LEAST-SQUARES MULTI-SPACECRAFT GRADIENT COMPUTATION

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The ability to compute gradients from multi-spacecraft measurements is of fundamental importance for magnetospheric missions such as Cluster, Themis, MMS, and Cross-Scale. The classical gradient computation technique (CGC) requires simultaneous measurements at four non-coplanar points to infer the spatial gradient. The standard curlometer is based on applying CGC to compute the derivatives of each magnetic field component, and to compute the current density vector from the curl of the magnetic field.
A least-squares gradient computation technique (LSGC) has recently been proposed as an alternative, as well as an associated curlometer. This technique has several interesting features. It obtains not only the gradient, but also a realistic error estimate on that gradient. LSGC works without any a priori limitation on the number of spacecraft or their configuration; it sorts out what data are relevant for computing a particular gradient by itself. It is also straightforward to impose constraints. For instance, one can compute the gradients of the three magnetic field components while including the zero divergence constraint, thus leading to a least-squares curlometer that satisfies the divergence-free condition by design. In this contribution, we will present an overview of the LSGC method.

gradient computation, curlometer, multi-spacecraft missions

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