**SH019 – Numerical Tools and Simulations for Heliophysics**

**A Dynamic PCA and Machine Learning Tool for Automated Identification of Solar Wind Disturbances Impacting Earth’s Magnetosphere**

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Earth’s magnetosphere is continuously impacted by solar wind and interplanetary magnetic field (IMF) disturbances, such as shocks, discontinuities, magnetic clouds and more. Understanding how such disturbances propagate from the Sun and what is their impact on the different magnetospheric domains is key to understanding and forecasting energy transfer from the solar wind to Earth. The large number of overlapping solar wind and magnetospheric missions carrying magnetometers and the recent advances in communications and data storage technologies have enabled an unprecedented quantity of high-fidelity magnetic field data captured by in-situ spacecraft to be available at the click of a button. However, this massive quantity of available data can prove unwieldy for researchers, limiting the identification of interesting phenomena and disturbances to a relatively small percentage of the total dataset. Several techniques have been previously developed for automated identification of specific types of magnetic anomalies, but these methods are typically mission-specific and can be difficult to generalize. We present initial results for a generic method of automated anomaly detection in magnetic field measurements based on dimensionality reduction and unsupervised clustering via machine learning. The benefit of our technique is its high degree of generalizability and flexibility which make it a most useful data survey tool for a wide range of magnetic field datasets. This method can also be applied simultaneously to other observed time-series properties like plasma density, pressure, and velocity for more accurate event identification. Additionally, the application of this method to data captured by multiple spacecraft enables the simultaneous identification of disturbances and the determination of their propagation characteristics. Initial evaluation of this technique has been performed using data from Magnetospheric MultiScale (MMS) and THEMIS-ARTEMIS missions, providing a testbed scenario for the future Heliophysics Environmental and Radiation Measurement Experiment Suite (HERMES) platform instruments that will measure solar wind and IMF properties from lunar orbit onboard the Gateway station.