複数衛星観測を用いた三次元平衡磁場構造の再現

長谷川 洋 [1]; ソネラップ ベングト [2]; 中村 琢磨 [3]
[1] JAXA・宇宙研; [2] ダートマス大; [3] 宇宙研

Reconstruction of three-dimensional, magneto-hydrostatic plasma and magnetic field structures from multi-spacecraft data

Hiroshi Hasegawa[1]; Bengt Sonnerup[2]; Takuma Nakamura[3]
[1] ISAS/JAXA; [2] Dartmouth Coll.; [3] ISAS,JAXA

A new data analysis method is presented for reconstruction of magnetic field and pressure distributions in steady, three-dimensional (3D), magneto-hydrostatic structures, using the field and plasma data taken by two closely separated spacecraft as they traverse such structures in space. The reconstruction is conducted by integration of the magneto-hydrostatic equations in a narrow parallelepiped region surrounding the spacecraft paths. A numerical code for such reconstruction has been developed, and is benchmarked by use of an exact spheromak-type solution of the equations and of synthetic data from 3D magneto-hydrodynamic simulations of localized guide-field reconnection. The results demonstrate that quasi-steady, 3D, quasi-magneto-hydrostatic structures can be reconstructed well within a sufficiently narrow domain. The method can be applied to structures of, e.g., flux rope-type and allows us to estimate various parameters characterizing the structures, such as current, field/pressure gradient, field-line curvature, the dimensionality (2D or 3D) of and direction of spatial variation in the structures, from only two-point measurements. It may become a useful tool for analyzing data from Cluster, for which full plasma measurements have been made on only two spacecraft, and those from future multi-spacecraft missions such as Magnetospheric Multi-Scale (MMS).

Sonnerup, B. U. O., and H. Hasegawa (2011), Reconstruction of steady, three-dimensional, magneto-hydrostatic field and plasma structures in space: Theory and benchmarking, J. Geophys. Res., 116, in press, doi:10.1029/2011JA016675.