DEVELOPING REALISTIC FLUCTUATIONS TO IDENTIFY FLUX ROPES SIGNATURES VIA DEEP LEARNING

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Abstract:

Identifying a coherent magnetic configuration of internal magnetic structures inside Interplanetary CMEs (ICMEs) caused by a spacecraft crossing a large flux rope with helical magnetic field lines topology is critical for predicting these structures' geomagnetic effect reaching Earth. The increased number of space- and ground-based capabilities increased the amount of data available, necessitating more people and methods to analyze this additional data. Dos Santos et al. (2020, Solar Physics) recently conducted a study to implement machine learning (ML) techniques and expand our understanding of the Space Weather hazard's main drivers. This study successfully interpreted the ICME in situ magnetic field observations using ML. It gained a thorough understanding of what to expect from in situ magnetic field observations when a spacecraft crosses flux ropes with different trajectories. We use a pre-existing Deep Neural Network handwriting model that has been trained with synthetic data with high accuracy in well-behaved events and then tested it against observed ICMEs from WIND from 1995 to 2015.

We correctly identified flux rope signatures in 84 percent of simple real-world cases and had a 76 percent success rate when applied to a more extensive set. Moreover, we use this established model to investigate magnetic field fluctuations in flux rope identification by analyzing observed fluctuations in magnetic components and constructing more realistic synthetic data.

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References: dos Santos, L.F.G., Narock, A., Nieves-Chinchilla, T. *et al*. Identifying Flux Rope Signatures Using a Deep Neural Network. *Sol Phys* **295,** 131 (2020). https://doi.org/10.1007/s11207-020-01697-x and Nieves-Chinchilla, T., Jian, L.K., Balmaceda,

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