Orientation and motion of two-dimensional structures in a space plasma

Hiroshi Hasegawa[1]; Bengt U. O. Sonnerup[2]; Christopher J. Owen[3]; Berndt Klecker[4]; Goetz Paschmann[5]; Malcolm W. Dunlop[6]; Henri Reme[7]

[1] TITECH; [2] Thayer Sch. of Engineering, Dartmouth Col.; [3] MSSL, Univ. Coll. London; [4] Max-Planck-Institut; [5] MPE; [6] Rutherford Appleton Lab.; [7] CESR

We present a new single-spacecraft technique for determining the orientation, motion, and intrinsic electric field of two-dimensional and time-independent structures in a space plasma. This least-squares method is based on Faraday's law, which, under the model assumptions, requires the intrinsic axial field to be constant in space and time. The technique is applied to a few flux transfer events (FTEs) and magnetopause crossings seen by the Cluster spacecraft and is compared to several other single- and four-spacecraft methods. In some of the FTEs, excellent agreement is found between the orientations from the new method and those obtained from optimal Grad-Shafranov reconstruction, a method that uses data from all four Cluster satellites. The method however fails for other FTEs and traversals of typical magnetopause in which no prominent flux rope-like structures are embedded, suggesting that it must be used with care. We also discuss the capability of the new method for determining the orientation and motion of planar (one-dimensional) structures.