Summary of Thomas Metcalf Travel Award

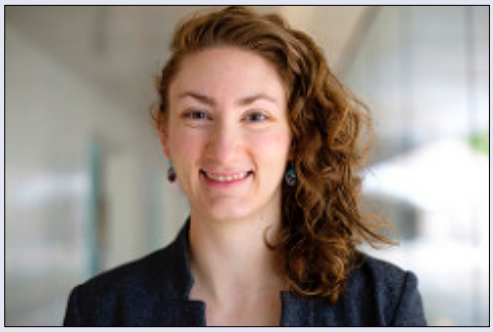
Machine Learning in Heliophysics

Amsterdam, The Netherlands, 16-20 September, 2019

Abigail Azari *NSF Graduate Research Fellow & PhD candidate, University of Michigan*

PhD Advisors: Dr. Michael Liemohn and Dr. Xianzhe Jia

Ms. Azari works at the intersection of data science and space physics to analyze large amounts of in-situ and remote sensing data to answer fundamental questions about planetary systems. Her PhD thesis focuses on observations of mass transport at Saturn. Previously, she worked at the IDA Science and Technology Policy Institute providing analysis and technical support to federal agencies on a variety of topics including climate data and space policy. She is interested in the application of machine learning for scientific discovery.



Oral Contribution *Multivariate Supervised Classification for Instabilities at Saturn Methods for Automated Event Detection in Magnetospheres*

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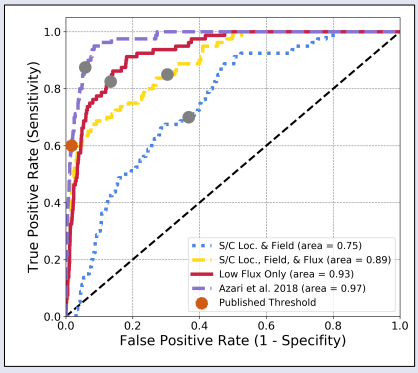
Early-Career Award for Best Oral Presentation



Performance of supervised logistic regression for event identification. The purple curve (best performance) represents physics informed inputs and outperforms other regressions even though they include additional data. The orange point represents a threshold of greater confidence for future analysis as compared to traditional machine learning (grey).

Shortened Abstract: In 2004 the Cassini mission arrived at Saturn. For the next 13 years the mission collected large amounts of data, resulting in a highly sampled magnetosphere of Saturn. Saturn is now the second most observed magnetosphere after that of Earth now allowing opportune applications of large scale statistical methods.

In this work we will first present a previous effort to both identify and characterize interchange injections from high-energy ion intensities using the methods commonly employed in supervised classification tasks merged with required physical assumptions of the Saturnian environment. This work created a unique and reproducible list of events by combining predictive data analytics with background plasma environment characterization, uniquely allowing for subsequent statistical analysis on these events. This represents the first automated event detection algorithm implemented to detect such events. We then discuss issues in automated data analysis within dynamic planetary system including non-equal sampling, extreme temporal and spatial variability, and missing or invalid values. **We focus on solutions to allow for the applications of classification tasks and automated event detection methods to benefit from the new surge of planetary space physics data now available to characterize the outer planets.**

Full text available at ml-helio.github.io

Ms. Azari presenting in-situ data of interchange injections at ML-Helio 2019. Photo Credit: Y. Rivera.

I want to thank SPD as well as the ML-Helio committees for the Metcalf award. This was the first ML-Helio conference and as such, provided a unique venue to discuss machine learning for heliophysics, from solar to planetary. As space missions enter into a new regime of data collection, interdisciplinary collaborations and knowledge sharing are essential to building up lessons for physics informed machine learning. Thank you for the opportunity to participate in this new and developing community.

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