Name: Marina M. Dunn (she/her/hers)

Code: 693

Home institution: Southeastern Universities Research Association

Name of task: Detection and Segmentation of Ice Blocks in Europa's Chaos Regions Using Deep Learning

Role in task/ what they do for CRESST:

As a Research Assistant working for NASA GSFC in the Planetary Systems Laboratory, I am currently researching deep learning approaches (such as Mask regional-convolutional neural network models) to detect and segment individual ice blocks in the “chaos terrain” regions of Europa using NASA Galileo imagery. It is speculated that these regions might include a thinner ice crust between ice blocks, and therefore may provide better access to Europa’s subterranean ocean. This makes chaos terrain favorable sites for future missions to image further, or even eventually land. It is still not fully known how all these regions formed and evolved, so we want to investigate them further to better understand this. Using modern deep learning methods to perform computer vision tasks like these can help automate and expedite many time-consuming tasks like mapping the locations and orientations of individual ice blocks. We have recently been able to moderately improve the model performance for this task and expect it to improve even more with better surface imagery from future spacecraft.

Background/ Autobiography:

I grew up near Nashville, TN, where I have performed most of my remote work for the last several years. In my hometown, STEM is not typically prioritized in education, but even as a kid, I was determined to study science and go to space. At 13, I became fascinated with astronomy after watching the 1997 adaptation of Carl Sagan's Contact and began volunteering at Vanderbilt University’s Dyer Observatory (where I still occasionally volunteer to this day). I received my bachelor’s degree in Astronomy from the University of Arizona in 2018. During my undergraduate program, I worked on a variety of research projects, including observing and characterizing exoplanet atmospheres, observing, and searching for dense clouds to find good candidates for future star formation, and developing proposals and building components for balloon-borne missions, such as NASA GUSTO. After graduating, I decided I wanted to explore the field of data science and find ways to incorporate it into my future work. I began learning

relevant skills and developed these further working in corporate programs at Apple to prepare for graduate school.

I recently completed my M.S. degree in Engineering: Data Science at the University of California, Riverside in June 2023, and completed several different internships during my program. From August 2021-May 2022, as part of NASA GSFC's Earth Information Systems team, I researched how to optimally store and access NASA Earth science datasets and models in the commercial cloud, developed improved interactive visualization/analysis dashboards for NASA fire data, including for near-real-time fire emissions forecasting, and developed a data pipeline for analyzing vegetation data from the Surface Biology and Geology hyper-spectral imaging SHIFT campaign. In Summer 2022, I was a Computing Scholar for the Lawrence Livermore National Lab Data Science Summer Institute, where I developed tools for visualizing machine learning (ML) model optimization and researched various ML methods for screening drug-like compounds that may prevent or treat SARS-CoV-2. In Fall 2022, I developed a project known as "The Machine Learning Showroom" as part of the NASA OCIO Information, Data, & Analytics Services (IDAS) team at Langley Research Center to support NASA's ongoing agency-wide digital transformation effort and the increased demand for data science services. Here, I developed multiple components to empower NASA teams to learn about ML and evaluate its use for their research; these include a collection of interactive, cloud-based coding notebooks featuring simplified ML models and an internal Microsoft SharePoint site. By offering a centralized, preconfigured, pre-authenticated space for NASA users to learn and experiment, we hoped to reduce complexity and reluctance to using ML and enable quicker and broader adoption throughout the agency.

Favorite part of being a CRESST Scientist?

I love that this is the biggest team I have gotten to work with among all of my research projects the past 2 years, and I like that I have been pushed out of my comfort zone to learn more about planetary sciences, especially content related to geoscience. Possibly a list of publications, presentations, conferences they have spoken at etc.

Publications

1. Calahan, J. K., Shirley, Y. L., Svoboda, B. E., Ivanov, E. A., Schmid, J. R., Pulley, A., Lautenbach, J., Zawadzki, N., Bullivant, C., Cook, C. W., Gray, L., Henrici, A., Pascale, M., Bosse, C., Chance, Q., Choi, S., Dunn, M., Jaime Frias, R., Kearsley, I., … Robinson, D. R. (2018). Searching for Inflow toward Massive Starless Clump Candidates Identified in the Bolocam Galactic Plane Survey. The Astrophysical Journal, 862(1), 63. https://doi.org/gkvm47

2. Nguyen, D. M. T., Cortes, J. C., Dunn, M. M., & Shiklomanov, A. N. (2023). Impact of Chunk Size on Read Performance of Zarr Data in Cloud-based Object Stores [Preprint]. ESS Open Archive. https://doi.org/10.1002/essoar.10511054.2

3. Dunn, M. M., Duncan, E., Trent, D., Santerre, J., Mills, A., Larsen, A., Neidel, I. & Nixon, C. A. (2023). Detection and Segmentation of Ice Blocks in Europa's Chaos Regions Using Deep Learning. [Unpublished manuscript].

List of awards won:

• 2023 UCR Bourns College of Engineering Commencement Graduate Student Marshal, 2023

UCR Graduate Division Grad Slam Finalist - University of California, Riverside

• 2023 Wanda Munn Scholarship (offered), 2023 WE Local Collegiate Competition Finalist,

WE22 Conference Grant (2022) - Society of Women Engineers

Three fun facts:

1. In my free time, I am a digital artist, I love cycling, and I dabble in web development.
2. I used to be an Irish step dancer for about 10 years.
3. When I was 4, I was obsessed with the NASA IMAX documentary film The Dream Is Alive and used to play a VHS tape of it on repeat constantly. Around this time, I also found out the Milky Way and Andromeda galaxies were going to collide in a few billion years and cried for at least a week.