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Time-normalized plasma flow mapping during the quadrature of SolO and SDO

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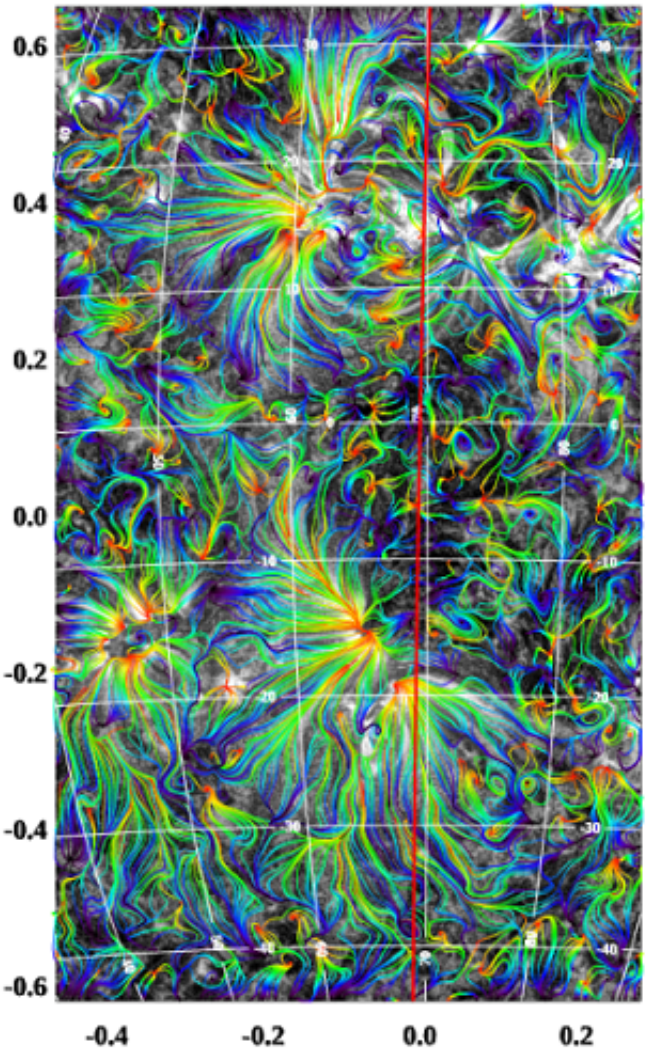
Observations of plasma motions in the low corona are often limited to magnetic field lines originating in active regions, which are ideal for spatial domain enhancements across individual extreme ultraviolet (EUV) images to see loops, flares, and other bright activity contrasted against dim background features.

The quiet Sun is essentially all dim background features, which requires advanced image processing and ideal observation parameters to emphasize the temporal domain in order to visualize faint, fine-scale plasma flows. We utilize time-normalized optical flow (TNOF) on large sets of high cadence EUV data by reducing instrumental noise to a high degree and then emphasizing the minor brightness variations indicative of plasma motion. Maps of plasma flow paths are produced via optical flow tracking algorithms by the computer vision method of Lucas-Kanade and the underlying velocity field is estimated with line integral convolution.

To test the effectiveness of the TNOF approach, we have applied this method to an EUV case study of data from EUI 174 and AIA 171 on 29 March 2022. This date marked a near-perpendicular line of sight orientation between the two spacecraft, had similarly short observation intervals, and provided the opportunity to compare contrast enhanced plasma features off-limb with temporally enhanced on-disk plasma motion.

In this case study, we generated movies and flow paths that show TNOF succeeds at qualitatively outlining plasma flow along magnetic field lines from both Solar Orbiter's and SDO's point of view which are in general agreement with potential field models. Additionally, detailed velocities of plasma motion within coronal loops, overall velocity trends, and a new quasi-magnetic flow trend within the quiet Sun are presented.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