# J-Filtering: Unveiling Current Structures in Space Plasmas with Multipoint Data Analysis

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**Résumé**

We present J-Filtering, a newly developped multi spacecraft analysis technique for measuring and visualizing local current distributions in space plasmas, designed to overcome the limitations of the traditional Curlometer method. The Curlometer, which uses four-spacecraft magnetic field measurements to estimate current density via the Maxwell-Ampère law, assumes a linear spatial variation of the magnetic field-a condition rarely met in dynamic space plasmas. J-Filtering adapts the optimal filter determination principle from the K-filtering method, defining filters to identify the current structures responsible for the magnetic fields measured by the spacecraft. This approach enables the estimation of current density without relying on the restrictive assumption of magnetic field linearity, and can therefore allow the detection of currents at scales both larger and smaller than the spacecraft configuration. We first detail the principles of J-Filtering and present how we validated the method by comparing the obtained results with those of the Curlometer for a crossing of the magnetopause by CLUSTER, i.e. when the linear approximation should hold. Next, we present the use of simulated currents and spacecraft configurations to assess the performance of J-Filtering in scenarios involving small-scale structures and imperfect tetrahedral shapes. We found that the technique is less sensitive than Curlometer to geometry, and that it can indeed accurately retrieve small scale currents. These results paves the way for applying J-Filtering to data of present mission, like the Magnetospheric Multiscale (MMS) mission, and in preparation of future multi points mission like HelioSwarm and Plasma Observatory.

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