SM14A-01 Reconstructing magnetotail reconnection events using data mining is feasible and repeatable

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16:02 - 16:12
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Abstract

A recent study by *Stephens et al.,* (2023) utilized a data mining (DM) algorithm, applied to over two decades of magnetometer observations from several magnetospheric missions, coupled with a flexible analytical formulation of the magnetic field generated by Earth's primary magnetospheric current systems to reconstruct the global configuration of the magnetotail during times when the Magnetospheric MultiScale (MMS) mission observed magnetotail reconnection in situ. Of the 26 MMS observed tail reconnection events, the DM reconstructed magnetic field contained a $B_z = 0$ isocontour within ~2 Earth radii (R_E) of the observed reconnection location for 16 of them. Another 8 event reconstructions resulted in a B_z minimum region, identified using $B_z = 2$ nT isocontours, within ~2 R_E. This consistency raises the possibility that the structure of the magnetotail reconnection is correlated with the substorm/storm state of the magnetosphere reflected by geomagnetic indices and solar wind conditions. To verify these results, we perform another set of data mining reconstructions using an additional 29 months of MMS magnetometer data and new validation methods. We first benchmark the analytical structure of the magnetic field using a prescribed magnetic field in the tail that contains x- and o-lines. Next, we quantify the consistency of the reconstructions, both in the in-sample (including event data) and out-of-sample (excluding event data) modes, by computing the skill score relative to random chance. Although the in-sample reconstructions generally have higher skill scores, the out-of-sample reconstructions are better at capturing the reconnection location than random chance. Last, a bootstrap analysis of a reconnection event indicates that the DM approach is not overly sensitive to the particular sampling of magnetometer records.

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