retrieval scheme composed of a Fortran radiative transfer engine driven by a Python inversion package. The module will retrieve the refractive index of the ocean surface, useful to determine the possible presence of contaminants such as oil, or any other substance capable of modifying the refractive index. The wind speed and the optical depth will also be simultaneously retrieved, since they help increase the accuracy of the refractive index retrieval.

Augmenting Research Scanning Polarimeter data records with climatological variables

Kip Nielsen | OSTEM Intern | GSFC – GISS – Code 611
Mentored By: Brian Cairns, Matteo Ottaviani
Science Mission Directorate (SMD)

Airborne and satellite observations of reflected sunlight are a major source of information on aerosols, clouds and surface properties. In particular, multi-angle optical polarization measurements provide unique and accurate measurements to learn about uncertain processes concerning clouds, aerosols, and surfaces. A crucial step for interpreting such observations is correcting the radiances measured at selected wavelengths for light absorption effects caused by gasses in the atmosphere. Climatologies and reanalysis databases are needed to provide accurate profiles of such trace gases to perform measurement corrections at the locations of interest. The main goals of this project are to 1) maintain a framework to automatically download required Modern-Era Retrospective analysis for Research and Applications, Version 2 reanalysis (MERRA-2) files collocated with measurements of the airborne Research Scanning Polarimeter (RSP) for integration within the RSP processing scheme, and 2) batch process and compare RSP and MERRA-2 precipitable water vapor for an entire field campaign.

8/10 2pm-3pmEST / 1pm-2pmCST / 11am-12pmPST

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The Habitability of Ancient Terrestrial Planets in Our Solar System

Sadie Welter | OSTEM Intern | GSFC – GISS – Code 611
Mentored By: Michael Way
Science Mission Directorate (SMD)

This project includes research based on the factors that make a planet habitable. Here, a perspective of the Solar System's past is taken to consider the possibility that Earth may not have been the only planet with life. Using simulations from the ROCKE-3D general circulation model (GCM), I have analyzed the habitability of Ancient Venus, Ancient Earth, and Ancient Mars. Panoply was used to visualize the GCM data, which was then used to calculate habitability metrics that analyzed specific planetary features. Here, knowledge of the emergence of life on Earth is used to compare and contrast to the planetary conditions of the simulations of each planet. This work gives insight on the features of planets that are conducive to life.

Quantifying the Habitability of Rocky, Earth-like Exoplanets Using Three-Dimensional General Circulation Models

Lana Joan Tilke | OSTEM Intern | GSFC – GISS – Code 611
Mentored By: Michael Way
Science Mission Directorate (SMD)

I used the simulations conducted by Way et al. in their 2018 paper “Climates of Warm Earth-Like Planets. I. 3D Model Simulations” to analyze the hypothetical exoplanets’ fractional habitabilities. Building upon previous quantifications of fractional habitability, I used Python to calculate the percentages of each planet’s surface area and volume considered to be habitable. In order for an area of a simulation to be deemed habitable, it must have a temperature between 0 and 100˚C, and have some form of water availability. Additionally, each fractional habitability has been further separated into land and ocean, because otherwise the ocean would completely dominate any subtleties in land habitability fractions.

8/10 3pm-4pmEST / 2pm-3pmCST / 12pm-1pmPST

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Analysis of Climate Model Simulations

Madeline Claire Casas | OSTEM Intern | GSFC – GISS – Code 600
Mentored By: Gavin Schmidt
Science Mission Directorate (SMD)

The assessment of the ability of climate models to match observed trends and variability seen in the real world is a key factor in building the credibility of their projections under future scenarios. We examine multiple factors in the representation of MSU and SSU diagnostics in historical simulations of climate change (1979-2014) using GISS ModelE contributions to the Coupled Model Intercomparison Project (Phase 6) (CMIP6). We explore the impacts of changing forcings, singly or as part of a subset, composition interactivity, the quality of the stratospheric circulation, vertical resolution, and possible impacts of the specification of volcanic aerosol depths. The goal of the project is to examine the way that different model processes and drivers impact the accordance of the model and historical observations.

Dust in the Wind: Soil, Dust, Aerosols, and Daily Variations in Air Quality

Samantha Frucht | OSTEM Intern | GSFC – GISS – Code 611
Mentored By: Ron Miller
Science Mission Directorate (SMD)

This project is focused on analyzing a dust storm, nicknamed "Godzilla", that occurred in June 2020. The dust cloud extended from the Saharan Desert to the Caribbean and reduced air quality to unhealthy levels for several days. Dust observations from the surface and from satellites were used to determine if the model illustrated the dust transport realistically. Next, the question became: was there an increased amount of dust in the Caribbean because of stronger winds or could there have been more dust lifted up into the air over the Saharan Desert? I was tasked with using the model to analyze the ratio of dust that came off the Saharan Desert and made it to the Caribbean. Six other years of model data were analyzed to see if the storm was an anomaly.

8/10 4pm-5pmEST / 3pm-4pmCST / 1pm-2pmPST

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Development of a Vegetation Database for Tundra Fires in Alaska

Ella Hall | OSTEM Intern | GSFC – Code 618
Mentored By: Elizabeth Hoy
Science Mission Directorate (SMD)

The Arctic is an area of fast paced environmental change. Tundra fires are increasing in frequency and magnitude, however there is still a gap in understanding these fires. To meet this need, we are undertaking an analysis of vegetation data in and near tundra fires in Alaska to better characterize burned areas and fire effects. Twenty-one ABoVE (Arctic-Boreal Vulnerability Experiment) vegetation datasets were analyzed for their usefulness in assessing tundra fire impacts in Alaska. This record consists of 3,685 data points from various vegetation plots around the region. These vegetation plots were visualized using geospatial software and then analyzed to understand environmental conditions at the various sites (such as snowpack, hydrology, soils, and vegetation regrowth). Overall, the development of this database will enable researchers to better characterize these tundra fires.

Impact of fire on soil moisture in Alaskan tundra

Leah Clayton | OSTEM Intern | GSFC – Code 618
Mentored By: Elizabeth Hoy
Science Mission Directorate (SMD)

Arctic wildfires are becoming more common in both boreal forest and tundra ecosystems. While the boreal forest biome is well researched, the impact of fire on tundra requires further investigation. Specifically, the soil hydrological regime post-fire is not well understood, yet soil moisture is a critical factor for permafrost resilience. This study compares soil moisture, measured as volumetric water content (VWC), within and outside of fire scars in three tundra regions: the Yukon-Kuskokwim Delta, Anaktuvuk River, and Noatak. An extensive in-situ soil moisture record, Soil Moisture and Active Layer Thickness (SMALT) dataset, was compiled from NASA’s Arctic Boreal Vulnerability Experiment (ABoVE) field campaign. Airborne SAR- derived soil moisture from the Permafrost Dynamics Observatory were used along with the SMALT dataset and fire scars in a space-for-time-swap to analyze the recovery of soil moisture over time. Geospatial analysis reveals visible alterations to the soil water content post-fire compared to surrounding tundra.

Discovering the research needs of current and potential partners and collaborators for NASA's Arctic Boreal Vulnerability Experiment (ABoVE)

Ryan Naylor | OSTEM Intern | GSFC – Code 618
Mentored By: Libby Larson
Science Mission Directorate (SMD)

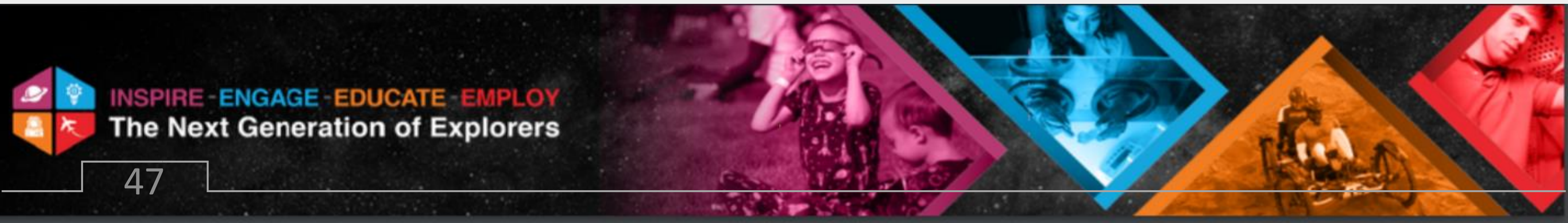
The Arctic Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology field campaign comprised of researchers who use field-based, remote sensing, and modeling approaches to understand the vulnerability and resilience ofwestern North American Arctic ecosystems and societies. One goal of ABoVE is to provide the scientific basis for informed decision-making, which requires knowledge of the identities and data needs of ABoVE’s partners and collaborators. Thisresearch sought to identify relevant existing and new communities, organizations, and institutions for ABoVE products andassesstheir research needs via the results of an online survey sent to all ABoVE participants. These results are compared with data about who has downloaded ABoVE data products. The analysis reveals the current relevancy of ABoVE to participants, identification of neworganizations, and potential gaps between data product access, usage, and engagement. Results indicate opportunities to tailor to the needs of current participants and focused outreach.

August 10 – Room E

8/9 9:45am-5pmEST / 8:45am-4pmCST / 6:45am-2pmPST

WebEx meeting: 415-527-5035, Access code: 199 429 0539

Time	Topic	Speaker
12:40	**Optical Amplifier Efficiency: Reducing Power Consumption Aboard Spacecraft** *Optics, Physics, Electrical Engineering*	**Bryan Chantigian – OSTEM Intern** Laser-Enhanced Mission Communication Navigation and Operational Services *Mentors: Rafael Garcia, code 566 & Dr. Scott Merritt, code 554*
1:00	**Enhancing the Bundle Protocol Network Simulator** *Delay/Disruption Tolerant Networking, Software Engineering*	**Carter Edmond – OSTEM Intern** Technology Enterprise and Mission Pathfinder Office *Mentor: Wes Eddy, code 580*



1:15	**Space-to-Ground Networks Detector Qualification Assessments** *Quantum Communications, Electrical Engineering*	**Eduardo Medina – OSTEM Intern** Technology Enterprise and Mission Pathfinder Office *Mentor: Dr. Angela Hodge, code 450.2*
1:30	**Quantum Simulations to Fortify Communications Security** *Quantum Communications, Physics, Cybersecurity*	**Caroline Fedele**, Pathways intern Telecommunication Networks & Technology Branch *Mentor: Dr. Harry Shaw, code 566*
1:50	**Applying Neural Network Methodology to Quantum Hardware** *Quantum Communications, Physics, Information Theory*	**Henry Elliott – OSTEM Intern** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentor: Dr. Harry Shaw, code 566*
1:55	**Multi-Party Quantum Clock Synchronization for Satellite Communication** *Quantum Communications, Physics, Information Theory*	**Manon Bart – OSTEM Intern** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentor: Dr. Haleh Safavi, code 566*
2:10	**Quantum Coding with Molecular Symmetries and Quantum Compressive Sensing for LIDAR** *Quantum Communications, Physics, Quantum Chemistry*	**Kyle Sherbert – OSTEM Intern** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentors: Mark Brumfield, code 450 & Dr. Harry Shaw, code 566*
2:45	**Generalized Framework for Redistributing Satellite Networks** *Applied Mathematics, Software Engineering, Mission Design*	**Taryn Jane Noone – OSTEM Intern** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentor: Dr. Harry Shaw, code 566*
3:05	**Plotting Ground Station Antenna Availability in Real-Time** *Telecommunications Engineering, Software Engineering*	**Jake Coughlin** Advanced Communications Capabilities for Exploration and Science Systems Project, Wallops Flight Facility *Mentor: Ben Weslowski, code 459*
3:20	**Improving Near Space Network Ease-of-Use with Systems Tool Kit** *Software Engineering, Systems Engineering*	**Zach Calcagno** Near Space Network, Wallops Flight Facility *Mentor: Joe Kambarn, code 459*
3:50	**Strengthening the Perimeter: Baseline Cybersecurity Audits** *Cybersecurity, Systems Engineering*	**Leonardo Muñoz** Advanced Communications Capabilities for Exploration and Science Systems Project, White Sands Complex *Mentor: Richard Pacheco, code 459*
4:05	**Driving Telescopes: Monitor and Control Software for the Low-Cost Optical Terminal** *Software Engineering, Optical Communications*	**Eric Yang – OSTEM Intern** Advanced Communications Capabilities for Exploration and Science Systems Project *Mentor: Vicky Wu, code 587*

August 11, 2021

August 11 – Room 0

Code 130 Interns [Room Link]

Social Media

1020a Priya Mittal

Mentored By: Madison Arnold

1030a Emma Edmund

Mentored By: Madison Arnold

Technology and Social Media

1040a Julie Freijat

Mentored By: Karl Hille

1050a Erica McNamee

Mentored By: Karl Hille

August 11 - Room A

8/11 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Roman Space Telescope & Coronal Microscale Observatory

Trey Potter | OSTEM Intern | GSFC – Code 590

Mentored By: Eric Golliher

Space Technology Mission Directorate (STMD)

"Roman Space Telescope: I created drawings for the placements of heaters, thermostats, and bonding materials on various components for the roman space telescope propulsion system. I also selected the heater that will be used from the manufacturer based off of power requirements and dimensional restrictions.
Coronal Microscale Observatory: I supplied calculations to the propulsion team for the necessary sizing of the propulsion tanks on each spacecraft. These numbers had to be quickly changed regularly based on new parameters from different subsystems that were working in parallel with the propulsion subsystems."

RST AMS Closeout Thermal Drawings

Lauren Zinkl | OSTEM Intern | GSFC – Code 545

Mentored By: Kimberly Brown

Science Mission Directorate (SMD)

The Nancy Grace Roman Space Telescope (RST) is a class A mission to explore dark energy and exoplanets. The main component that protects the telescope is the Outer Barrel Assembly (OBA). The OBA provides both thermal and structural support for the telescope as well as keeping any stray light from interfering with the telescope. My project focusses on the thermal hardware drawings of the AMS Closeout panels which separates the warm and cold zones of the OBA. Thermal hardware drawings provide a blueprint for the technician on the placement and processing of the thermal components on each subsection. Throughout this project, the heaters, thermostats, and sensors have been located on each panel and the bonding processes of the hardware have been displayed on the thermal drawings for the AMS panels.

Roman Space Telescope spacecraft thermal design: defining multilayer insulation

Leanne Montgomery | OSTEM Intern | GSFC – Code 545

Mentored By: Kimberly Brown, Rob Chalmers

Science Mission Directorate (SMD)

The Roman Space Telescope (RST) will operate at Lagrange point 2, where the spacecraft will be exposed to the vacuum of deep space and uneven solar radiation. This project attempts to fully describe the MLI types that have been established for subsystems and components of RST. Through this project, 55 spacecraft locations requiring thermal blanketing have been identified and associated with one of 14 different MLI types to most effectively meet individual thermal requirements. The design for the blanketing on the communications module was considered especially closely, including the shape, attachment points, venting, and grounding requirements, and a CAD model was produced to illustrate these.

RST Thermal Hardware Modeling

Payton Jackson | OSTEM Intern | GSFC – Code 545
Mentored By: Kimberly Brown & John Hawk
Science Mission Directorate (SMD)

Thermal hardware is a major component in the design of a spacecraft due to the severe temperatures of space. In the current state of the Roman Space Telescope design, direction for thermal design in all subsystems is becoming more defined, but work is still needed to show those designs in mechanical models as well as document them in drawings. I will present my work with the RST regarding the modeling of thermal designs in the computer-aided design software, CREO. I will review the thermal modeling conducted for the Deployable Aperture Cover (DAC), Avionics Panels, and Outer Barrel Assembly (OBA). With this work, RST will move closer to having a concrete and integrated design, as well as documentation for future assembly.

8/11 1pm-2pmEST / 12pm-1pmCST / 10am-11amPST

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Roman Space Telescope

William Harvey | OSTEM Intern | GSFC – Code 545
Mentored By: Kimberly Brown
Science Mission Directorate (STMD)

I am working with the thermal team for the Roman Space Telescope mission. Throughout the summer I have been helping construct thermal models of various brackets that interface with different subsystems on the Roman Space Telescope. This project has consisted of learning computational software for heat transfer called thermal desktop. This software utilizes both finite elements solids and nodes to track the heat path through a solid. In addition to this I have been learning CREO, mainly how to view objects and pull different dimensions. Finally, this summer I have been networking with other engineers, learning about what they do, and getting and incredible look into all the work that is done at Goddard Space Flight Center.

Thermal Engineer for the Roman Space Telescope Instrument Carrier

Ryan Herberg | OSTEM Intern | GSFC – Code 545
Mentored By: Christine Cottingham
Science Mission Directorate (SMD)

A summary of applied thermal modelling utilizing Thermal Desktop to inform design decisions relating to the Roman Space Telescope's Instrument Carrier. Includes a thorough study of thickness effects for cryopanels above the spacecraft of the telescope. Study consisted of creating and utilizing a complete Thermal Desktop representation of the panels and their thermal control systems. Concluded in a final suggested solution for the plates thickness and specifications for the thermal control systems. Along with other minor parts that were created, including the Wide Field Instrument V-bar, these modelling solutions progressed the design for the RST and informed the IC team of the thermal realities present to better clarify predictions for upcoming vacuum testing and flight.

Roman Space Telescope

Christopher Dardano| OSTEM Intern | GSFC – Code 540

Mentored By: Robert Chalmers

Space Technology Mission Directorate (STMD)

I am a thermal intern for the Roman Space Telescope project (RST). It's my responsibility to take geometric models of the space craft components and analyze them using a software called Thermal Desktop. I can simulate the temperature of a component I am analyzing under heat loads in orbit. Furthermore, after analysis, I need to decide heater requirements of the component I am analyzing. To keep the components of the spacecraft at operational temperatures, heaters are required to maintain them. The power, size, and location of each heater can be changed to fit the mission requirements.

Upper ACS Thruster Soackback Analysis and Ka-Band Hat Coupler Analysis

Cole Woodmansee | OSTEM Intern | GSFC – Code 5450

Mentored By: Rob Chalmers

Science Mission Directorate (SMD)

This project presentation will be discussing soakback analysis performed on the 1-pound Upper ACS Thrusters, designing High Gain Antenna System (HGAS) testing configurations, and work on Ka-band and S-band hat couplers' thermal models. The soakback analysis consists of analyzing temperature plots of prop lines and valves after thrusters are turned off or as they are engaged in a pulse-firing mode. My previous work on HGAS test configurations included the stowed boom version. I had to make a deployed version to ensure clearance in the testing chamber. The hat couplers needed to be imported into AutoCAD, expanded into individual components, and assigned correct properties to perform accurate thermal analysis.

8/11 2pm-3pmEST / 1pm-2pmCST / 11am-12pmPST

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GEMU Rest Sink

Cory Scaffidi | OSTEM Intern | GSFC – Code 583

Mentored By: Sharon Orsborne, Rhea Mortam

Space Technology Mission Directorate (STMD)

My assignment was to create a sink, or something that can send data over the internet, for the GEMU project. For this I was tasked to use the Jersey API so that I could make the sink to be RESTful, which means it follows the Representational state transfer (REST) standard. I was also tasked with creating the test cases and robot framework tests to make sure everything works as intended. Robot framework tests allow me to create a test server that can receive the message that the sink sends out to check if anything is sent incorrectly or if there are any other issues with the sink that can't be tested without a realistic example.

GEMU

Spencer Chen | OSTEM Intern | GSFC – Code 583

Mentored By: Sharon Orsborne, Rhea Mortam

Space Technology Mission Directorate (STMD)

For my project, I am in charge of the websocket part while the other intern is in charge of the Rest part. Making it as a websocket, there can now be interaction with the client. For example, when the client tries to connect to the server, the api will call connectToServer which would connect. Once connected, the api calls open and then the client is now able to send messages. When the client wants to close the connection or there's an error, the client can no longer send messages and will be alerted of the reasoning. To connect to a server, the serverURI is needed and preferably the name of the connection as well. The client is a sink because it's where information is collected so the websocketaClientSink class facilitates actions between the client and the server.

GMSEC

Gabriel Batizy | OSTEM Intern | GSFC – Code 583

Mentored By: Jay Bugenhagen

Center Operations

The Goddard Mission Services Evolution Center (GMSEC) project develops the GMSEC suite of software components that aim to standardize interfaces, provide middleware infrastructure, and allow missions and users to decide which components fit best in their mission operation center design. The GMSEC suite takes advantage of a unique architecture, featuring standardized messages and formats defined by the GMSEC team to facilitate easy and flexible integration of components. This flexibility allows missions and users to add custom GMSEC compliant software, adapt legacy components, and remove components to better adjust to the evolution of a mission. The GMSEC Applications Programming Interface (API) provides a multi-language, cross-platform, standard communications interface to support communication between products.

Coronal Diagnostic Experiment (CODEX)

Rachel Berley | OSTEM Intern | GSFC – WFF – Code 548

Mentored By: Geoff Rose

Science Mission Directorate (SMD)

Dynamic response of a notional radiator panel on the Coronal Diagnostic Experiment (CODEX) bound for the International Space Station (ISS) was investigated. The goal of the study was to verify suitability of the panel design with respect to a candidate launch vehicle acoustic environment through exhibiting positive margins of safety against failure. A finite element model of the radiator panel was constructed using FEMAP/NASTRAN software, and the acoustic spectrum was applied to the panel using methods found in a random vibration seminar series developed by Goddard Space Flight Center (GSFC) Code 542. Panel stress and deformation results from the analysis study were found to be within acceptable limits with positive safety margins confirming a satisfactory design.

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Final Results of Analysis of NavCam-1 Image Anomalies at Bennu

Brooke Elizabeth Hursh | OSTEM Intern | GSFC – Code 551

Mentored By: Brent Bos

Science Mission Directorate (SMD)

As OSIRIS-REx approached Bennu, NavCam 1 acquired images to support optical navigation and science observations. Some of these images contained anomalies, which were initially assumed to be radiation artifacts occurring in single image frames. However, on January 6, 2019, NavCam 1 observed anomalies occurring over multiple image frames, which were determined to be particles ejected from Bennu's surface. This event reclassified Bennu as an active asteroid. The observation of several more mass ejection events allowed for the cataloging of confirmed multi-frame particle streaks.

Single-frame anomalies were cataloged as well, with the intent to create qualitative metrics to identify them as either a real object or radiation artifact. This project concludes three summers of analysis, presenting two image metrics which use characteristics of particles and cosmic rays from the catalog to estimate the probability an anomaly in a single image frame was caused by a real object.

cFS Software Development with GSFC 582

Oliver Hamburger | OSTEM Intern | GSFC – Code 582

Mentored By: Elizabeth Timmons

Space Technology Mission Directorate (STMD)

This project involves updating and developing cFS apps to support the newest version of cFS. cFS's external code Interface needed heavy updates to the testing pipeline and as well as the source files. Other cFS apps were also in need of updates to be compatible with caelum such as FTDP and more. To accomplish this task, research into testing pipelines, cmake recipes, and the updated cFE api's and macros was needed. By keeping cFS apps updated to the latest version of cFS, upcoming missions can dive straight into development without having to worry about compatibility issues.

File Signature Verification in cFS

Simon Kroll | OSTEM Intern | GSFC – Code 582

Mentored By: Elizabeth Timmons

Space Technology Mission Directorate (STMD)

This project updates the core Flight System's (cFS) File Manager application (FM) to accept a command to verify the signature of a file. cFS is a reusable open-source software framework and collection of software applications written in C that is used for a number of NASA flight projects. The FM application is used by cFS to manage onboard filesystem operations and services. A file verification command was developed as part of FM for files signed using SHA256 signatures and RSA encryption. The command implementation utilizes a third-party cryptography library to perform the decryption and hashing required for file verification. Using file verification protects the integrity of transmitted files by ensuring data received was signed by a trusted source and has not been modified or corrupted during transmission.

Machine Learning for Scientific Datasets

Heriberto Carbia | OSTEM Intern | GSFC – Code 587

Mentored By: James Mackinnon

Science Mission Directorate (SMD) & Space Technology Mission Directorate (STMD)

The project consists of developing machine learning models capable of performing realtime lidar analysis to be used to characterize topography and vegetation structure for the Concurrent Artificially-intelligent Spectrometry and Adaptive Lidar System (CASALS). In order to train such models, G-LiTH data will be processed into simulated CASALS training datasets. Since models are trained on multivariate time series data, the model architecture used is that of a Temporal Convolutional Network (TCN). TCNs are a recently developed special type of convolutional network that have recently shown success in handling times series data, while also using less parameters than other traditional approaches. One of the main goals of the project is to find out if such models can be used to predict forest type to optimally process and store data onboard. Can boundaries between structurally distinct stands, based on percentile patterns, be identified that relate to land cover attributes?

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In-Space Assembly and Servicing of a Large Space Telescope

Helen Herring, Anthony Limiero, Kylie Diaz, Daniel Troyetsky | OSTEM Interns | GSFC – Code 500

Mentored By: Bo Naasz, Tammy Brown, Russell Snyder, Brian Roberts, Jeffrey Bolognese, Matthew Bolcar

Space Technology Mission Directorate (STMD)

With future space telescope concepts reaching their theoretical size limit due to launch vehicle constraints, assembling a telescope in space is the only way to continue increasing aperture size. This project conducts an analysis of the systems needed to assemble a 20-meter space telescope on orbit. The tasks included in the project include a discussion of the use cases fulfilled by a large space telescope, an analysis of the required temporal and spatial thermal stability, and considerations for robotically assembling harnessing for large structures. The team also developed a concept of operations for robotic assembly without on-orbit human involvement, and conducted a preliminary review of the verification and validation processes required for such a telescope to successfully conduct science operations.

August 11 - Room B

8/11 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Heliophysics Science: Solar Theory and Computational Studies

Stephen Naus | OSTEM Intern | GSFC – Code 670

Mentored By: C DeVore

Coronal and Solar Wind Models and Data Used to Drive and Validate Them

Daniel Iong | OSTEM Intern | GSFC – Code 671

Mentored By: Charles N. Arge

Science Mission Directorate (SMD)

This project explores the use of dynamic time warping (DTW) for evaluating solar wind velocity and IMF polarity predictions from the Wang-Sheeley-Arge (WSA) model using an ensemble of ADAPT realizations as input. Dynamic time warping is an algorithm for measuring the similarity between two time series by first computing an optimal alignment between them. A canonical application of DTW is to cope with different talking speeds in speech recognition. Prediction models, such as the WSA model, have traditionally been evaluated using metrics such as root mean squared error or Pearson correlation coefficient. However, these metrics fail to account for local shifts and contractions between prediction and observation. We identify issues with applying the vanilla DTW algorithm to compare WSA model output with ACE observations and investigate potential extensions to mitigate some of these issues. Further work is needed to make the DTW algorithm more robust in this context.

Utilizing Electron Heat Flux to Improve IMF Polarity Specification for Validation of the Wang-Sheeley-Arge Model

Elizabeth Wraback | OSTEM Intern | GSFC – Code 671

Mentored By: C. Nick Arge

Science Mission Directorate (SMD)

The corona and solar wind predictions of the Wang-Sheeley-Arge (WSA) model are validated by in-situ solar wind observations. The original method for specifying the in-situ interplanetary magnetic field (IMF) polarity for validation of the predicted IMF only considered the observed Bx component of the magnetic field. This approach fails about 25% of the time when the magnetic field does not fit the simple Parker Spiral paradigm. We created a rigorous methodology using electron heat flux to reliably determine the IMF polarity approximately 90% of the time. From this, a new set of criteria, along with uncertainty estimates, was created to use the magnetic field to specify the IMF polarity for validation of the WSA predictions, since electron heat flux is not available for real-time forecasting. This set of criteria was implemented in WSA and the results will be presented here.

Identifying Coronal Holes in Solar Observations Through Active Contours Without Edges

Jeremy Alexander Grajeda | OSTEM Intern | GSFC – Code 671
Mentored By: Charles Nick Arge
Science Mission Directorate (SMD)

This project explores the process of developing coronal holes segmentations through the application of the Active Contours Without Edges (ACWE) algorithm. ACWE is an image segmentation technique that defines one or more contours or "snakes" which separate an image into foreground and background. This is achieved through an iterative process, evolving an initial set of contours to maximize the homogeneity of foreground and background regions subject to a weight constraint that defines how homogenous each region should be. When adapted to coronal hole segmentation, ACWE is first seeded with a group of initial contours consisting of dark pixels within the solar EUV image; this segmentation is then evolved to produce homogeneous regions that are no longer defined by an intensity threshold.

8/11 1pm-2pmEST / 12pm-1pmCST / 10am-11amPST

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Testing and Calibration Support for the HERMES-NEMESIS Magnetometer

Connor DiMarco | OSTEM Intern | GSFC – Code 6730
Mentored By: Eftyhia Zesta
Science Mission Directorate (SMD)

Create software for the Ground Support Equipment for the Lunar Gateway HERMES-NEMISIS (Noise Eliminating Magnetometer In a Small Integrated System) instrument. Adapt existing codes (Fortran, IDL, MATLAB, and C++) to a unified GSE system (Python) that collects data from the NEMISIS electronics and provide visualization tools for quick assessment of the data during the testing and calibration phase of the instrument.

The Python programs decode raw data dumps from the instrument in real time, organize the packets, filter and manipulate data, and provide outputs. Examples outputs are Time Series, Noise Density, Fast Fourier Transforms, and Spectrograms. Programs are accessed through a GUI created in Python.

Understanding Solar Energetic Particles

Eldon Sullivan Scott III | OSTEM Intern | GSFC – Code 6720 - NCSCP
Mentored By: Georgia DeNolfo
Science Mission Directorate (SMD)

This project focuses on the observation that electron precipitation can be seen in the magnetosphere but we are unsure what causes this precipitation. In the project, we look at electron count rates alongside different wave data to determine which wave activities are influencing the electrons. Finally, we look at whether solar wind is driving this wave activity and furthermore the REP events.

UVI-GREAT Flight Instrument Energy and Energy Resolution Calibration

Kaheem Walters | OSTEM Intern | GSFC – Code 672
Mentored By: Georgia de Nolfo
Science Mission Directorate (SMD)

This project was to complete the data acquisition and analysis component for the gamma ray detection instrument of the University of the Virgin Islands' Gamma Ray Experiment for Astrophysical Transients (UVI-GREAT) by reproducing the data produced at the GSFC laboratory using instrumentation at the University of the Virgin Islands' lab. Once complete, the UVI-GREAT will be on the High-Altitude Student Payload (HASP) to detect gamma ray bursts (GRBs) that correspond to collapsing neutron stars and black holes. Gamma ray bursts are energetic electromagnetic events produced by merging neutron stars and black holes that are hypothesized to be the counterparts of gravitational waves. To complete the project, we will demonstrate the performance of the instrument consisting of a cesium iodide scintillator crystal, arrays of silicon photo-multipliers, DRS4 evaluation board for waveform capture, and a BeagleBone Black by identifying photoelectric peaks from laboratory radiation sources such as cesium-137 and cobalt-60.

Searching for new gas elements in the lunar atmosphere

Daniel Zhou | OSTEM Intern | GSFC – Code 6730
Mentored By: Menelaos Sarantos
Science Mission Directorate (SMD)

While the tenuous atmosphere of the Moon is relatively unaltered today, future manned missions will inevitably disturb its composition. In this project, we processed and analyzed spectroscopic data obtained by the Lunar Atmosphere and Dust Environment Explorer (LADEE) during its five-month orbit around the Moon in an attempt to identify and place upper limits to previously undetected gas elements in the tenuous lunar atmosphere. Discovering undetected elemental species in the lunar atmosphere will help further build upon our current characterization of the lunar atmosphere and better our understanding of the origins of the atmospheres of the Moon and other small bodies in our Solar System.

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Characterizing Coronal Hole Boundary Regions with Fractal Analysis

Isaac AshLind | OSTEM Intern | GSFC – Code 671 – SPEID
Mentored By: Nicholeen Viall
Science Mission Directorate (SMD)

The solar corona is the optically thin outermost layer of the solar atmosphere. A coronal hole is a region of the corona where the diffusion of plasma along open field lines has left a relatively cool patch of corona with very low plasma density. The plasma that escapes the solar atmosphere along open field lines comprises the solar wind. Therefore, understanding coronal holes is essential to understanding the solar wind. While coronal holes are clearly visible in extreme ultraviolet images, the precise characterization of their boundaries remains elusive. In order to characterize this irregularity, we calculate box-counting dimensions for coronal hole boundary contours and surrounding boundary regions. A box-counting dimension is a non-integer number, or fractal dimension, that quantifies complexity. With this tool, we can investigate coronal hole boundary regions numerically and systematically.

Solar Wind Observational Analysis

Taylor Paul | OSTEM Intern | GSFC – Code 671 – SPEID

Mentored By: Nicholeen Viall-kepko

Science Mission Directorate (SMD)

In this project, we utilize Ulysses data to investigate periodic density structures in the solar wind coming from the polar regions of the Sun. We perform a time series analysis using Fast Fourier Transform (FFT) to identify the structures. Then, we compare the periodic density structures originating in polar region to those previously found in the ecliptic in both remote and in situ observations of solar wind. We measure the solar cycle and latitudinal dependence of the periodic density structures. Understanding periodic density structures will provide additional constraints on the mechanisms behind the release and acceleration of the solar wind.

Mechanical Engineering and Data Analysis to Inform Scientific Instrument Design

Tyler Wolf | OSTEM Intern | GSFC – Code 673

Mentored By: Robert Michell

Science Mission Directorate (SMD)

This project involves aspects of mechanical engineering design to modify existing designs of a previous intern in order to produce a fully functional instrument design. The design is intended to be manufactured for testing and eventually be flown. The purpose of the instrument is to introduce a large field of view (FOV) high energy particle (HEP) spectrometer to the compact instrument area. This instrument specifically will allow scientists to compare the amount of absorbed versus reflected HEP in the Earth's atmosphere. After design validation, this instrument is intended to be flown as both a stand-alone cube sat instrument and also an onboard sounding rocket instrument.

Analyzing the Relationship between Solar Wind Drivers and Magnetospheric Response Parameter: A Storm is Brewing

Wayland Fung | OSTEM Intern | GSFC – Code 675

Mentored By: Shing F. Fung

Science Mission Directorate (SMD)

This project analyzes magnetospheric state data by finding a relationship between solar wind properties and magnetospheric properties that react to solar winds. The magnetospheric state data is a set of magnetospheric values in hourly time intervals derived from several spacecraft in geocentric orbit that collect solar wind data (driver parameters) and magnetospheric data (response parameters). One of these response parameters, Storm Time Disturbance (Dst), is important in determining if there is an existing geomagnetic storm and its intensity as well as determining the phase of the storm. However, it is not exactly known how Dst changes relative to the driver parameters. This project aims to answer this by observing what magnitudes of driver parameters occur at each phase of a geomagnetic storm by using data analysis.

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Estimation of second-order gradients from MMS velocity measurements in the analysis of electron vorticity dissipation in reconnection

Lee Roger Chevres Fernandez | OSTEM Intern | GSFC – Code 673

Mentored By: Deirdre E. Wendel

Science Mission Directorate (SMD)

Magnetic reconnection is an important phenomenon that occurs throughout the universe in magnetized plasmas. One of the unresolved questions regarding magnetic reconnection is how it dissipates energy, an important aspect of reconnection's energy budget and efficiency. The boundary conditions and $E_\perp$ impose vortex null points along each of the reconnecting magnetic field lines within the electron diffusion region (EDR). We engage in the calculation and analysis of the electron dissipation inferred from spacecraft observations of reconnection, using NASA's Magnetospheric Multi-Scale (MMS) mission. The use of quadratic spatial interpolation allows us to derive a second-order gradient for the electron velocity in the vicinity of the EDR. We will compare these gradients to the wave vector analysis in the spectral domain, where we have used the method developed by Bellan to determine the vector k. This work on second-order gradients will be a new approach for data analysis efforts.

Virtual: Developing a Machine Learning Cloud Thermodynamic Phase Model for MODIS

Ryan Song | OSTEM Intern | GSFC – Code 613- NCSCP

Mentored By: Dr.Chenxi Wang

Science Mission Directorate (SMD)

Detecting clouds and identifying their thermodynamic phases using satellite observations is often a critical initial step in many cloud remote sensing algorithms. In this project, the intern will migrate the previously developed ML model to a different satellite instrument MODIS. As expected, the new ML-model will be trained and validated using reference labels from CALIOP measurements. The most challenging part is that, since the MODIS and CALIOP have similar ground tracks, a model trained with MODIS-CALIOP data could be largely biased for off-track areas. Therefore, the intern will utilize results from the previous VIIRS model as part of the training/validation datasets to overcome the sampling issue. The major objectives/tasks of this project include: • training/validating a new ML model using satellite data, • testing model performances in both on-track and off-track areas, • visualizing and comparing outputs from the current ML model and other existing algorithms.

Applying Deep Learning Methods to Trace and Model Dust Storms in the Sahara

Analiese Parsons | OSTEM Intern | GSFC – Code 613

Mentored By: Dr. Tianle Yuan

Science Mission Directorate (SMD)

8/11/2021 3:00:00 PM EST | Link

This project models dust storms in the Sahara by analyzing NASA high rate SEVIRI image data from the Meteosat Second Generation-11 geostationary satellite and using a dust RGB. This was done by producing the images through python code and outlining the dust storms using RGB interpretation. Dust from Saharan dust storms is transported from Northern Africa to the Americas by trade winds and is crucial for climatic processes. This model helps to show the genesis and progression of the dust storms, which is important in studying how they affect climate change. The results are significant for previous research stating a severe reduction in Saharan dust activity.

Apply Deep Learning Methods to Explore NASA Data

Theng Yang | OSTEM Intern | GSFC – Code 613

Mentored By: Tianle Yuan

Science Mission Directorate (SMD)

This project aims to use neural networks to analyze Merra satellite images. Using a U-net convolutional neural network, we were able to predict the cloud fraction given the sea surface temperature, relative humidity, estimated inversion strength, and other variables. Cloud fraction plays a crucial role in Earth's energy budget by reflecting sunlight into space and absorbing radiation from the Earth's surface. Predicting cloud fractions allows us to study the formation of cloud fractions and the impacts on Earth's climate. With a convolutional long-short-term memory model (ConvLSTM), we were able to forecast wind vectors given historical data. Understanding wind vector and wind vector forecast give us a tool to predict and track hurricanes and other storms.

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Computer modeling in support of Surface Biology and Geology mission

Ayron Ralston Frederick Fears | OSTEM Intern | GSFC – Code 618 – SPEID

Mentored By: Benjamin Poulter

Science Mission Directorate (SMD)

This project investigates patterns of biodiversity using remote spectroscopic measurements in the visible to shortwave infrared and lidar observations made over the Cape Floristic Region (CFR) within South Africa. GEDI lidar data from the NASA Earthdata database is used to acquire measurements such as relative height (RH) metrics, solar elevation, Plant Area Index, and canopy cover. DESIS imaging spectroscopy data from the tcloud database is used to acquire three "scenes" to calculate biodiversity. These observations will be used to investigate the effect of invasive tree species on the biodiversity within the region. Using the DESIS scenes taken during the summer season, we can calculate the biodiversity with precise latitude-longitude coordinates and match them with the RH metrics from the GEDI data. The GEDI measurements will be used to determine if the plant life is one of the three invasive species so we can get a clear figure of their effect on the region.

Computer modeling in support of Surface Biology and Geology mission

Keerthana Pullela | OSTEM Intern | GSFC – Code 618 – SPEID

Mentored By: Alexey Shiklomanov

Science Mission Directorate (SMD)

The purpose of my project was to quantify and study uncertainty in spectroscopic data using computer modeling. Factors such as imperfect calibration of instruments and imperfect sensors can lead to uncertainties in top-of-atmosphere radiance measurements. This ultimately causes the uncertainties in the estimated surface reflectance that I was trying to observe. Using the Hypertrace software, I was able to simulate all of these sources of uncertainty and the changed values to reflect changes in data.

The method I used was taking known surface reflectance, prescribed atmospheric conditions, and other presets, and using the software to produce outputs such as top-of-atmosphere radiance and posterior uncertainty. I was then able to produce graphs of the top-of-atmosphere radiances and surface reflectances, which were estimated from the top-of-atmosphere radiances. I also produced graphs that showed the variations in TOA radiance and estimated reflectance when the AOD and H2O values in the config files were changed.

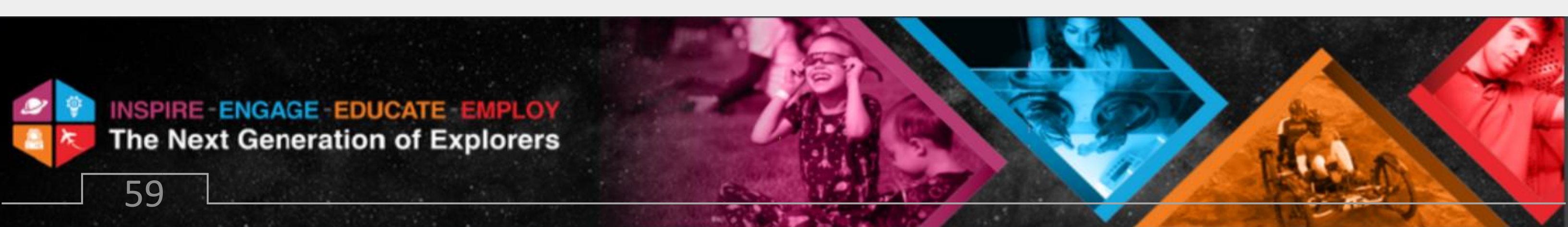
Optimizing Data Formats for EIS Fire Portal Pilot Study

Johana Chazaro Cortes | OSTEM Intern | GSFC – Code 618

Mentored By: Alexey N. Shiklomanov

Science Mission Directorate (SMD)

The Earth Information System Fire Portal is Cloud-based project designed to support the understanding and analysis of current and projected fire activity through interactive user interfaces that centralizes NASA fire data. This is being done by connecting the multitude of data repositories and models for full integration and use for real time analysis of data relating to fire emissions. Efforts over this summer were focused on optimizing the conversion and consolidation of existing datasets into analysis ready and cloud optimized formats and developing a cloud-enabled API to efficiently access these data products on demand.



August 11 - Room C

8/11 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Research Scanning Polarimeter Monitoring and Data Management

Jared Junkin | OSTEM Intern | GSFC – GISS – Code 610
Mentored By: Andrzej Wasilewski

RSP - Code Conversion

Michael Grossman | OSTEM Intern | GSFC – GISS – Code 610
Mentored By: Andrzej Wasilewski
Science Mission Directorate (SMD)
Translate and recode existing C++ files/function responsible for receiving data from the RSP over NASA network into Python

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Identifying Building Level Environmental Hazard Impacts

Kathryn McConnell | OSTEM Intern | GSFC – GISS – Code 611
Mentored By: Christian Braneon
Science Mission Directorate (SMD)
This research integrates sociological and geographical methods to investigate building damage and reconstruction patterns following the 2018 Camp Fire. It investigates: (1) the relative influence of social and physical characteristics on damage outcomes, and (2) the influence of social characteristics on reconstruction probability. Analysis is conducted primarily with fine-scale aerial imagery (NAIP) in the Google Earth Engine cloud computing platform, and draws on machine learning techniques for variable selection and image classification.

The Role of Acetone on Global Atmospheric Composition

Alexandra Rivera | OSTEM Intern | GSFC – GISS – Code 611
Mentored By: Dr. Kostas Tsigaridis, Greg Faluvegi
Science Mission Directorate (SMD)
This project assesses an improved acetone tracer scheme for the GISS Earth System Model, ModelE. Acetone is an abundant organic compound with important influence on ozone and atmospheric self-cleaning processes. The budget of acetone is influenced by various sources and sinks. Direct sources include anthropogenic, natural vegetation, oceanic, and biomass burning emissions, while chemistry forms acetone from other organic compounds. Sinks include deposition onto the land and ocean surface, as well as chemical loss. An extensive literature review was conducted to determine how well the values from the GISS acetone tracer scheme are supported. Other results of this study include seasonality, spatial distribution, and field measurement comparisons of acetone-related processes in the GISS model. Overall, the

development of a global acetone budget is crucial to parameterizing and understanding the role of acetone in the atmosphere.

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Improving an Earth and Planetary Climate Model Emulator

Rose Nicole Una, Jasmine Kaur Singh | OSTEM Interns | GSFC – GISS – Code 611

Mentored By: Dr. Marcus van Lier-Walqui, Dr. Greg Elsaesser

Science Mission Directorate (SMD)

This project aims to improve climate model neural network emulators so that physics parameters can be more efficiently optimized and climate models can more accurately simulate Earth and planetary climates. For Earth, we improved the GISS (ModelE) Earth global climate model (GCM) machine learning emulator to accurately emulate the connections between ~50 input parameters and ~35 ModelE outputs that are compared to diverse satellite observations. On the planetary side, the ROCKE-3D Land Planets GCM uses a model ensemble to simulate the climates of oceanless Earth-like planets. The goal of the ensemble is to quantify the uncertainty in habitability using several parameters that cannot directly be observed, and we use the ensemble to develop and train a neural network emulator. This presentation will address the techniques used, our results, and the impact of machine learning on climate model emulator development not only for Earth, but other planetary bodies as well.

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Code Development for Retrieval of Snow Properties

Gabriel Myers | OSTEM Intern | GSFC – GISS – Code 611

Mentored By: Matteo Ottaviani

Science Mission Directorate (SMD)

The retrieval of snow properties and their evolution in polar regions is a very important component of climate research. We are in the process of developing a new retrieval scheme that exploits the polarization state of the light measured by satellite sensors (POLDER), in addition to measurements of intensity only (like those of MODIS).

Formulating aquatic remote sensing for the Surface Biology and Geology mission

America Alvarez | OSTEM Intern | GSFC – Code 6180

Mentored By: Kevin Turpie

Science Mission Directorate (SMD)

The 2017 Decadal Survey report of the National Academies of Science, Engineering and Medicine Committee for Earth Science and Applications from Space recommended the development of a mission for designated observation of Surface Biology and Geology (SBG). The SBG mission, currently preparing for formulation in the next year, will support a VSWIR imaging spectrometer and multi-band thermal imager to provide Earth observations of a broad range of environments, including inland and coastal aquatic environments and systems to understand, assess, and monitor processes in aquatic ecosystems and resources. Since remote sensing of these areas requires special treatment and techniques to acquire accurate information, the SBG mission must develop tools to provide accurate identification of the location of aquatic targets and address the unique characteristics of such environments. To support these tasks, an aquatic mask for coastal and other aquatic regions of interest will be developed using existing datasets and GIS tools.

August 12, 2021

August 12 - Room A

8/12 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Mars Sample Return Spin Eject Mechanism Spring Test Design

Kian Vilhauer | OSTEM Intern | GSFC – Code 544

Mentored By: Russ Stein, Trevin Dear

Space Technology Mission Directorate (STMD)

One of the final steps in the Mars Sample Return (MSR) mission's Capture Containment and Return System (CCRS) is the ejection of an Earth re-entry vehicle containing the protected collected samples. The subsystem responsible for this action is the Spin Eject Mechanism (SEM). The ejection is controlled by the precise release of energy from several springs in the SEM that will be compressed for the duration of the mission, up to 8 years. This project involved the design of a test to evaluate the decrease in force in these springs due to long-term compression over the mission duration. Work supporting a project from a previous session – designing a cheaper version of a release device for ground testing – was also performed and will be discussed briefly.

Robot Autonomous Obstacle Avoidance Using Q-Learning

Emily Jackson, Melody Chu, Kyle Krieger | OSTEM Interns | GSFC – Code 5440 - NCSCP

Mentored By: Dr. Umeshkumar Patel, Jacob Rosenthal

Space Technology Mission Directorate (STMD)

A team of high school interns in the Electromechanical Systems Branch have been advancing the implementation of Q-Learning, a form of machine learning, in an existing MATLAB simulation. The program depicts a simulated robot autonomously navigating obstacles within a track. In a previous project, other Q-Learning strategies were tested but were unable to yield a successful navigation through the track without hitting an obstacle. In lieu of this, the team decided to optimize the existing simulation code, as well as develop and observe the effects of an incremental learning method on the Q-Learning data. The simulation's Q-Learning data will eventually be used to aid a physical mBot robot through a real-world track.

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Multifunctional Sensor Platform Enabled by Nanomaterials for Space Missions

David Leskauskas | OSTEM Intern | GSFC – Code 5920

Mentored By: Mahmooda Sultana

Space Technology Mission Directorate (STMD)

Nanomaterials offer a unique set of characteristics that enable the creation of low power, lightweight, miniaturized instruments to be utilized for next generation space missions. The focus of this project is on the processing and analysis of graphene and carbon nanotube chemical sensor data in order to correct for sensor drift and reduce inherent noise. Additionally, a Raman spectroscopy data analysis python program was developed for the automated measurements of important figures of merit including material identification, peak intensities, positions, intensity ratios and more. Samples with similar spectra and figures of merit are automatically clustered together in order to identify processing trends and nanomaterial functionalization that will be utilized to develop chemically selective sensors.

Lynx Mask Architecture Optimization

Camille Edwards | OSTEM Intern | GSFC – Code 553

Mentored By: James Chervenak

Space Technology Mission Directorate (STMD)

Lynx, an X-ray observatory, uses thousands of pixels to perform imaging X-ray spectroscopy with fine angular resolution that will provide information about black holes, stellar evolution, and galactic evolution. This instrument will require a multitude of pixels at a fine scale. To facilitate focal plane design, Lynx requires a modular wiring system, allowing for efficient exchange of components, a reduction in time needed for manual adjustments, and minimization of error introduced when modifying designs. For this project, I focus on creating and developing a portion of this system, specifically incorporating wiring density and fabrication rules, a tool that will support Lynx's future development and optimization of mask architecture. Combining component generation, wire pathway coding, microwave bias line design, and mutual inductance testing results in a proof of concept chip capable of orchestrating over 6000 single pixels.

CCAg Thin Film Development

Adrianne Fantasia | OSTEM Intern | GSFC – Code 546

Mentored By: Mark Hasegawa

Space Technology Mission Directorate (STMD)

My project will discuss thin film development and new methods and technology that can be used to improve these films' capabilities. My work includes research on a variety of topics. My project will portray my findings along with suggestions for future work.

Evaluation of Thermal Control Thin Film Coatings

Henry Renze | OSTEM Intern | GSFC – Code 546

Mentored By: Mark Hasegawa

Space Technology Mission Directorate (STMD)

This project researched thermal fatigue and thermal cycling of thin film coatings (TFCs). Intern reviewed literature to learn about thermal fatigue and its history, how to conduct thermal cycling testing, and failure modes in other systems and how they are similar/different from TFC failure modes. Intern later used spreadsheets to analyze data and draw conclusions as to how to conduct thermal cycling testing of thin film coatings at GSFC. Thermal cycling testing would help determine the durability and strength of thin film coatings.

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Dosimetry Verification for LWS across SET Experiments

Anna Tender | OSTEM Intern | GSFC – Code 5610
Mentored By: Michael Campola
Space Technology Mission Directorate (STMD)

This project focuses on the total-ionizing dose tolerance on various experiments flown on the Living With a Star (LWS) Space Environment Testbed-1 (SET-1) carrier which orbited the Van Allen Radiation Belt from 2019 to 2021. In this, we explore the circuitry used to read out the dosimeters for radiation dose tolerance with respect to variables such as threshold voltage and temperature. We seek to provide insight on and verify dosimeter reads from ground testing results to improve cost-efficency. Ultimately, this project aims to improve design and operations guidelines and test protocols so that spacecraft anomalies and failures due to environmental effects during operations are reduced.

Radiation Effects Analysis and Testing for Space Systems 02 - Virtual

Daniel Scott Ellis | OSTEM Intern | GSFC – Code 5610
Mentored By: Michael Campola, Jason Osheroff
Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

Develop a modular cryostat for use with the REAG group's Gamma Irradiator, but capable of being used at other sites, such as LBNL. The cryostat must hold test devices at temperatures below 77K in a vacuum for lower threshold irradiation damage tests. A unique feature this cryostat has is the capability to maximize the number of test devices being tested simultaneously, during both TID and SEE tests. It melds together mechanical, radiation, vacuum, and cryogenic engineering to develop a device suitable for the Gamma Irradiator's unique footprint. Contact was made to manufacturers and suppliers to determine likely costs as well as operational performance.

Portable Cryostat Radiation Analysis

Jared Hensley | OSTEM Intern | GSFC – Code 5610
Mentored By: Michael Campola
Space Technology Mission Directorate (STMD)

A radiation analysis of a portable cryostat currently under design was conducted using Geant4. The simulation model was first validated by comparing results between a shielding analysis conducted in Geant4 with the shielding model SHIELDOSE-2. Once the simulation was validated, the cryostat design was simplified for compatibility and imported into the simulation. Various testing environments were simulated including gamma testing and heavy-ion testing. The result of the analysis gave an ionizing dose map over the test plate to determine the best placement of test equipment to receive a desired dose.

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GSFC Mission & Optical Design Database

Sophia Nasreen Riazi-Sekowski | OSTEM Intern | GSFC – Code 551- NCSCP
Mentored By: Dr. Joseph Howard
Science Mission Directorate (SMD)

The GSFC Mission & Optical Design Database (MODD) is a reference tool that has been under development since 2007. MODD includes information like the f/#, entrance pupil diameter, field of view, spectral range, and spatial and spectral resolution of all optical instrument systems worked on by GSFC for NASA missions throughout the agency's history and across the departments of Earth Science, Planetary Science, Astrophysics, and Heliophysics. MODD has the potential to aid engineers in designing new optical systems by providing relevant parameter and performance information for similar historical instruments. During this internship period, the priorities have been to complete missing information, to add credible references and diagrams, to improve access to and increase awareness of the database, and to track the historical progression of optical design and NASA's science goals.

GSFC Mission and Optical Design Database

Timothy Denego| OSTEM Intern | GSFC – Code 0511
Mentored By: Dr. Joseph Howard
Science Mission Directorate (SMD)

This project is adding orbits first to the database that's already been started form previous interns, additionally, the FPA number of pixels, pixel pitch, FPA format, science bits per day, and total bits per day. The orbits range from the Lagrange points to the various orbits above the earth. The FPA, pixel pitch and format are for each respective instrument. The database helps with anyone within NASA that are curious about the past, current, and future missions that GSFC is or was affiliated with. There is basic information about spacecraft, their instruments, and objectives as well. The database allows inquirers to find such information with ease and without having to do too much research.

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ORCAS Public Outreach

Alisa Slonaker | OSTEM Intern | GSFC – Code 550 - NCSCP
Mentored By: Eliad Peretz
Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

My project is with communications for the ORCAS (orbiting configurable artificial star) mission. My job is to find out where missions get funding at NASA and find out how to reach stakeholders and the general public to get the word out about the mission and its importance in order to ultimately win funding for the mission. I am currently researching the structure of missions at NASA, how the satellite works, and setting up interviews with ORCAS engineers and scientists to learn more about how the function of the satellite and the information it will provide us and why that information is important right now.

Orbiting Configurable Artificial Star (ORCAS) Mission Architecture

Christine Hamilton | OSTEM Intern | GSFC – Code 550
Mentored By: Eliad Peretz
Science Mission Directorate (SMD)

The Orbiting Configurable Artificial Star (ORCAS) mission is a hybrid space and ground observatory which aims to enable ground observations of near-diffraction limited resolution and exquisite sensitivity. A highly elliptical orbit family has been developed which allows for observations of 10 minutes to several hours, depending on target declination and wavelength. In this project, we develop a tool based on this orbit family which generates a mission schedule that meets all mission requirements and can be altered in real time in the case of disruptions to the mission. We show that the mission could enable 300 adaptive optics and 1500 flux calibration observations throughout its lifetime.

Orbiting Configurable Artificial Star (ORCAS)

Ellouise Moehring | OSTEM Intern | GSFC – Code 5500

Mentored By: Eliad Peretz

Science Mission Directorate (SMD)

The ORCAS mission will enable new science at a SmallSat budget a decade ahead of its time. As a hybrid space and ground observatory, ORCAS will provide unprecedented angular resolution, exquisite sensitivity and a unique flux calibrator. By enabling adaptive optics and flux calibration observations, ORCAS will deliver highly detailed images, unlocking the ability to detect a population of supermassive black hole binaries for the first time, as well as constraining the number densities of the faintest star forming clumps and understanding dark energy by measuring the distances of 10 billion year old supernovae. It will also deliver calibrated light that will vastly improve cosmology measurements, among many other advances. The mission will operate in collaboration with the W. M. Keck observatory.

August 12 - Room B

8/12 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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eViz : Enabling the easy generation of visualizations using different modalities

Deepthi Raghunandan | OSTEM Intern | GSFC – Code 606

Mentored By: Carlos A Cruz

Space Technology Mission Directorate (STMD)

Programming solutions that manage data streams need to be able to handle client requirements as the incoming data changes. Data scientists often leverage human effort to manually manage changes in data. Though reliable, these methods can require undue effort and are rarely scalable. To reduce these efforts and enable ease of use, we developed a visualization pipeline that automatically manages data streams. This presentation will discuss our pipeline's architectural design, the tools/libraries we leveraged, and our learnings. We will also demonstrate the multiple ways in which we have provided access to the pipeline, and the visualization results for our clients.

Assessing the value of remote sensing data in hydrological modeling

Logan Michelle Qualls | OSTEM Intern | GSFC – Code 606

Mentored By: Craig Pelissier

Science Mission Directorate (SMD)

Long Short-Term Memory (LSTM) models are currently state-of-the-art and begin to address the temporal dimensionality of the rainfall/runoff process, but lack the ability to address the spatial dimensionality. By training and comparing models with no spatial inputs to models trained with spatial data, we can begin to characterize and quantify the value of spatial data, in our case remote sensing data, in hydrological predictions.

High Performance Computing in the Cloud

Christine Mbagwu | OSTEM Intern | GSFC – Code 6060

Mentored By: John (Hoot) Thompson

Science Mission Directorate (SMD)

This project involves the use of a high-performance computing (HPC) computer cluster utilizing the Amazon Web Services (AWS) console to submit Slurm scripts through a secure shell protocol for batch submission from a Jupyter Notebook. Jupyter Notebooks are a collaborative, integrated development environment (IDE) gaining popularity for a variety of computing uses, such as Big Data integration and scientific visualization. Scientists in NASA's Earth Science Division develop data and use compute-intensive models to assess climate change and its impact on the environment. Using an Elastic File System (EFS)—a shared repository for both job input and output data—we initiated a cluster, creating an interactive JupyterLab dashboard for users to submit jobs. The combined method of deploying Slurm on an HPC cluster and developing a Python GUI that shields system and Linux complexities from users enables researchers to focus on their science, rather than system administrative tasks.

High Performance Computing in the Cloud

Isa Nawaz | OSTEM Intern | GSFC – Code 606 - NCSCP

Mentored By: John H. Thompson

Science Mission Directorate (SMD)

This project demonstrates the viability of High Performance Computing (HPC) in the Cloud, specifically in Amazon Web Services (AWS). We are using Amazon Athena as a Standard Query Language (SQL) service to scan through S3 (Amazon simple storage service) cloud buckets and identify attempts to break into NASA cloud servers. The query gathers data during the attempts such as IP addresses and number of attempts. We can then link the data to Amazon QuickSight, a service that allows us to connect to Athena and visualize the data as more intuitive graphs and charts. Using these services in tandem allows a method of understanding the raw data in our AWS S3 buckets. We can use the same technique to analyze output data from jobs run on AWS HPC compute clusters.

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Deep Learning Benchmarks for GPU Accelerated Climate Simulation

Ian Thomas | OSTEM Intern | GSFC – Code 606

Mentored By: Laura Carriere, Kenneth Peck

Science Mission Directorate (SMD)

As machine learning applications begin to leverage GPU compute to accelerate the training of deep neural networks, a need for quality GPU benchmarks is rising. In this project, we explore the performance of various GPU compute platforms available at NASA through a standardized machine learning benchmark consortium. As the experiments are being performed at the NASA Center for Climate Simulation, the primary focus of this project is how well GPU compute units perform in a deep learning climate segmentation benchmark used at various TOP500 supercomputing systems. Benchmarking results may then be published to a public results listing alongside results from other national laboratories and supercomputing centers.

Remote Visualization in High Performance Computing

Noah Oller Smith | OSTEM Intern | GSFC – Code 606

Mentored By: Laura Carriere, Nicko Acks

Science Mission Directorate (SMD)

This project focuses on comparing remote visualization tools available in high performance computing on NASA's supercomputing cluster, Discover. This includes the process of installing and analyzing the performance impacts between these software packages. Security issues that could come from using these tools, such as port forwarding, also had to be considered.

Mapping Fractional Water Cover using SmallSat Imagery in Alaska

Allison Baer | OSTEM Intern | GSFC – Code 600

Mentored By: Dr. Mark Carroll

Science Mission Directorate (SMD)

Over 40% of the United States' surface water is found in the State of Alaska. This project uses SmallSat imagery from Planet Labs to map fractional water cover in the Yukon Delta region of Alaska. We assessed spatial and temporal trends in surface water cover from the years 2019-2020 to assess change over time.

Coastal Arctic Data Synthesis Project

Jacob Dietrich | OSTEM Intern | GSFC – Code 610

Mentored By: Antonio Mannino

Science Mission Directorate (SMD)

The Arctic-COLORS program (Arctic-Coastal Land Ocean inteRactionS) is an interdisciplinary NASA-OBB (Ocean Biology and Biogeochemistry) field campaign to study the nearshore coastal Arctic as an integrated land-ice-ocean-atmosphere-biosphere system in recognition of the Arctic experiencing an unprecedented amplification of global climate change. Currently the Arctic-COLORS timeline is within Phase 1: Pre-Arctic-COLORS, which involves a two-year activity to compile biogeochemical remote-sensing and field data to create a repository for use when the formal Arctic-COLORS program begins. For this, we worked to identify, download, and document existing biogeochemical data from coastal regions within the Arctic-COLORS domain. This domain includes a geographical range from around the Mackenzie River in Canada near Inuvik to the Yukon river, though additional nearshore coastal Arctic data was mined from other regions.

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AI/ML Applications to Support Earth Science Data Center Operations

Nathaniel R. Crosby, Rohan O. Dayal, Kristina A. Stoyanova | OSTEM Interns | GSFC – Code 6102

Mentored By: Irina Gerasimov, Armin Mehrabian

Science Mission Directorate (SMD)

Project 1 (Nathaniel, Rohan, Kristina) Creating a knowledge graph to connect scientific publications and datasets for improving discovery of GES DISC's data and services:
The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) archives and distributes to the public hundreds of Earth Science data collections. These collections are used in research, resulting in thousands of scientific papers published each year. As new users come to GES DISC for the data, it is important for them to understand how these data were used in the prior research. For this we are creating the Knowledge Graph that connects research paper citation and the data collection metadata. The relationships created in the graph have potential for the Web applications that utilize this information to directly connect the paper research to the GES DISC datasets and services. We will demonstrate these relationships using the Web application prototype.
Project 2 (Kristina) Improving Earth Science dataset search with publications content via Knowledge Graph linkage:
The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) archives a large number of Earth observational datasets. Thousands of the publications are created each year based on these datasets. The content of these publications can be used for discovery of the datasets based on the characteristics of applicational research. We leverage the content of these publications to retrieve the information about phenomena and domains where measurements from the datasets were utilized through linking these publications and dataset in Knowledge Graph. We

retrieve phenomena and domain information using SWEET ontology and produce the set of keywords that are linked to the datasets. Further, we evaluate this link strength according to the frequency of dataset usage in the papers mentioning these keywords. We demonstrate how this linkage can improve dataset search by comparing the search results obtained from Common Metadata Repository (CMR) search and the publications based data.
Project 3 (Rohan) Automated classification of scientific publications linked to GES DISC datasets:
The data collections archived and distributed by the GES DISC NASA data center are widely utilized for various Earth Science studies. As these collections are created, many research works are published regarding the collections, algorithms, validations and applications. Since GES DISC collects these publications and provides their citations for the users, it is helpful to categorize them based on how they relate to the datasets they are associated with. Specifically, whether the publication that is linked to GES DISC dataset is using it for applicational research, or if it describes the algorithm for dataset creation, or the validation of the dataset, or provides the general overview of the data collection. Currently, this process requires simple manual labelling, and as such, may be possible to solve via automation. To approach this problem, we developed machine learning classifiers to predict the category a publication belongs to. We used manually labeled publications as training data for supervised machine learning algorithms: Random Forest and Naive Bayes. We achieved classification accuracy that is substantially better than the baseline accuracy, thus greatly improving the efficiency of the publication internal analysis.

Predicting blowing snow using machine learning

Daniel Kiv | OSTEM Intern | GSFC – Code 613
Mentored By: Yuekui Yang
Science Mission Directorate (SMD)
This project examines the interactions of blowing snow across Antarctica, which is experiencing profound changes that affect Earth's climate system. Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite data can be used to identify blowing snow, but doesn't give a complete, hourly, picture of Antarctica. A supervised machine learning model was trained using satellite data from CALIPSO, as the ground truth, and the Modern-Era Retrospective analysis for Research and Applications, version 2 (MERRA-2), a global atmospheric reanalysis, to classify features such as clouds, clear skies, and blowing snow. Additionally, the height and optical depth of the blowing snow is predicted. This approach helps to understand the effects of blowing snow, through radiative transfer, on the climate and how blowing snow is transported across Antarctica.

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Identification and Analysis of Southern Ocean Cyclones with DSCOVR-EPIC Observations

Joy Song | OSTEM Intern | GSFC – Code 613- NCSCP
Mentored By: Yuekui Yang
Science Mission Directorate (SMD)
This project identifies summertime Southern Ocean cyclones and studies their spatial distributions, tracks, and strengths represented by the pressure of the cyclone center. Due to the lack of observations in the area, previous studies have been mainly utilizing modeled or reanalysis data. NASA's EPIC captures images of the entire sunlit side of Earth at least once every two hours. This capability allows us to track the features of the Southern Ocean cyclones during the Southern Hemisphere summertime. For this project, EPIC images during 12/01/2021-02/28/2021 are visually inspected, and each cyclone is labelled. A python program is developed to read and save the cyclone center geolocation from EPIC data and

the sea level pressure from NASA MERRA-2 data. With the saved data, analysis on the cyclone occurrence, tracks, and strength is conducted. The visually identified cyclones will also serve as the truth in a machine learning model under development.

Machine Learning Approach to Classify Precipitation Type from a Passive Microwave Sensor

Spandan Das | OSTEM Intern | GSFC – Code 613 - NCSCP
Mentored By: Jie Gong
Science Mission Directorate (SMD)

This project uses the atmospheric data provided by NASA's Global Precipitation Measurement (GPM) mission's Core Observatory satellite's Microwave Imager (GMI) in conjunction with the readings from its Dual-Frequency Precipitation Radar (DPR) to train machine learning models to classify precipitation into different categories, namely: No Precipitation, Convective, Stratiform, Mixture, and Other. Many previous ML solutions were flawed because of the heavily biased training dataset, since no precipitation scenes are much more frequent than precipitation scenes. We trained six different machine learning models on 84 days of 2017 data from GPM's Core Observatory Satellite and our best models were able to obtain around 87% accuracy on the holdout data. Overall, we were able to build multiple successful models with good performance, and more importantly, we overcame the inherent data bias.

Lidar Automation Software/Hardware Engineer

Trong Nguyen | OSTEM Intern | GSFC – Code 614
Mentored By: Dr. John Sullivan
Science Mission Directorate (SMD)

This project required me to assist in engineering projects related to automation of optical assemblies. the position involved design of electrical prints, software programming, automating hardware controls, and control panel design. This included interface systems with motorized actuators and other control motors, electrical subsystems, and data acquisition machines.

Clustering of aerosol optical properties using a novel approach modeled after a repulsive Coulomb force optimized by simulated annealing

Tyler Grear | OSTEM Intern | GSFC – Code 6101
Mentored By: Dr. Patricia Castellanos
Science Mission Directorate (SMD)

Forward radiative transfer calculations model how light is transmitted through the Earth system. These are essential for applications such as observing system simulation experiments (OSSEs) and remote sensing retrieval algorithms. The purpose of this work was to reduce the computational burden of these calculations by constructing representative samples that retain the information required to effectively calculate the radiative transfer. A synthetic dataset of aerosol optical properties was generated using GEOS-5 containing the aerosol optical depth (AOD) of five species: sea salt (SS), dust (DU), organic carbon (OC), black carbon (BC), and sulfate (SU). A five and six-dimensional feature space of AOD for each species was constructed then clustering algorithms were employed to provide class labels of points having similar optical properties. Two clustering algorithms were utilized in this work, agglomerative clustering (AC) and a novel approach called balloon clustering (BC) based on the concept of a repulsive force between two charged particles. The two approaches were benchmarked based on their ability to generate an effective set of representative samples thus reducing the computational burden for radiative transfer calculations.

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Automatic Detection of Melt Ponds on Summer Sea Ice using ICESat-2

Mia Vanderwilt | OSTEM Intern | GSFC – Code 615
Mentored By: Rachel Tilling, Nathan Kurtz
Science Mission Directorate (SMD)
8/12/2021 4:00:00 PM EST | Link

This project develops an automated detection algorithm for melt ponds on Arctic sea ice using laser altimetry data from NASA's ICESat-2 satellite mission. Melt ponds - which can cover up to half of the Arctic summer sea ice surface - complicate laser altimetry measurements used in sea ice thickness estimates. ICESat-2's classification system for higher level sea ice products is currently unable to isolate ponded surfaces, and elevation estimates variably correspond to pond bottoms, surfaces or some intermediate. This project uses ICESat-2 photon cloud data, calculations of photon signal-to-noise ratio and curve fitting to identify melt ponds with double surface returns. The approximate depth of the melt pond and the total ponded area of each satellite track can then be recovered. A choice of surfaces (either pond top or bottom) will improve the accuracy of sea ice thickness estimates and further resolve the extent of Arctic sea ice cover decline.

Enhancing Parallel Performance of the GEOS Numerical Weather Model with Hybrid MPI+OpenMP

Natalie Patten | OSTEM Intern | GSFC – Code 610
Mentored By: Thomas Clune
Science Mission Directorate (SMD)

Previous work has demonstrated that the parallel performance of the dynamical core of the Goddard Earth Observing System (GEOS) weather model can be improved by 25%-50% at extreme resolutions by introducing fine-grained OpenMP parallelism. And while other components of GEOS scale adequately under pure MPI, GEOS as a whole cannot profitably leverage those performance improvements unless all components are also instrumented with OpenMP. To accomplish this with minimal software changes, we have implemented a high-level strategy which takes advantage of the hierarchical structure of GEOS and only requires instrumenting a single short procedure. This approach required development of new infrastructure capabilities to split existing data structures into multiple pieces that can be assigned to individual OpenMP threads. Here we describe the required software changes and summarize the impact on parallel performance.

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The Heavy Burden of Desert Dust on Premature Human Mortality

Alexander Yang | OSTEM Intern | GSFC – Code 613 - NCSCP
Mentored By: Hongbin Yu
Science Mission Directorate (SMD)

Dust particles with a diameter of 2.5 micrometers or smaller, are ubiquitous around the globe. Being over 30 times smaller than a human hair, we rarely notice them in our everyday lives. However, these dust particles could pose great risk to human health. In this study we use NASA MERRA-2 dust PM2.5 concentration to estimate dust's adverse health impacts. Globally, dust PM2.5 contributes to an estimated 3,270,000 (2,640,000 – 3,850,000) cardiopulmonary and 143,000 (68,700 – 210,000) lung cancer mortalities. This compares to about 60% of mortalities caused by pollution. The impacts are substantial in West Africa, where dust from the Sahara Desert is blowing throughout the year. The estimated mortality due to dust is 530,000 (441,000 – 695,000) for cardiopulmonary and 8380 (4420 – 11,000) for lung cancer. Our study highlights that people should pay close attention to the health impacts of dust particles, and that climate change's effect on future dust emissions and human health should be of a great concern.

Wildfires in the American West Over the Last Four Decades

Benjamin Lee | OSTEM Intern | GSFC – Code 613 - NCSCP
Mentored By: Hongbin Yu
Science Mission Directorate (SMD)
Since June this year, we have all heard of big wildfires in California, Oregon, and other western states. These fires have caused tremendous damages, loss of properties, and polluted the air we breathe. Occasionally, wildfire smoke sweeps across the continent and reached the mid-Atlantic region. Has something like this ever happened before, or will it happen again? In this study, we use NASA MERRA-2 1980-2020 data to examine how wildfires in 12 western states have trended over the past four decades. We found that summertime (August and September, in particular) wildfire activities have been increasing substantially, particularly since 2010. 2020 was by far the worst year. In comparison to the 1980's, fire activities in 2020 had increased by a factor of 5 and up to 20, depending on the states. We also found that the increase of fire activities has been associated with an increase of both average and maximum temperature and a decrease of precipitation, suggesting the role of climate change in the increase of wildfires.

Characterizing Marsh Vegetation in the Chesapeake Bay Using SAR and Optical Satellite Data

Daniel Donahoe | OSTEM Intern | GSFC – Code 610
Mentored By: Dr. Stephanie Schollaert Uz
Science Mission Directorate (SMD)
Our objective was to use remotely sensed data to understand the current distribution of common species of vegetation in Chesapeake Bay marshes using optical and radar remote sensing data. We evaluated remotely sensed data using Google Earth Engine and classified areas of known emergent vegetation in the Bay. These areas were also classified by species type. Results from this study could be used to inform natural resources managers in the Bay concerned with tidal marsh habitat.

Water quality monitoring around Lancaster, Virginia

Samantha Smith | OSTEM Intern | GSFC – Code 610
Mentored By: Stephanie Uz
Science Mission Directorate (SMD)
We explored whether septic tank failures associated with a suspected increase in population around White Stone, Virginia during the COVID-19 pandemic led to an observable degradation in water quality that resulted in local shellfish bed closures in the Chesapeake Bay. We used in situ water quality data, septic tank failure reports, and multispectral satellite imagery to examine potential associations between septic failures, wastewater runoff, and poor water quality events. These findings will inform future exploratory analysis of hyperspectral imagery in preparation for the Surface Biology and Geology (SBG) Mission.

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Sythetic Aperature Radar Instrument Development

Trey Crump | OSTEM Intern | GSFC – Code 610

Mentored By: Martin Perrine

Diurnal and Seasonal Variations in Vegetation Function at Leaf and Canopy Scales Using Field and Satellite Data

Jisoo Kim | OSTEM Intern | GSFC – Code 618

Mentored By: Petya Campbell

Science Mission Directorate (SMD)

During the summer of 2019, optical measurements representative of vegetation function were collected on maize under nitrogen (N) treatments. The field-based continuous observations include: 1) leaf-level fluorescence and photosynthetic efficiency; 2) canopy reflectance and solar induced fluorescence (SIF) collected using a dual spectrometer FLoX; and 3) gross primary productivity (GPP) and ecosystem respiration. VENµS (ISA/CNES) provided mid-day satellite reflectance imagery. Relationships between the diurnal leaf observations of photosynthetic efficiency, canopy SIF, and GPP were established. Mid-day chlorophyll red-edge VIs and NDVI were strongly correlated between FLoX and VENµS ($p<0.001$, $r2=0.95/0.99$), demonstrating the capability of high spectral resolution remote sensing data to scale canopy-level spectral measurements. Furthermore, the VIs of N-treated maize were consistently higher than those of untreated maize until about halfway through the growing season.

The analysis of such data types serves for developing product prototypes of vegetation function for the upcoming NASA Surface Biology and Geology mission.

The Universe is #trending: Using Social Media to Communicate Cutting-Edge Astrophysics

Amie Martinez | OSTEM Intern | GSFC – Code 660

Mentored By: Barb Mattson

Science Mission Directorate (SMD)

This project translates exciting scientific results into fun and engaging social media products. With over 1.3 million followers across Facebook and Twitter, NASA Universe shares the story of NASA astrophysics by providing creative and educational content for all space lovers. From leveraging popular hashtags and holidays to using emojis and GIFs, NASA Universe taps into people's curiosity by making unexpected connections between the universe and pop culture. This project contributes to NASA Universe's mission by creating new content on how constellations guide us to some of the most incredible and mysterious objects of the universe. This “Week of Constellations” social media campaign features daily posts and related content to ultimately encourage people to look up at the stars.

X-Raying the Million-Degree Gases in Galaxies

Elizabeth Bradshaw | OSTEM Intern | GSFC – Code 662 - NCSCP

Mentored By: Dr. Edmund Hodges-Kluck

Science Mission Directorate (SMD)

This project seeks to uncover the nature of the hot interstellar medium (ISM) in other galaxies. Data from the orbiting Chandra and XMM-Newton x-ray observatories is processed to create x-ray spectra from regions of dwarf starburst galaxies. Using specialized software, these spectra are analyzed to determine the temperature or temperatures of the hot ISM. The temperature can be determined using this method across the entire galaxy; however, this measurement may not be reliable. One goal of this project is to determine whether these data are unreliable. If so, this unreliability could result from the presence of bright point-sources such as x-ray binaries, or the hot ISM may not be isothermal. By analyzing specific regions of a galaxy, this project can study the hot ISM at a smaller scale. This project also studies the effect that region size and location can have on results. This research will provide greater insight into the complexity of the temperature of the hot ISM in other galaxies.

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EXCLAIM!

Trevor Oxholm, Sarah Stewart, Tyler Cashalo Cox| OSTEM Interns | Angelo Gannon | GSFC – Code 665

Mentored By: Eric Switzer

Science Mission Directorate (SMD)

The EXperiment for Cryogenic Large-Aperture Intensity Mapping (EXCLAIM) is a balloon-borne telescope designed to survey star formation in windows from the present to z = 3.5. During this time, the rate of star formation dropped dramatically, while dark matter continued to cluster. EXCLAIM maps the redshifted emission of singly-ionized carbon lines and carbon monoxide using intensity mapping, which permits a blind and complete survey of emitting gas through statistics of cumulative brightness fluctuations. EXCLAIM achieves high sensitivity using a cryogenic telescope coupled to six integrated spectrometers with spectral resolving power R = 512 and employing kinetic inductance detectors. Here we describe various projects within the EXCLAIM instrument, including the optical implementation of the receiver and detector test system, flight software for ADCS, and optomechanical design.

3:30pmEST / 2:30pmCST / 12:30pmPST

Security Orchestration, Automation, and Response (SOAR) Technology Integration Research

Quinshay Hall | OSTEM Intern | GSFC – Code 710 – SPEID

Mentored By: Martin Ramos

Center Operations

This project conducts an analysis on the benefits and challenges of SOAR integration within NASA. Security Orchestration, Automation, and Response (SOAR) is a collection of software tools that enable organizations to streamline security operations though orchestrating and automating manual processes helping to optimize workflow. Using journal articles and market guides to obtain background research and conducting stakeholder meetings, additional insight into currently used SOAR technologies was gathered. This information gathered was used to develop a list of SOAR technology recommendations for future NASA cybersecurity integration.

Analysis of Zero Trust Architecture and Its Impact on NASA GSFC's Computing Environment

Vincent Johnson | OSTEM Intern | GSFC – Code 710 – SPEID

Mentored By: Stephen Gilmer

Center Operations

The purpose of this presentation is to discuss findings of a benefits analysis of implementing Zero Trust Architecture in NASA GSFC's computing environment.

August 13, 2021

August 13 - Room A

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Section 508/Web Accessibility Testing

Juliet Yang | OSTEM Intern | GSFC – Code 585- NCSCP

Mentored By: Mary Goldfarb

Space Technology Mission Directorate (STMD)

This project supports web accessibility testing to ensure that all NASA websites meet Section 508 and WCAG 2.0 guidelines. Under the law, these guidelines require that all federal agencies make electronic information/technology equally accessible to everyone regardless of disability. The primary goal of this project is to conduct a Section 508 audit for the Workmanship module of the Lab Quality Management System (LQMS) website, analyze the tested code for compliance, and propose recommendations to correct the accessibility issues detected. This presentation will give an overview of web accessibility and federal guidelines as well as detail the process behind accessibility testing, reporting, and remediation.

A Preliminary Review of Survey Analysis Methods to Support the NASA GSFC Engineering and Technology Development (ETD) Training and Evaluation Team

Alexis de Silva | OSTEM Intern | GSFC – Code 592

Mentored By: Geraldine Robbins and Becky Derro

Science Mission Directorate (SMD)

The NASA Goddard Engineering and Technology Directorate (ETD) Technical Development and Training Programs are rigorously evaluated using surveys collecting both open-ended comments and Likert-type responses. This collected data prompted a preliminary investigation of appropriate statistical analysis methods that could respond to the limited flexibility of ordinal data. We believe the collected data generally meet the assumptions for the Goodman-Kruskal Test of Association and the Kruskal-Wallis H Test for the Differences in Medians. Due to the preliminary nature of this work, notional data are used for presentation and no results will be reported. However, this work warrants further examination.

Technical Development Program Web Developer

Jie Li | OSTEM Intern | GSFC – Code 592

Mentored By: Rebecca Derro

Science Mission Directorate (SMD)

I am building and designing a website that for SEED engineers that NASA to keep track of their history and progress. The website was based on an excel sheet that was used to do the same thing in the past. The website make everything easier to use and add really nice visual for the users. These include graphs, tables, and being able to easily view details on yourself and over participants.

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Connecting Earth Science Data with Usage - Virtual

Vanessa Chatman, Andrew Cramer | OSTEM Interns | GSFC – Code 580 – SPEID

Mentored By: Christopher Lynnes

Science Mission Directorate (SMD)

Developing a machine learning pipeline to automatic the classification of research article topics, where topics are geophysical descriptors. The resulting classified documents will be added to the Usage-Based Discovery graph database, along with corresponding NASA Earth Science datasets, with the intent of linking the NASA data product with uses of it that can be searched by topic. The project will aid in the following goals (1) creating a wider representation of how and how much NASA Earth Science data products are used, (2) identifying when NASA data products have been used even when they are not clearly cited, and (3) providing the UBD search tool end-user with set of recommended datasets based on a given topic query.

Development of Lunar Navigation Pipeline with TRN and Lidar Altimetry

Chris Gnam | OSTEM Intern | GSFC – Code 5950

Mentored By: Carolina Restrepo, Andrew Liounis

Space Technology Mission Directorate (STMD)

This project aimed to develop a pipeline for evaluating the quality of Lunar Digital Elevation Maps (DEMs) for use in lunar landing terrain relative navigation (TRN). This was done through both direct comparison whereby the maps were rendered and then compared to images taken by the Lunar Reconnaissance Orbiter’s Narrow Angle Camera (NAC), as well as indirectly by simulating a full navigation scenario and looking at the overall navigation performance. A variety of tools were used including FreeSpace for rendering images for the simulated case, Monte for orbit determination, and the Goddard Image Analysis and Navigation Tool (GIANT) for template matching as part of TRN. A new pushbroom model was also implemented into GIANT allowing for the direct comparison to NAC images.

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GPU-accelerated Ray Tracing for GIANT Relative Navigation

Andrei Shpilenok | OSTEM Intern | GSFC – Code 595

Mentored By: Andrew Liounis & Kenneth Getzandanner

Space Technology Mission Directorate (STMD)

Hardware accelerated ray tracing was developed for games and animation, but it can be used by NASA to greatly speed up certain relative navigation techniques. By moving from a CPU-based approach to one on the GPU via Vulkan, this project speeds up the Goddard Image Analysis and Navigation Tool's relative navigation speeds by over 40x.

cFS Cryptography Library

Aman Thanvi | OSTEM Intern | GSFC – Code 500

Mentored By: John Lucas

Space Technology Mission Directorate (STMD)

This effort provides a software-only solution using the latest CCSDS Space Data Link Security Protocol - Extended Procedures (SDLS-EP) to secure communications between a spacecraft running the core Flight System (cFS) and a ground station. I am learning about an existing Small Satellites mission, it's architecture, and the cryptography standards before integrating the Cryptography Library. This effort leverages the NASA Operational Simulator for Small Satellites (NOS3) virtual environment.

Formation Control of SmallSat Constellations

Matthew Zaffram | OSTEM Intern | GSFC – WFF – Code 598

Mentored By: Pavel Galchenko

Space Technology Mission Directorate (STMD)

This project expanded 42 simulation framework to enable the study of formation control and methods for orbit visualization, selection, and analysis for SmallSat formation flying missions in a multi-body regime by creating a common set of computational tools for use by scientists and engineers. These methods and tools will facilitate the mission design process, allowing for advanced mission concept planning and evaluation, helping to identify propellant efficient formations and control strategies for both attitude and translational dynamics, thereby enabling future formation missions such as constellations, starshades, and servicing. Additionally, the added capabilities were tested to gauge performance and validate results, then demonstrated in context of the mission architecture for Virtual Telescope X-Ray Observatory (VTXO).

STOCS

Scott Russell | OSTEM Intern | GSFC – Code 542- NCSCP

Mentored By: Sandra Irish

Space Technology Mission Directorate (STMD)

I am creating a new STOCS program in Excel to be used instead of the older Fortran program. I am making this program easier to use than the old program, and I am adding more versatility by including deformations of extruding structures of a main body. I am also creating an easy to read manual that will teach how to use the program. I am learning Femap and NASTRAN in order to check that the calculations in my program give the correct results.

8/13 3pm-4pmEST / 2pm-3pmCST / 12pm-1pmPST

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OSAM-1 Robot Ground System Support

William Xie | OSTEM Intern | GSFC – Code 583

Mentored By: Vuong Ly

Space Technology Mission Directorate (STMD)

I extended functionality for rdt-graphs, a data aggregation and visualization tool I developed last year, for the OSAM-1 mission. Then I incorporated AprilTags, a QR-code-like system of fiducial markers into the OSAM-1 Algorithm Development Platform (ADP) as a proof of concept for future NExIS missions.

THz Technology Development

Julia Polster | OSTEM Intern | GSFC – Code 5550

Mentored By: Berhanu Bulcha

Space Technology Mission Directorate (STMD)

This project revolves around investigating the components and design of a THz absorber. Primarily, the project is focused on researching materials and polymers that could serve as the substrate in an absorber, and that would meet the necessary electric and mechanical properties. A key property being kept in mind is that of a material having a high loss tangent, so as to better have the THz waves attenuate. As there are seemingly limited options within the existing materials, also being investigated is the possibility of a new polymer that better suits the project being created. Furthermore, work is being done to incorporate the new material or polymer into a design for an absorber.

August 13 - Room B

8/13 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Primary Production for Genetic Programming

James Giltner, Adrian Jimenez | OSTEM Interns | GSFC – WFF – Code 610

Mentored By: John Moisan

Science Mission Directorate (SMD)

This project works on collecting data sets from ocean scientists from around the world and putting them together in a file that NASA will eventually use to create a model to predict the rate at which algae can grow using only observations made from satellites. John Moisan's interns work to retrieve these data from different scientists or laboratories from different nations around the world. We work on creating a data file that will be used to train a computer program to predict how fast algae in the ocean grow. Our efforts include using Python and Pandas to create a text file with the different observations from various field studies. We also create README summaries of the measurements for the global ocean, such as mean values for different months and oceans. We assist in collecting and creation of a data set that will be applied to a Genetic Programming effort to develop and test a satellite-based algorithm for ocean net primary production.

Automated Classification of GES DISC User Support Tickets (ACOUSTICS)

Samuel Smith | OSTEM Intern | GSFC – Code 600

Mentored By: Jennifer Wei

Science Mission Directorate (SMD)

The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) is a leading data center that provides earth science data, information, and services to users all around the world. In order to further improve the GES DISC data services, user data and service analytics have been collected over the past year. In this project, we are analyzing user support tickets through GES DISC's tracking tool system. In particular, we experiment with machine learning and natural language processing practices to classify a ticket as one of four categories: findability, accessibility, interoperability, or reusability (i.e., F.A.I.R). This entails pre-processing the textual data, extracting features, and evaluating classification algorithms. The goal of this work is to use this model to classify historical tickets to gain a broader understanding of the GES DISC user needs.

JWST Commissioning & Keck 3-micron Dust Emission Studies

Arianna Dwomoh | OSTEM Intern | GSFC – Code 665

Mentored By: Erin C. Smith

Science Mission Directorate (SMD)

This project focuses on both James Webb Space Telescope commissioning and 3-micron dust emissions. I worked to supplement analysis tools that will be used to check out and measure the performance of the James Webb Space Telescope on orbit, allowing it to properly complement and extend the discoveries of the Hubble Space Telescope. In addition to the commissioning work, I looked at organic dust around evolved stars. I investigated spectral variation of Polycyclic Aromatic Hydrocarbons within the planetary nebula NGC 7027. I was able to do so by fitting the PAH features with a gaussian and measuring their equivalent widths.

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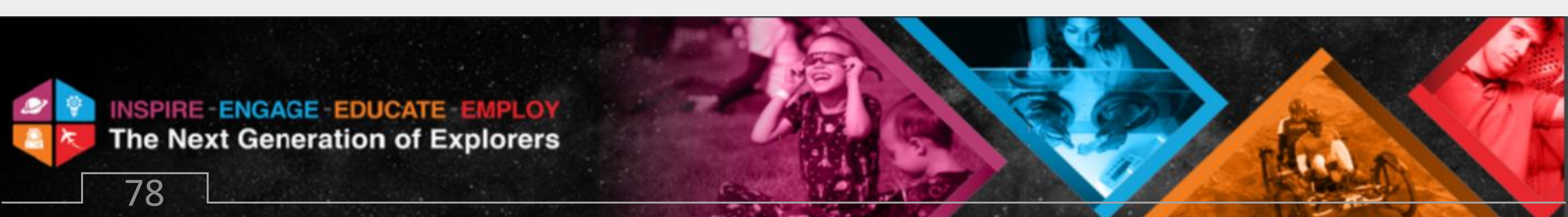

K-Type Star EUV Spectra in a Nutshell

Lori Huseby | OSTEM Intern | GSFC – Code 667

Mentored By: Sarah Peacock, Kenneth Carpenter

Science Mission Directorate (SMD)

Stellar Extreme Ultraviolet (EUV) radiation can influence crucial factors for habitability for K dwarf systems, such as atmospheric escape and water loss on close-in exoplanets. This range is currently unobservable due to interstellar contamination and a lack of operational instruments, so modeling EUV spectra becomes lucrative. Using the PHOENIX atmospheric code, and current Hubble Space Telescope Far and Near Ultraviolet data as guidance, K-type star EUV spectra were modeled. We generated grids of spectra based on the characteristics of K0-K9 stars, which revealed that individualized grids for each spectral subtype will need to be computed, rather than one generalized grid for all K dwarfs. These models will be added to a future database, accessible to the community and searchable using Galaxy Evolution Explorer (GALEX) data. The synthetic spectra can be utilized for studies of star-planet interactions and aid in the identification of potentially habitable planets in K dwarf systems.

Instrument Simulations for Next-Generation Gamma-Ray Telescopes

Rhea Senthil Kumar | OSTEM Intern | GSFC – Code 661

Mentored By: Carolyn Kierans, Henrike Fleischhack

Science Mission Directorate (SMD)

The All-Sky Medium Energy Gamma-ray Observatory (AMEGO-X) is a proposed gamma-ray telescope with an expected sensitivity 10 to 100 times better than current instruments in the same regime. A precise reconstruction algorithm is needed to trace the path that photons and particles take through the instrument and obtain a higher sensitivity. This project focuses on testing the performance of Kalman filter reconstruction in the tracker and fitting the spatial distribution of energy deposits in the calorimeter layers of the instrument. By fitting the distribution of energy deposits, the loss of energy throughout the telescope can be modelled and corrected for. High-energy simulations were performed to improve the Kalman filter's energy spectrum reconstruction and determine the energy resolution for AMEGO-X. The following presentation will discuss in detail Kalman filters, energy fitting, and the results obtained from this study.

Machine learning for the classification of X-ray binary stars in the optical

Adam Friedman | OSTEM Intern | GSFC – Code 660

Mentored By: Brian Powell

Science Mission Directorate (SMD)

The project utilizes NCCS GPUs remotely in order to create recurrence plots of TESS light curves in the optical and pick out promising X-ray binary candidates. Using recurrence plots allowed for the data to be presented to a neural net in a way that highlighted general-patterns over specific details. I then examined known X-ray binary optical light curves for reference and categorized TESS optical light curves into one of two categories: X-ray binary or not X-ray binary. Through rigorous accumulation of training examples, I was able to use a neural net that examined recurrence plots of TESS light curves and picked out promising candidates for new X-ray binaries. These candidates not only resemble known X-ray binary optical light curves but also have some significant source of X-ray light within a few arc-seconds of the target.

Measuring the Milky Way with Bayesian Inference Using Simulated LISA Data

Kelvin Shi | OSTEM Intern | GSFC – Code 663

Mentored By: James I. Thorpe

Science Mission Directorate (SMD)

This project is a continuation of a previous project that focused on measuring the Milky Way from simulated LISA data using simpler methods. LISA is a gravitational wave detector planned for launch in 2034 that would be able to observe ultra-compact binaries in the galaxy. In order to expand on the research, we used an MCMC ensemble sampler to fit a model to the data. By comparing the MCMC outputs from the original key file data and the LISA detection data we can determine how well LISA will be able to measure the shape and size of the Milky Way.

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LISA Multi-Source Bayesian Inference

Kevin Liu | OSTEM Intern | GSFC – Code 663

Mentored By: John Baker

Science Mission Directorate (SMD)

This project focuses on the improvement of existing gravitational wave (GW) analysis tools for the Laser Interferometer Space Antenna (LISA), a future space-based GW detector. These tools are designed to characterize massive black hole binary (MBHB) and galactic binary (GB) sources from GW data via Markov chain Monte Carlo (MCMC) methods for Bayesian inference. We tested the MBHB and GB codes on simulated LISA data to optimize their performance and compatibility, providing user feedback as well. Our testing contributes to the interoperability of the two codes, aiding efforts towards a "global fit" model that employs multi-source analysis of GW data.

Relative Navigation for the Cal X-1 Formation-Flying Mission

Shane Lowe | OSTEM Intern | GSFC – Code 6620

Mentored By: Maxim Markevitch

Science Mission Directorate (SMD)

Despite advances in ground calibration, cross-comparison of current X-ray observatories reveals systematic discrepancies of more than 10%. The Cal X-1 mission will address these discrepancies by establishing an in-orbit X-ray flux standard. This will be achieved using a pair of SmallSat-sized spacecraft flying in formation, one hosting an absolutely calibrated X-ray source and the other hosting a simple X-ray telescope. The distributed architecture of Cal X-1 imposes strict requirements on relative navigation, which is the focus of my project. Specifically, I will discuss the development of an error budget for relative navigation and pointing, and the design and performance of a suitable relative navigation system.

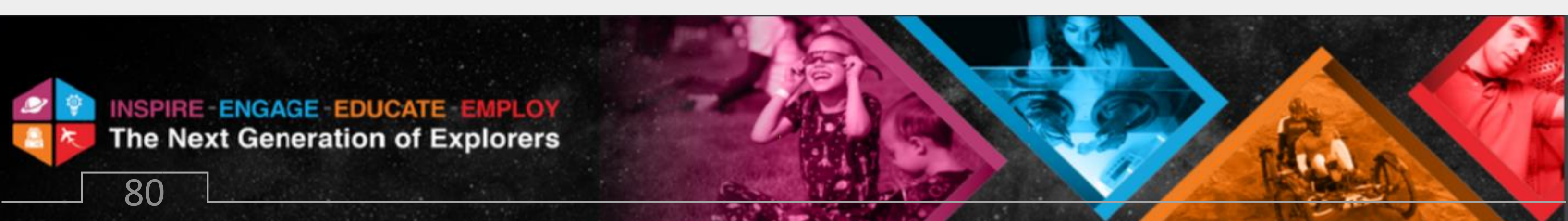
Fermi LAT Gamma-Ray Analysis of the Blazar 1ES 1215+303

Jordan Forman | OSTEM Intern | GSFC – Code 660 – SPEID

Mentored By: Dr. Rita Sambruna, Dr. Janeth Valverde

Science Mission Directorate (SMD)

In this project, a gamma-ray analysis of the Blazar 1ES 1215+303 was performed utilizing data sourced from the Fermi Large Area Telescope (LAT). The data spans over six months from January 1st, 2021 to July 1st, 2021. The analysis was performed using the "Fermi Science Tools" and the results of this analysis show that there has been a recent decrease in the flux of this source. Blazars are a particular subcategory of Active Galactic Nuclei (AGN), which play a key role in our understanding of the high-energy universe. AGN produce jets of high energy particles and radiation across all wavelengths, and can potentially reveal crucial information about the galactic evolution of its host galaxy. The nature and origins of these jets are still under strong research. This project aims to investigate the recently recorded data of 1ES 1215+303 and the possible implications of its analysis results.



Stratospheric Ballooning for Astrophysics

Nicholas Schneider | OSTEM Intern | GSFC – Code 665

Mentored By: Alan Kogut

Science Mission Directorate (SMD)

Stratospheric balloons that rise above our atmosphere to the edge of space are excellent methods of observing our galaxy and the universe. However, strong winds at high altitudes during balloon climbout and variations in stratospheric winds can push balloons over densely populated areas. As this prevents a safety risk, the stratospheric balloon project worked to improve the current prediction methods that are used by the balloon teams to give go/no-go decisions on launch day. The developed method analyzed prior flight deviations from their predicted trajectories and factored this into a gaussian weighting system which used population density mapping of the region to better predict the total population overflown by the balloon.

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Space-based Gravitational Wave Science and Analysis

Raphael Rose | OSTEM Intern | GSFC – Code 660

Mentored By: Ira Thorpe

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Modeling Earth Albedo Contribution to Course Sun Sensors in a Low Earth Orbit

Emily Ballantyne | OSTEM Intern | GSFC – Code 591

Mentored By: Paul Mason

Science Mission Directorate

Course Sun Sensors (CSS) are used in many spacecraft in order to determine sun direction for accurate pointing of solar panels, thrusters, sensors, and more. However, sunlight reflected from Earth's atmosphere and surface (the Earth albedo) can interfere with the sun vector determined by the CSSs onboard. This project utilizes the data from the Earth Probe Total Ozone Mapping Spectrometer (EP/TOMS) in order to model this interference within the 42 spacecraft simulation software and determine the total contribution from the Earth albedo. This information will be useful for early orbit attitude determination of the Roman Space Telescope (RST) and is also of general interest for all spacecraft; particularly those in a low earth orbit (LEO).

Wiki Content for 591 Projects

Asia Gray | OSTEM Intern | GSFC – Code 591 - NCSCP

Mentored By: Paul Mason

Space Technology Mission Directorate (STMD), Aeronautics Research (AERO)

This project entails developing TEAMS wiki content for the projects conducted under the Code 591: Attitude Control Systems Branch. First, an in-depth understanding of the focus and objectives of the general scope of the branch is required. An overview of attitude control systems and guidance, navigation, and control systems is made to cover the main principles of the branch. Then, an organized and sequential table of contents is constructed to organize the research and information. Next, a description and synthesis of the tools used (analysis, simulations, and jitter) are incorporated into the wiki. Finally, the design practices are reviewed and explained. This wiki is designed for internal as well as external consumption.

OSAM-1

Daniel Fabres | OSTEM Intern | GSFC – Code 483
Mentored By: Paul Mason
Science Mission Directorate (SMD)
8/13/2021 11:00:00 AM CST | Link

OSAM-1 (short for On-orbit Servicing, Assembly and Manufacturing 1) is a robotic spacecraft that has the tools necessary to service satellites and extend their lifespans even if they were not designed to be serviced on orbit. OSAM-1 will use a robotic arm to attach itself to a satellite and use tools to access the satellites fuel tank and refuel it. I am working of scripts to assist in the testing of the gripper tool used on the robot arm to make simulations using Adams (A multibody dynamics simulation tool) easier by highlighting when speeds surpass a specific threshold.

Multi-Body 3D Models for Dynamics Validation in Smallsat Missions

Romana Hladky | OSTEM Intern | GSFC – Code 591
Mentored By: Naeem Ahmad, Paul Mason
Space Technology Mission Directorate (STMD)

The Attitude Control Systems Engineering branch uses a program called 42 to simulate attitude and orbital dynamics of spacecraft prior to their launch. This project's goal was to create multi-body models for five current CubeSat missions. Single body models, though more time efficient, are less accurate than multi-body models due to the loss of variability found in the joints of a multi-body model. A multi-body model can fully simulate the movements of the spacecraft such as solar array or boom deployment, which drastically change the moment of inertia of the spacecraft and thus yield more accurate results and allow for superior dynamics validation. These models were created in both Meshlab and Wings 3D with specifications provided by the Mechanical teams. Body orientation and joint information were then compiled as an input file for 42 to prepare for testing and use.

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PACE Controller and Trajectory Design

Ryan Kinzie | OSTEM Intern | GSFC – Code 5910
Mentored By: Dr. Huaizu You (Mentor), and Dr. Joseph Galante (Co-Mentor)
Science Mission Directorate (SMD)

The goal of this project is to design a controller and/or trajectory for the PACE satellite and prove that the designed controller and/or trajectory are able to meet the specified stability margins for the mission. Simulations of the controller and/or trajectory will be performed in simple and high-fidelity models of the PACE satellite in MATLAB/Simulink. The simplified models include a linear single axis model of the satellite as well as a nonlinear three degree-of-freedom rigid body model of the satellite with reaction wheel dynamics. Additionally, the single axis linear model includes the flexible modes of PACE along with sensor and reaction wheel dynamics.

OSAM-1 Bagging Design

Bryce Stephens | OSTEM Intern | GSFC – Code 500 – SPEID - NCSCP

Mentored By: Vincent Holmes

Science Mission Directorate (SMD)

The primary objective of this project is to develop a plan describing how the OSAM-1 spacecraft will be bagged to prevent contamination throughout testing at Goddard. A deliverable is a storyboard that includes a flow chart describing each step of the integration & testing cycle and when a change in the bagging is required for the spacecraft. The story board will include photos of different mechanical ground support equipment used in testing, testing facilities, and CAD models of the spacecraft in different bagging configurations. The CAD models of the different bagging configurations are to be modeled in Creo 7, and provide a baseline for the assembly of the configurations.

OSAM-1 MGSE Design Support

Marcus Gilmore | OSTEM Intern | GSFC – Code 543 – SPEID

Mentored By: Vincent Holmes

Science Mission Directorate

This project involved creating a story board to illustrate the process that the OSAM-1 space vehicle will go through in order to complete the Mass Properties test. I will also be designing an adapter plate to interface between the space vehicle and the test equipment.

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Radiometer Calibration using Convolutional Neural Networks

John Bradburn | OSTEM Intern | GSFC – Code 5550

Mentored By: Paul Racette

Science Technology Mission Directorate

Microwave radiometry relies on frequent recalibration of the instrument, whether performed in real time or post-processing. This calibration involves the retrieval of the radiometer gain and offset, typically by performing a linear regression using two or more known calibration reference temperatures and measured voltage counts, which are then used to obtain an estimate of the antenna temperature. This project seeks to improve upon this method by using a Convolutional Neural Network (CNN) to directly obtain an estimate of the antenna temperature using the radiometer parameters and calibration measurements as inputs. A radiometer model has been created and is used to generate synthetic radiometer data for CNN model training and validation. A second CNN model is also trained to retrieve the radiometer gain and offset to estimate the antenna temperature. Both CNN models are evaluated and compared to the linear regression model.

PACE RWA Test Data Processing

Bradly Rivera Muñiz | OSTEM Intern | GSFC – Code 596

Mentored By: Carlos Durán Aviles

Science Mission Directorate (SMD)

This project consists of a major revision and upgrade to the Reaction Wheel Assembly (RWA) data processing toolkit. The RWA is part of the Guidance Navigation and Control (GNC) system for the Plankton, Aerosol, Cloud, ocean Ecosystem mission (PACE), a mission to extend and improve NASA's 20-year plus record of satellite observations of global ocean biology, aerosols, and clouds. The upgrades include a module for multivariable plotting, a statistics suite, a multi-wheel data co-relation algorithm, and a reaction wheel electronics board diagnostics tool. The upgrades incorporated in this revision are instrumental for performance and functional requirements verification.

Mathematical Modeling Highly Absorptive Material for Use in Infrared Range

Kevan Kazeminezhad | OSTEM Intern | GSFC – Code 550- NCSCP

Mentored By: Ron Shiri

Optimizing Black-Silicon Model for Broadband Infrared Range and Optimizing Vision System Placement for Mars Sample Return (MSR) Earth Return Module (ERM) Heat Shield

Kevin Griffin | OSTEM Intern | GSFC – Code 551

Mentored By: Ron Shiri

Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

8/13/2021 2:00:00 PM EST | Link

The instruments of the future space-based telescope missions require highly absorbent material that can be scaled from UV to IR and submillimeter light ranges. A new breed of metamaterial has been discovered that will push the envelope on light absorption. We are working to scale Black Silicon (BSi) to be super absorbent for a large bandwidth ranging from UV to submillimeter light waves. This project continues the optimization of a Black Silicon (BSi) model in the COMSOL multiphysics software, which was started in the Spring 2021 semester. Working with experts in the field, the intern is continuing to produce more accurate COMSOL data. Once the data from the COMSOL model matches lab measured data, the COMSOL model is verified and geometry optimization can occur. Along side this project, the intern has also been working with the Mars Sample Return (MSR) team to optimize vision system placement on the Earth Return Module (ERM). Utilizing Solidworks, a vision cone and heat shield assembly model was created to assist with optimization. The system constraints are as follows: 100% surface coverage, 2px/mm minimum resolution, and with as few cameras as possible. The placement solution was then moved on to a vision team for further analysis.

August 16, 2021

August 16 – Room A

8/16 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Mining the Nancy Grace Roman Space Telescope

Bryan Felix | OSTEM Intern | GSFC – Code 600

Mentored By: Bernard Rauscher

Science Mission Directorate (SMD)

The Nancy Grace Roman Space Telescope Project (“Roman”) has produced a wealth of data coming from infrared instruments. These datasets are highly dimensional and contain as many as 16 million unique data points. Thus, it is hard to analyze and integrate all the information in a comprehensive way. The purpose of this project is to mine the dataset using machine learning and other techniques to first, identify the datapoints that can be understood empirically; second, identify outliers and classify their behavior; and third, with complementary information on the telescope instruments, identify parameters that minimize a measure of accuracy.

Study of AI & Machine Learning in Ocean Coast Applications

Cesar Rojas | OSTEM Intern | GSFC – Code 600

Mentored By: Batuhan Osmanoglu, Rustem Albayrak

Science Mission Directorate (SMD)

Review and survey Machine Learning in Ocean Coast applications. First, I will then proceed to collect data sets for modeling from public remote sensing data and in-situ sensor data outlets. Second, I will prepare gathered data, perform statistical modeling analysis, and train a model for event prediction. Third, I will calibrate the model to improve accuracy and apply it to solve a problem. For example, I can create a chlorophyll map, plot directional flow speed, and classify algae.

Machine Learning Analysis of EMRI Waveforms

Courtney McIntosh | OSTEM Intern | GSFC – Code 663

Mentored By: Jeremy Schnittman

Science Mission Directorate (SMD)

The ultimate goal of this project is to develop Machine Learning algorithms that can analyze data from the planned LISA mission and similar endeavors in order to identify Extreme Mass Ratio Inspirals and determine essential parameters of their existence, such as mass, spin, and angular momentum. The current push for this project is to generate accurate simulations of these EMRIs for a wide bank of test data.

Development of Detector Qualification Assessment Plan

Eduardo Medina OSTEM Intern | GSFC – Code 600

Mentored By: Dr. Angela Hodge and Guan Yang

Science Mission Directorate (SMD)

Create a qualifications assessment plan for a microchannel plate photomultiplier (MCP-PMT) that will be deployed for the Marconi-2 quantum communication demonstration. The goal of the project is to make sure the MCP-PMT is adequate to operate at optimal conditions after being sent to low space orbit. This is mainly done through networking and literature survey.

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Optical Variability of Green Pea Galaxies

Julissa Sarmiento | OSTEM Intern | GSFC – Code 660

Mentored By: Dr. Sangeeta Malhotra, Dr. James Rhoads

Science Mission Directorate (SMD)

Green Pea galaxies are compact galaxies found at low redshift. They are Lyman-alpha emitting galaxies with low metallicity and high star formation rates, and have been shown to be good analogs to high-redshift galaxies. Green Peas were first identified through the citizen scientist program, Galaxy Zoo, where their appearance earned them the name "green peas." Our aim with this project is to determine if a sample of Green Peas exhibit any flux variations in optical light that can be attributed to active galactic nuclei (AGN), or massive black holes. We use archival data from the Transiting Exoplanet Survey Satellite (TESS). Of our sample of about 1000 Green Peas, 220 have data from TESS and no confounding bright neighbors. We are studying the light curves to determine how many of them show variability. This method can find very low mass black holes in these dwarf galaxies quite robustly.

Net Carbon Exchange Estimator Utilizing Historical Data

Kyle Johnson | OSTEM Intern | GSFC – Code 614
Mentored By: Joanna Joiner
Science Mission Directorate (SMD)

I am working to estimate the net carbon exchange of ecosystems. Continuing the previous work, which applied simple machine learning algorithms to the easier problem of gross uptake of carbon by plants, we are working to give modelers an estimate of the net exchange – how much carbon is then given back to the atmosphere through plant and soil respiration. To accurately estimate this value, we consider how much carbon was taken up previously, not just how much is being taken up currently. This requires taking present satellite data as inputs, but also past satellite data and the same for meteorological data. To expand on the current, simple neural network, we incorporate memory effects by implementing the Long Short-Term Memory (LSTM) network algorithm.

Analysis of Air Quality Episodes using Multi-Instrument Datasets

Maurice Roots | OSTEM Intern | GSFC – Code 6140
Mentored By: John Sullivan
Science Mission Directorate (SMD)

This work is motivated by a need for analysis of air quality episodes in the U.S. Mid-Atlantic region using high resolution observations of ozone and its precursors. Previous studies highlight that high level of pollution over the Chesapeake Bay can potentially recirculate back over land and significantly affect surface air, and thus human health. We have performed an investigation of a recent air quality event (May 19 – 21, 2021) with the analysis of datasets across multiple platforms (such as TOLNet/Ozone Lidar, Pandora, ceilometers, wind profilers, and in-situ samplers) to further the understanding of water-land pollution dynamics and meet the current needs of NASA's decadal survey and the future TEMPO mission.

Calculating ionization of intergalactic gas from cosmological simulations

Nicole Taylor | OSTEM Intern | GSFC – Code 665
Mentored By: Dr. James Rhoads
Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

Understanding galaxy formation through the use of galaxy simulation(s) and developing contour plots, from pre-existing 2D ionization calculations. Furthermore, developing python code to perform three dimensional ionization calculations to determine the ionization calculations for a full suite of lightcone simulated results; and modeling those calculations as either longer or shorter ionization calculations relative to the modeling of the bubbles to a range of redshift and cosmic time.

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Modelling Tidally-Induced Seismicity for Planet-Moon Systems

Ethan Lopes | OSTEM Intern | GSFC – Code 698
Mentored By: Terry Hurford
Science Mission Directorate (SMD)

Planetary interiors are best understood through seismic analysis. However, before placing seismic instruments on other terrestrial bodies, it is necessary to predict both the magnitude of possible seismic events and how often they can occur. Since the energy dissipation for tidally-active planetary systems is likely directly related to their seismic activity, it is imperative to the advancement of space exploration to first better understand the link between tidal dissipation and seismic activity. Here, we investigate the production of seismic energy within tidally-active bodies through creating a stochastically comprehensive model and using Apollo lunar data to constrain the model's parameters. This project builds upon the research of Hurford et al. (2020).

Interplanetary Shocks: Energized particles in action

Wyatt Broscious | OSTEM Intern | GSFC – Code 670

Mentored By: Georgia De Nolfo

Science Mission Directorate (SMD)

I will be analyzing cdaweb data to conclude if solar shocks energize electrons. A solar shock occurs when the sun lets out a large amount of matter after fusion into the cosmic background which then pushes already occurring radiation out of the way, but since the solar wind is moving faster than the radiation, it is pushed up against the wave like a snowmobile. this ends up creating a solar shock. I will be showing this by presenting data which indicates what it looks like when a solar shock occurs and then using that data to analyze trends and conclude if electrons are energized by solar wind aka interplanetary shocks.

GMSEC Requirements Migration

Hugo Favila | OSTEM Intern | GSFC – Code 583

Mentored By: John Bugenhagen

Center Operations

The main project involved automating requirements analysis for the Goddard Mission Services Evolution Center (GMSEC) development team. GMSEC provides a suite of software components for a scalable and extensible framework for ground mission operations. The framework works by standardizing messages and formats in a subscribe/publish communication interface between middleware products. GMSEC's software components are developed and updated in the GitLab and Jira tracking environment. However, changes to software requirements are handled by the System Engineer team using MagicDraw modeling tools, where intermediate steps exist that slow the requirements process and do not make the process readily visible to other GMSEC software developers. To eliminate these steps, requirements for each software component were reformatted and migrated into GitLab via AsciiDoc tables and description lists. This will allow for a more robust and open automated process to analyze and change software requirements for the various GMSEC teams.

August 17, 2021

August 17 – Room A

8/17 12pm-1pmEST / 11am-12pmCST / 9am-8amPST

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Occupational Health/Industrial Hygiene Systems and Webpage Development

Julia Olores | OSTEM Intern | GSFC – Code 360

Mentored By: Jeffrey Dalhoff and Lisa Cutler

Center Operations

Within the Safety and Mission Assurance (SMA) Directorate, the Safety Division strives to ensure Goddard Space Flight Center's operations are managed safely in compliance with regulations and NASA requirements to protect its people and assets. In fulfilling these aims, there was a recognized need for a Safety Division website that provides relevant and timely information on an array of safety programs, policies, and procedures. This project involved producing a website that will serve as a Center resource, informing Goddard's organizations on institutional and systems safety matters. In developing this website, meetings were held with SMA employees to determine website style and usability in order to make content delivery efficient, while maintaining a clean and engaging design. Gaining insight on the Safety Division's objectives and developing skills in User Experience/User Interface (UX/UI) Design were essential to this project.

Risk Based Assessment of Test Coverage: A Model for Verification Process

Rufino A. Perea | OSTEM Intern | GSFC – Code 300

Mentored By: Bhanu Sood

Certain types of failures in flight hardware can impact mission deliverables, prompting Project personnel to seek higher confidence level of defect detection during I&T activities. Current environmental verification simulate stress conditions hardware will be subjected to in space, yet in the design process, the selection of test methods is unknown from uncertainties of how many defects a test plan will cover/detect. This work develops a framework to assess verification test plans identified in GSFC-STD-7000A, producing Under-Covered Defects, Not-Covered Defects, Defect Coverage, and Defect-Type-Coverage metrics outputting the efficacy of test plans to improve test selection from known failure modes. There remains a need to evaluate the effectiveness of different test sequences to provide a uniform means of comparing testing sequences utilized by different Projects/Programs. Benefits of framework implementation include, analysis of test methods before actual simulations/tests, yielding higher CL during integration producing a reduction of test-cycles while ensuring coverage of key defects.

Supply Chain Data Management and Data Analysis

Bryana Beckford | OSTEM Intern | GSFC – Code 3820

Mentored By: William Conn

Center Operations

Developing supplier risk quantification methods and tiered visibility map in the Meta Information System Application, assisting in populating services for supply chain website, and developing internal and external surveys for supplier research analysis.

Rotation Strategy Optimization for Quasi-Static CT Imaging

Tyler Leibengood | OSTEM Intern | GSFC – Code 541

Mentored By: Justin Jones

Space Technology Mission Directorate (STMD)

This project involved developing a program to determine the optimal rotation strategy for a concept multi-source computed tomography (CT) prototype (first pioneered by GSFC colleagues Dr. Keith Gendreau et al as "static CT"). This concept leverages recent technology developments in miniature x-ray sources, enabling the use of multiple sources in one CT system, requiring far fewer steps than conventional, single-source CT. Groups of several x-ray sources are clustered into modules which are equally spaced in a ring, with gaps between modules. Here we introduce a "quasi-static" version in which limited rotation is used to increase fidelity of the scan. A generalized solution was developed to determine the rotation step increment necessary to ensure equally spaced projections while imaging, using geometric design parameters as inputs. These derived angles can then be used to program a rotation stage and to inform the CT reconstruction algorithm of the exact perspectives each image was taken from.

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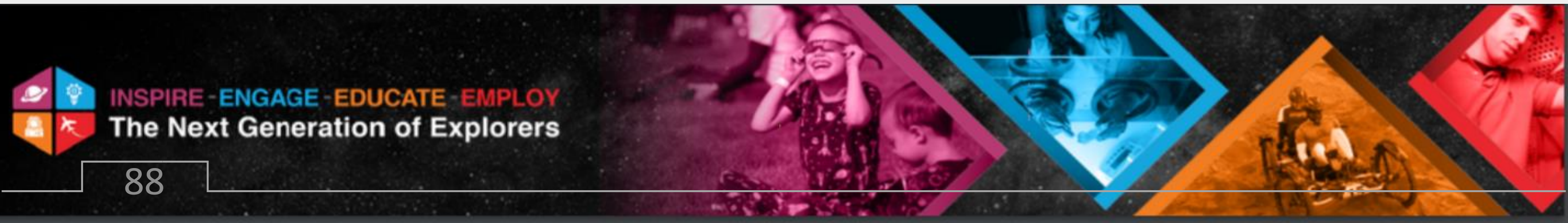

Modular Reconfigurable Testbed Rover for Space Applications

Michael Klooster, Joshua Martin, Wilbert Ruperto-Hernandez | OSTEM Interns | GSFC – Code 544
Mentored By: Umeshkumar Patel, Jacob Rosenthal
Space Technology Mission Directorate (STMD)

This project develops software and hardware design for a modular rover that can be quickly and easily reconfigured as a testbed for a variety of planetary rover and mobile sampling systems. Over the course of this project, a modular software architecture using the Robot Operating System has been designed and implemented in both simulation and an off-the-shelf rover kit. The software architecture is robot-agnostic and descriptions of new robot architectures can be added quickly to test a variety of rover designs. Simultaneously, a novel method of passive suspension has been developed to improve upon conventional rocker and rocker-bogie systems. The new suspension systems enables wheels to remain in constant contact with the ground by adjusting camber angle upon contact with obstacles.

Development of Verification Methodology for Fixed-Point Digital Controllers

Emma Sellers | OSTEM Intern | GSFC – Code 544
Mentored By: Umeshkumar D. Patel, Jacob A. Rosenthal
Science Mission Directorate (SMD)

This project aims to develop a novel verification methodology to aid in mitigating common errors that occur in the realization of digital controllers due to finite word length (FWL) effects. By employing a concrete understanding of quantization and FWL effects, such as, stability of the system, minimum phase of the system, limit cycles, arithmetic overflow, and FWL optimization, an app has been created that enables the reduction of FWL effects during the design phase of the controller. The app allows for rapid detection of design errors caused by finite word-length (FWL) format and permits the designer to quickly see the results of slight changes to the overall system which results in an improved design and safer fixed-point digital controller.

Mars Sample Return - CCRS

Marcos E. Ibarra | OSTEM Intern | GSFC – Code 544
Mentored By: Kevin Eisenhower
Science Mission Directorate (SMD)

Capture, Containment & Return System (CCRS) is one of the systems within the Mars Sample Return mission. The mission is to bring Mars samples back to earth in a safe and efficient manner. For this to be possible, a substantial amount of testing of the mechanisms needs to be done on Earth in "like zero-G" environments. One of these tests will be conducted in a near-frictionless air bearing table, which will simulate a 2D "like zero G" environment. I contributed to the development of this test through the creation of analytic 2D dynamic/kinetic simulations using a software called WM2D. Through the simulations, I can assist CCRS engineers in decisions they need to make for the air bearing tests, thus potentially saving NASA time and resources. Additionally, I assist CCRS engineers by drafting a hinge-based Linear Transfer Mechanism using Creo and modeling a path of motion for the system.

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Laser technology development for planetary applications

Deborah Barduniotis | OSTEM Intern | GSFC – Code 544
Mentored By: Anthony Yu, Michael Krainak
Science Mission Directorate (SMD), Space Technology Mission Directorate (STMD)

The goal of this project was to use numerical modeling to evaluate the performance of an instrument that is being designed for space and an instrument that is currently in orbit. For future planetary science missions, the Photonic Integrated Circuit TUned for Reconnaissance and Exploration (PICTURE) instrument is being developed. The instrument is a mid-infrared spectrometer designed to have high-resolution with small size, weight, and power (SWaP) requirements. This project was undertaken to see if Lumerical, a photonic simulation software, could demonstrate and verify the expected resolution of the PICTURE instrument. Currently in orbit, the Lunar Orbiter Laser Altimeter (LOLA) instrument began its mission in 2009 with the goal of precisely mapping the lunar surface. MATLAB was used in this project to analyze the performance of the LOLA instrument twelve years into its mission.

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Lab Quality Management System (LQMS) Hazard Sign

Justin Holt | OSTEM Intern | GSFC – Code 585

Mentored By: Malinda Hammond

Center Operations

This project integrates into the Lab Quality Management System (LQMS) the ability to auto-generate “hazard signs” for any lab in the system. These signs help to quickly and effectively ascertain which hazards a lab contains as well as vital emergency and safety information.

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Investigate the feasibility of using solar array concentrators on spacecraft solar arrays.

Jayson Chin | OSTEM Intern | GSFC – Code 5870

Mentored By: David Simpson

Space Technology Mission Directorate (STMD)

A solar array is a device with multiple solar cells connected. The solar array draws from the light provided by the sun and converts the light into electricity. If there was a way to boost the power received by the solar array, it would assist in making the satellite more efficient in completing tasks. To bring more energy to the solar array, two mirrors would be attached to the sides of the solar panel to concentrate all the light towards the center of the array for maximum power. The task that was assigned is to find what angle of theta is the best to get the light from the sun to the center of the array to see how much energy the ray will receive and if it could be implemented in future satellites.

Investigating Core Flight Software

Wilbur Dahn | OSTEM Intern | GSFC – Code 5870

Mentored By: David Simpson

Science Mission Directorate (SMD), Aeronautics Research (AERO), Center Operations

First, I installed the core flight software by resolving dependencies and wrote up an install tutorial. Now, I'm working on calculating when cube satellites will reenter the atmosphere. This requires programming, math, and reading TLE data to accomplish this. Essentially, my program will take the BSTAR data (which is a specialized value for air drag) and throw it all into an array. From there, it takes the BSTAR equation and solves for air density (using the mass and average cross section of the satellite which I calculated). Finally, it will take this air density and create an air density vs time graph. From this, and using orbital perturbation theory, I should be able to calculate when the satellite will reenter the atmosphere.

CBOR Decoding for Wireless Communication Demonstration of Hardware Accelerated cFS Disruption Tolerant Networking Bundle Protocol

Kenzie Milhous | OSTEM Intern | GSFC – Code 587

Mentored By: Jonathan Boblitt

Science Mission Directorate (SMD)

This project focuses on creating a core that takes in CBOR-encoded data per clock cycle and decodes this input data one byte at a time using a finite state machine to produce the complete set of output data in groups of 8 bytes. This core is written in VHDL and is synthesized, implemented, and initially simulated using Vivado. Validation and verification are performed by first creating a C script that generates random data and then comparing the expected output data to the actual output data using an in-depth testbench that is built and simulated using VUnit and ModelSim. This project assists in the development of the FPGA Accelerated Bundle Protocol 7 and only covers a subset of CBOR encoding major types.

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Visual Inertial SLAM Prototype Development and Stochastic Performance Modeling

Kalonji Harrington | OSTEM Intern | GSFC – Code 6910 – SPEID

Mentored By: Joseph Galante and Paul Mason

Space Technology Mission Directorate (STMD)

A particular challenge for autonomous vehicle operation is efficiently mapping out an area and tracking important features within it, a task known as Simultaneous Localization and Mapping (SLAM). One strategy performing SLAM is to design a visual-inertial system (VINS), which can be created with any fixed camera and inertial measurement unit. The purpose of this project is to develop a prototype of such a system and assess its performance by fitting it to a stochastic time series model. Recommendations are then made for future missions based on this analysis. As a secondary project, similar time series analysis techniques were applied to PACE star tracker and gyroscopic data in order to assess and improve the precision of its navigational instruments.

Orbital Debris General Catalog

Aurelia Moriyama-Gurish | OSTEM Intern | GSFC – Code 592

Mentored By: Ivonne Rodriguez

Space Technology Mission Directorate (STMD)

Orbital debris is becoming an increasing concern with over 18,000 tracked objects larger than 10 cm and many millions smaller untracked objects in Low-Earth Orbit (LEO), Medium Earth Orbit (MEO) and Geosynchronous Earth Orbit (GEO) environments. The purpose of this project is to create a graphical catalog of guidelines for generic spacecraft components, to aid missions in rapid determination of demise capabilities when the component is exposed to atmospheric reentry. The demise capabilities of these components are dependent upon several variables, including: the inclination of orbit, material of the component, largest cross-sectional area of the component, and the density of the component itself. Each of these variables are changed throughout the catalog in order to remain relevant to a variety of missions and the results are graphically represented.

Miniaturized instruments enabled by nanomaterials for space missions

Cody Larsen | OSTEM Intern | GSFC – Code 592
Mentored By: Mahmooda Sultana
Space Technology Mission Directorate (STMD)

This project conducts research and develops machine learning algorithms for the analysis and enhancement of gas, pressure, and temperature data from a miniaturized, lightweight instrument that is being developed for next generation space missions. Multiple machine learning models were developed to distinguish and differentiate between different factors that contribute to signal measurement of the instrument, and to predict future values and relationships between the values for enhancement of the level of detection capabilities of the instrument. The models were optimized and then compared and ranked to find which performed the best for several data sets. Work was also performed preprocessing the raw data in order to correct for drift and to find an optimal way to denoise the data.

Miniaturized Instruments Enabled by Nanomaterials for Space Missions

Burleigh Charlton| OSTEM Intern | GSFC – Code 590
Mentored By: Mahmooda Sultana
Space Technology Mission Directorate

"This presentation summarizes work on two projects: Multifunctional Senor Platform(MSP) and Quantum Dot Spectrometer(QDS). The quantum dot spectrometer is an attempt to miniaturize a spectrometer for use on spacecraft. This is achieved by using special filters known as quantum dots with explicit transmission curves to observe a spectrum and reconstruct it without the use of reflection gratings or mirrors. I will present my work on developing and streamlined a data processing pipeline to convert images of pixels into a transmission array as well as my mathematical work on reconstructing the original spectrum from an array of transmissions. This process is a meeting of machine learning, bayesian regression, and algebraic geometry. The MSP is an electronic nose in development for determining quantities of gas in an environment. This presentation will detail denoising and extracting data from our platform by implementing stochastic resonance to detect data below thresholding. Comparing various denoising methods, as well as the development process for a tailored information criterion to serve as a quantification of our fitting."

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Increasing Optical Cherenkov Model Fidelity for tau-induced EAS in the nuSpaceSim Simulation Package

Fred Angelo B. Garcia | OSTEM Intern | GSFC – Code 661
Mentored By: Dr. Tonia M Venters & Dr. John F Krizmanic
Science Mission Directorate (SMD)

nuSpaceSim is a simulation package designed to aid cosmic tau neutrino detection via atmospheric interactions. Extensive air showers (EAS) are particle cascades that induce optical Cherenkov and radio signals detectable by sub-orbital and other space-based observatories. This software simulates all aspects of neutrino detection-- from Earth propagation to EAS formation and detector response-- by physics library sampling. However, the current optical model uses generalizations about the EAS and the particle decay products of which they are induced. This project focuses on increasing the accuracy and fidelity of these showers by generating libraries of composite EAS, integrating them with current Cherenkov models. This aims to take into account the variability in the physical processes leading to the signal and, in turn, the variability in the signal itself. All of this is part of the effort to study the PeV regime in the context of Very-High Energy astroparticle physics and multi-messenger astrophysics.

Rendering 3D Models of Early Spacecraft

Avery Walters | OSTEM Intern | GSFC – Code 690

Mentored By: Dr. David Williams

Science Mission Directorate (SMD)

I'm using Blender to make a detailed 3D model of the 1981/1982 Soviet Venera 13/14 landers. The two landers are nearly identical and were sent one after the other. For my project, I've used historical records, diagrams, and photographs to reproduce the Venera landers in a digital environment so that we are able to capture better photos and share them as public domain.

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Mission Cloud Platform Hub

Mahdi Saeedi, John Cain, Terrel Credle | OSTEM Interns | GSFC – Code 730 – SPEID

Mentored By: Joseph Foster, Liz Harvey

Center Operations

Mission Cloud Platform Hub will serves as a tool for clients looking to deploy software to cloud. It will assist clients with cost estimations, and help them get familiar with services available through AWS. The project is a cloud native web application that is composed of a Frontend made using JavaScript, HTML, CSS being tied together using React, and Yarn (a modern project dependency management tool). The Backend is a Python web application being tied together using Flask framework. In the first version of this product the ability to visualize pricing data (using React, and D3), and processing raw data from AWS efficiently was focused on. The key elements when considering tools were speed of design process, expandability, and cloud native best practices. After considerable research we believe the presented Minimum Viable Product (MVP) represents a solid foundation to expand Mission Cloud Platform Hub from.

Investigation of Affected Population During a Near-Earth Object Impact as a Function of Impact Location and Probabilistic Damage Radius

Kyla Carte | OSTEM Intern | GSFC – Code 401

Mentored By: Ruthan Lewis, Brent Barbee (Alternate Mentor)

Science Mission Directorate (SMD)

For this planetary defense project, the focus is finding the total impacted population for every location on Earth as if it were the central location of an asteroid impact. A simulation is run for the project with the usage of Python programming, global population datasets, and a Badness Percentile chart with 4 rings of damage radii for percentiles 25, 50, 75, and 100. The 4 rings consist of rings unsurvivable, critical, severe, and serious in terms of damage and impact. This project enables there to be understanding of the levels of devastation there would be for any location that were to be potentially impacted by an asteroid. Therefore, benefiting future planning for planetary defense in the event an asteroid needs its impact trajectory slightly altered or to know general potential impacts.

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Quantum Coding with Molecular Symmetries and Quantum Compressive Sensing for LIDAR
Kyle Sherbert | OSTEM Intern | GSFC – Code 450 & Code 556
Mentored By: Mark Brumfield & Dr. Harry Shaw
Human Exploration and Operations (HEO)
Kyle Sherbert implemented a quantum algorithm and performed compressive sensing via the reconstruction of a complete image of Earth's surface from partial data. Sherbert's project will enable the Concurrent Artificially-intelligent Spectrometry and Adaptive Lidar System (CASALS) satellite to optimize power consumption in LIDAR (LIght Detection And Ranging) scans. In addition, Sherbert designed ways to store quantum information within the multiple configurations of a molecule, using the symmetry properties of different configurations to help protect against environmental interference. His work is a foundational step in the development of NASA's quantum communication network.

Blue Marble - An Interface for the Earth Information System (EIS) Pilots and Active Catalog of NASA Tools and Datasets
Alexander Baekey | OSTEM Intern | GSFC – Code 610
Mentored By: Julia Breed
Science Mission Directorate (SMD)
This project focuses on developing interactive data visualizations for Blue Marble, an interface for the Earth Information System (EIS) pilots and active catalog of NASA tools and datasets. Blue Marble and the EIS pilots (Fires, Sea-Level Rise, Freshwater) will provide reliable information, scientific guidance, and user-friendliness to a wide range of users, from researchers to the public. The EIS pilots take advantage of remote sensing data along with data fusion and assimilation techniques to present major climate crises in scientific detail through guided "storymaps", which involve GIS visualization and Jupyter notebooks. The design of Blue Marble is based around user journeys, established from meetings with scientists, industrial workers, small farmers, city planners, educators, journalists, advocacy organizations, and government officials. The final resulting product of this project is a deployed web app to provide interactive graphs to meaningful end-user applications.

Formation/Cluster Flight Software Simulation
Erkin Verbeek and Bruce Barbour | OSTEM Interns | GSFC – Code 595
Mentored By: Dr. David E. Gaylor
Space Technology Mission Directorate (STMD)
The goal of this project is to develop an open-source, multi-spacecraft software simulation environment to support advanced guidance, navigation, and control (GN&C) algorithm research, trade studies, and mission concept studies for distributed space systems. To use the software, a user specifies the simulation parameters through an intuitive user interface that is implemented using JAVA Swing elements. The simulation results are computed using Basilisk (BSK), an astrodynamics framework built by The University of Colorado Boulder, and these results are then presented to the user through various generated plots. With a modular architecture in mind, the software supports both developer- and user-built modules that can be written and implemented into the tool. Despite using BSK as the initial astrodynamics suite, the ultimate goal is to have an embedded abstraction layer that allows users to swap out BSK for any astrodynamics suite from a supplied list to promote user familiarity and solution validation.

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Goddard Enhanced Onboard Navigation System Software Development

Adrian Benny Juarez | OSTEM Intern | GSFC – Code 595

Mentored By: David E. Gaylor

Space Technology Mission Directorate (STMD)

This project involves the development of software unit testing for Goddard Enhanced Onboard Navigation System (GEONS), a flight software package for onboard spacecraft navigation, needed to meet NASA Procedural Requirements (NPR) 7150.2. The GEONS v3.0 release will be utilized in the On-Orbit Servicing, Assembly, & Manufacturing 1 mission. Using NASA's spacecraft trajectory optimization and mission analysis software General Mission Analysis Tool (GMAT) to serve as a basis for comparison, numerical integrators for GEONS and GMAT are selected to propagate an orbit for one period while holding the initial conditions the same. The integrators are compared with the intention of selecting an integrator for both software that will produce the closest results possible. This is followed by conducting varying propagations in which the accelerations due to various perturbing forces are compared between GEONS and GMAT ultimately leading to the verification and validation of GEONS force models.

OSAM-1 Rendezvous Trajectory Monitoring using Relative Orbital Elements

Matthew Hunter | OSTEM Intern | GSFC – Code 595

Mentored By: David Gaylor

Space Technology Mission Directorate (STMD)

The On-orbit Servicing, Assembly, and Manufacturing 1 (OSAM-1) mission will demonstrate new technologies for autonomous rendezvous, proximity operations, and docking with a client satellite. The relative approach trajectory has been designed to emphasize passive safety from unintentional collisions throughout the rendezvous and docking phase of the mission. Safe separation is typically evaluated by ground controllers through numerical propagation of the last known state of the spacecraft, a process that can be computationally intensive especially when incorporated into Monte Carlo analysis. Relative orbital elements (ROE) represent the linearized relative motion of two spacecraft and are slowly varying, allowing them to characterize the entire relative motion between the spacecraft in closed-form. This project derives the requirements to guarantee passive safety in ROE-space and demonstrates their advantages for efficient Monte Carlo analyses and potential on-board applications.

August 23, 2021

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Using Artificial Intelligence to Learn Lessons from Research Proposal Evaluations

Dedelolia Olungwe | OSTEM Intern | GSFC – Code 600

Mentored By: Dr. David Leisawitz

Science Mission Directorate (SMD)

This project involves looking for common lessons learned in various proposal evaluation departments, such as PICASSO, MATISSE, DALI, and CLDTCH. Each proposal has identified strengths and weaknesses that are analyzed in order to check for a common trend or importance. This is done by experimenting with artificial intelligence, using the Natural Language

Processing (NLP) technique, that looks at numerous words and attempts to derive sentences that it thinks are most important. Following that procedure, we can judge for ourselves whether the AI approach is giving us useful results based off what we think.

Understanding Solar Energetic Particles With STEREO HET

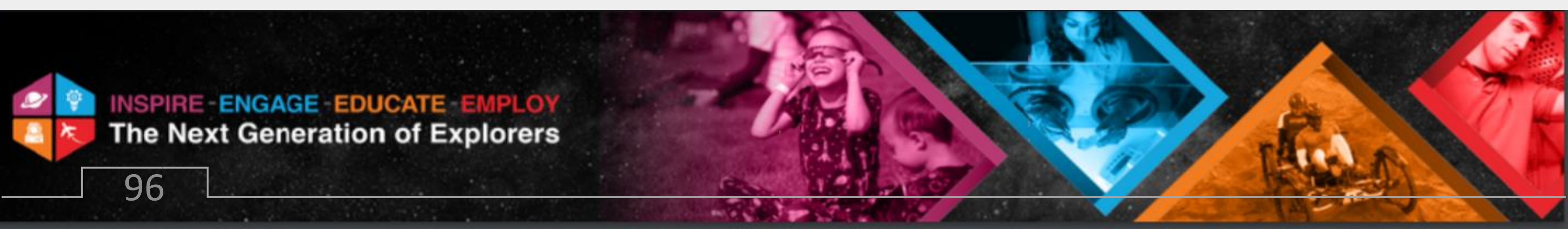
Daniel Gendy | OSTEM Intern | GSFC – Code 672
Mentored By: Eric Christian, Georgia de Nolfo
Science Mission Directorate (SMD), Center Operations (CMO)

The project evaluates solar energetic particles (SEPs) in the Heliosphere utilizing in situ data from the STEREO mission. More specifically, raw data from the High Energy Telescope (HET) corresponding to the abundances and energy spectra of electrons, protons, He, and heavier nuclei was extracted. C codes were modified and written to analyze Pulse heights and fluxes in a readable format. Plots of the data were formulated in Python. Low fluxes of heavier elements prompted a revaluation of the onboard binning process. New selection criteria will be generated to orient the particle energy loss in the detectors with the expected locations of the energy tracks corresponding to each element.

Planetary Geology Analog Data Analysis for Sub-surface Ice Detection

Adam Johantges | OSTEM Intern | GSFC – Code 6901
Mentored By: David Hollibaugh Baker
Science Mission Directorate

This project focuses on the analysis and archiving of planetary analog field data collected by the Goddard Instrument Field Team (GIFT). In particular, this work will support the analysis of data collected at Iceland field sites [including radar data, bore holes, unmanned aerial vehicle (UAV) imagery and Digital Elevation Models] to characterize volcanic and buried ice deposits. Results from this work will help to inform the characterization of similar deposits on the Moon and Mars. Project tasks include the geospatial and geomorphic analysis of volcanic and permafrost landforms, correlation with ground-penetrating radar and bore holes, and geostatistical analysis of airborne Synthetic Aperture Radar (SAR) data. Other tasks will include supporting the archiving of field data collected by the Goddard Instrument Field Team.



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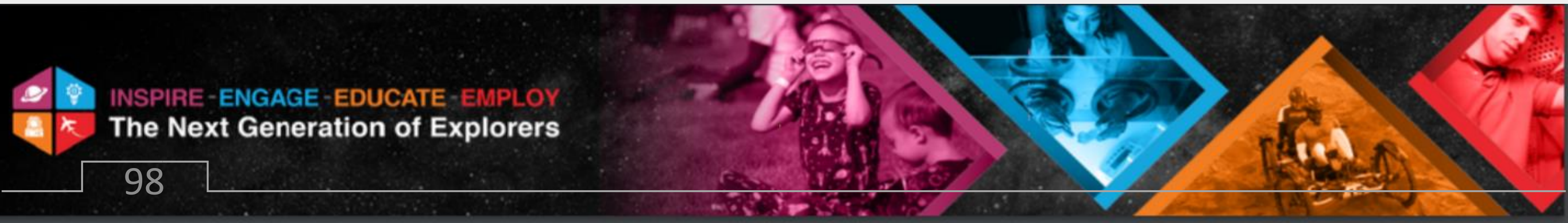
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