Project Details

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Program Element: Data, Tools, & Methods

Topic: Effects of Ionospheric-Magnetospheric Plasma Redistribution on Storms

Project Title:
Developing Tools of Automatic Coronal Mass Ejection Detection and Characterization

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Summary:
The objective of this proposal is to develop a software package to automatically detect, characterize and catalog corona mass ejections (CMEs) using coronagraph imaging observations. The package provides the following specific functionalities: (1) CME initial detection, using image processing methods based on thresholding, histogram analysis and morphological analysis. (2) CME tracking and characterization based on a continuous sequence of images, taking advantage of the coherent nature of CME movement. (3) CME event classification using various existing data mining methods based on the large number of parameters generated. (4) generation of an accurate and complete CME catalog. (5) developing a near-real time detection and warning module for space weather forecasting. The automated method is far more efficient than the human manual inspection method. The automated method also extracts a large number of meaningful parameters for scientific research, free of human bias. The proposed software package will be developed based on ongoing SOHO/LASCO C2 data, and will be applied to the upcoming STEREO/SECCHI data. We will test and validate the tool package with the manual-based CDAW catalog and the existing CACTUS automated catalog. Comparing with the existing catalogs, our catalog will be much more comprehensive in terms of number and accuracy of the parameters. The proposed near-real-time module will be timely, which is critical for space weather applications. The package will be developed with the IDL programming language.

CMEs are the main drivers of particle storms, geomagnetic storms and other severe space weather phenomena. The timely detection and complete catalog of CMEs serve many purposes of the LWS programs. The amount of data available becomes overwhelming. There is a strong need to automate the event detection and classification processes. The proposed methodology helps convert NASA mission data into scientific information quicker and better, or otherwise can not be obtained. Hidden scientific facts could be found through mining the large parameter space produced by automatic means. Therefore, this project will increase the scientific productivity of the SMD research endeavors from present and future NASA missions. This project will be carried out through an inter-discipline effort among experts in computer science and solar physics at George Mason University, through collaboration with the Naval Research Lab. A large part of the funding will be used to support a graduate student working toward his Ph.D. dissertation. This project directly addresses the NASA strategic sub-goal 3B and is highly relevant to the strategic sub-goals 3C. If awarded, we plan to organize a summer school addressing the LWS data environment as an E/PO effort.

Publication References:

Summary: no summary

Reference: Olmedo, O.; Zhang, J.; Wechsler, H.; Poland, A.; Borne, K.; (2008), Automatic Detection and Tracking of Coronal Mass Ejections in Coronagraph Time Series, Solar Physics, Volume 248, Issue 2, pp.485-499, doi: 10.1007/s11207-007-9104-5