Paul HORTON
Exploration Systems Design (Systems Engineering) PhD Candidate

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Fifth-year PhD candidate in Exploration Systems Design (Systems Engineering) at Arizona State University's School of Earth and Space Exploration and NASA Space Technology Graduate Research Opportunity (NSTGRO) fellow seeking to leverage a unique Software Engineering and Applied Physics background as well as years of experience designing machine learning systems at NASA's Jet Propulsion Laboratory to perform innovative systems engineering design in planetary science and astronomy.

🎓 EDUCATION

Arizona State University (ASU) *(italicized dates indicate anticipated graduation)*

May 2025	**PhD in Exploration Systems Design (Systems Engineering)**	GPA : **4.00**
	School of Earth and Space Exploration (SESE)	
	Diss. : Development, Implementation, and Impacts of Novelty Detection Systems for Mission Operations	
Dec 2019	**MS in Software Engineering**	GPA : **4.00**
	Ira A. Fulton Schools of Engineering	
	Thesis : Simulating Atmosphere and the TolTEC Detector Array for Data Reduction Pipeline Evaluation	
May 2018	**BS in Applied Physics**	GPA : **4.01**
	College of Integrative Sciences of Arts (CISA)	
	BS in Software Engineering	GPA : **4.06**
	Ira A. Fulton Schools of Engineering	
	Graduated *summa cum laude* and Barrett, the Honors College Scholar	
	Thesis : The History and Application of Optical Communications in Deep Space	

🏆 SCHOLARSHIPS AND AWARDS

2020-2024	**NASA Space Technology Gradute Research Opportunity (NSTGRO)**
	Funded fellowship for "PLANET : Planner-in-the-Loop Assistant for Novelty Extraction and Targeting"
2019-2020	**JPL Strategic University Research Partnership (SURP)**
	Funded research proposal for machine learning mission operations systems
2016-2017	**Fulton Undergraduate Research Initiative (FURI)**
	Funded research proposal for investigating engineering education at hackathons
2014-2018	**Broadening the Reach of Engineering through Community Engagement (BRECE)**
	Scholarship program and community for local and global engineering engagement
2014-2018	**New American University Scholar - President's Award**
	Scholarship program for incoming freshmen with outstanding academic qualifications
2014-2018	**Undergraduate Dean's List (All Semesters)**

💼 PROFESSIONAL RESEARCH EXPERIENCES

May 2022 to Present	**Visiting Researcher, ROMAN SPACE TELESCOPE, NASA GODDARD, Greenbelt, MD**
	› Designing and evaluating preliminary analysis systems to identify anomalies in detector frames using heuristic and data driven methods of novelty detection
	`Data Science` `Python` `MATLAB` `Novelty Detection`
May 2021 to Present	**Lead Payload Software Engineer, ASTHROS, NASA JPL, Pasadena, CA**
	› Led the development of a multi system readout architecture for a spectrometer array using RabbitMQ
	› Prototyping a system to perform on-board assessment of science data to identify anomalous spectra
	`Systems Engineering` `Embedded Systems` `Networking` `Python` `Novelty Detection` `Astrophysics`
May 2020 to Aug 2020	**Visiting Researcher, DATA PRODUCT GENERATION SOFTWARE GROUP, NASA JPL, Pasadena, CA**
	› Developed a machine learning API to produce novelty scores for the Planetary Data Systems's Imaging Node
	› Utilized Amazon Web Service's SageMaker to test and deploy endpoints for image analysis
	`Data Science` `Amazon Web Services` `API Development` `Data Wrangling`

May 2019 to Aug 2019	**Summer Internship, Machine Learning and Instrument Autonomy Group, NASA JPL, Pasadena, CA**

> › Refined over 100 hand engineered features using parallel processing to increase classification efficiency and enable real time analysis of terrain features on a innervated rover wheel
> › Optimized the readout process of embedded sensors on a robotic test rig to increase data collection rates

`Data Science` `Python` `Embedded Systems` `Parallel Processing` `Feature Engineering` `Terramechanics`

May 2018 to Aug 2018	**Summer Internship, Machine Learning and Instrument Autonomy Group, NASA JPL, Pasadena, CA**

> › Generated, refined, and utilized a data set of over 100 dust devil regions on Mars to perform feature augmentation using tubular image filtration for pixel based classification
> › Demonstrated the feasibility of COSMIC, an on-board analytic suite for Mars satellites to autonomously perform change and anomaly detection as well as summarization of the Mars surface

`Data Science` `Data Wrangling` `Python` `Machine Learning` `Feature Engineering` `Planetary Science`

🔍 Academic Research Experiences

Aug 2021 to Present	**Graduate Research Assistant (PhD), THz Astronomical Instrumentation Lab, ASU SESE, Tempe, AZ**

> › Orchestrated 2 small scale demonstrations of the readout and ground operations systems for ASTHROS, a larger NASA JPL led mission
> › Mentoring undergraduate students to design flight ready software for ASTHROS

`Systems Engineering` `Embedded Systems` `Networking` `Python` `Novelty Detection` `Astrophysics`

Aug 2019 to Aug 2021	**Graduate Research Assistant (PhD), Bell Research Group, ASU SESE, Tempe, AZ**

> › Utilizing machine learning and human centered design to develop technologies for planetary scientists to intelligently perform data discovery and efficiently plan mission operations for MSL Curiosity

`Data Science` `Deep Learning` `Python` `Software Engineering` `Planetary Science`

Aug 2018 to Dec 2019	**Graduate Research Assistant (MS), THz Astronomical Instrumentation Lab, ASU SESE, Tempe, AZ**

> › Developed a scientifically accurate simulation of high resolution 7000 detector readout data for TolTEC, a three-color millimeter wavelength camera on the Large Millimeter Telescope
> › Implemented industry best practices to scientific code development by introducing version control, Docker, and documentation to a team of developers from 7 institutions across 3 countries

`Software Engineering` `Docker` `GitHub` `C++` `Python` `Astronomy`

Sept 2017 to May 2018	**Undergraduate Research Assistant, Astronomical Instrumentation Lab, ASU SESE, Tempe, AZ**

> › Collaborated with the Deep Space Optical Communications team at NASA JPL to create an adjustable simulation of Serially Concatenated Pulse Position Modulation (SCPPM) for the Psyche mission

`Optical Communications` `Physics` `Python`

Aug 2016 to May 2017	**Undergraduate Research Assistant, Maker Research Group, ASU Polytechnic School, Mesa, AZ**

> › Applied deductive thematic analysis to investigate the hackathon ecosystem under a project based learning framework to identify engineering education in nontraditional learning environments

`Engineering Education` `Project Based Learning` `Hackathons` `Thematic Analysis`

📑 Publications and Presentations

1. **Paul Horton**, Christian Thompson, Chris Groppi, Youngmin Seo, and Jose V. Siles. On-board science data quality analysis using anomaly detection for ASTHROS. In *SPIE Astronomical Telescopes + Instrumentation*, 2024
2. **Paul Horton**, Nargess Memarsadeghi, and Jordan A. Caraballo-Vega. Anomaly detection for the roman space telescope wide field instrument's science data processing pipeline. In *SPIE Astronomical Telescopes + Instrumentation*, 2024
3. Christian Thompson, **Paul Horton**, Chris Groppi, Jose V. Siles, and Jonathan H. Kawamura. Architecture of ASTHROS's internal onboard communications system using RabbitMQ. In *244th American Astronomical Society Meeting*, 2024
4. **Paul Horton**, Christian Thompson, Chris Groppi, Jose V. Siles, and Jonathan H. Kawamura. Readout system architecture and on-board analysis pipeline for ASTHROS. In *244th American Astronomical Society Meeting*, 2024
5. **Paul Horton**, Christian Thompson, Chris Groppi, Jose V. Siles, and Jonathan H. Kawamura. Architecture of ASTHROS' spectral data collection and onboard anomaly detection pipeline. In *Scientific Ballooning Technologies Workshop*, 2023
6. **Paul Horton**, Christian Thompson, Chris Groppi, Jose V. Siles, and Jonathan H. Kawamura. Readout systems network design and on-board analysis for ASTHROS. In *32nd International Symposium on Space Terahertz Technology*, 2022
7. **Paul Horton**, Hannah R. Kerner, Samantha Jacob, Ernest Cisneros, Kiri L. Wagstaff, and James Bell. Integrating novelty detection capabilities with msl mastcam operations to enhance data analysis. In *2021 IEEE Aerospace Conference*, pages 1–8. IEEE, 2021
8. **Paul Horton**, Sanjna Ravichandar, Jake Lee, Hannah Rae Kerner, Anil Natha, Soliman Tariq K, Kevin Grimes, Kiri Wagstaff, Rishi Verma, and James McAuley. Novelty and discovery content analysis methods for the planetary data system image atlas. *AGUFM*, 2020, 2020

9. Zhiyuan Ma, Michael McCrackan, N. S. DeNigris, Kamal Souccar, Grant W. Wilson, **Paul Horton**, Dennis Lee, Philip Mauskopf, Giles Novak, Iván Rodríguez-Montoya, and Javier Zaragoza-Cardiel. The TolTEC data analysis pipeline and software stack. In Juan C. Guzman and Jorge Ibsen, editors, *Software and Cyberinfrastructure for Astronomy VI*, volume 11452, pages 551 – 562. International Society for Optics and Photonics, SPIE, 2020

10. Hannah R. Kerner, Kiri L. Wagstaff, Brian D. Bue, Danika F. Wellington, Samantha Jacob, **Paul Horton**, James F. Bell, Chiman Kwan, and Heni Ben Amor. Comparison of novelty detection methods for multispectral images in rover-based planetary exploration missions. *Data Mining and Knowledge Discovery*, Jun 2020

11. Gary Doran, Steven Lu, Maria Liukis, Lukas Mandrake, Umaa Rebbapragada, Kiri L Wagstaff, Jimmie Young, Erik Langert, Anneliese Braunegg, **Paul Horton**, Daniel Jeong, and Asher Trockman. COSMIC : Content-based onboard summarization to monitor infrequent change. In *2020 IEEE Aerospace Conference*, pages 1–12. IEEE, 2020

12. **Paul Horton** and Lukas Mandrake. Feature augmentation using tubular image filtration for autonomous on-board classification of mars dust devil tracks. *AGUFM*, 2018:P41D–3760, 2018

13. **Paul Horton**, Shawn S Jordan, Steven Weiner, and Micah Lande. Project-based learning among engineering students during short-form hackathon events. In *Conference proceedings of American Society of Engineering Education (ASEE) annual conference and exposition*, 2018

👥 EXTRACURRICULAR ACTIVITIES

sunhacks - ASU's Largest Student Organized Hackathon (Formerly Desert Hacks)   2016 - Present

2021-Present	Alumni Advisor
2018-2021	Director of Technology for sunhacks Fall 2019, 2020, 2021
2018-2018	Director of Marketing for sunhacks Fall 2018
2016-2017	Organizer and Founding Member for Desert Hacks Spring 2017