Calibration of wave vector analysis techniques for low frequency waves detected by MMS in the terrestrial magnetosphere and magnetosheath regions

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There are certain difficulties in determining wavelengths using in-situ single-spacecraft data without assuming the dispersion relation of the waves. Wave vector analysis techniques using multi-spacecraft data have been developed after the 1990s in space science [*Neubauer and Glassmeier*, 1990; *Narita et al*., 2011]. Recent MMS mission enables us to resolve smaller wavelength in the ion kinetic range [*Narita et al.*, 2016]. While the developed techniques provide the wave energy distribution in the frequency-wave vector domain with high resolution, some parameters can affect significantly on the distribution. We perform the wave vector analyses using synthetic multi-spacecraft data and investigate two parameters: the noise tolerance parameter *n* and degree of freedom for ensemble averaging *m*. The synthetic data are constructed assuming low frequency waves detected by MMS in the terrestrial magnetosphere and magnetosheath regions. We compare the results obtained by beam former projection, Capon's minimum variance projection, extended MUSIC, and MSR technique quantitatively to identify adequate parameters *n* and *m* for the target waves.

