HelioSwarm: Leveraging Multi-Point, Multi-Scale Spacecraft Observations to Characterize Turbulence

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There are many fundamental questions about the temporal and spatial structure of turbulence in space plasmas. Answering these questions is complicated by the multi-scale nature of the turbulent transfer of mass, momentum, and energy, with characteristic scales spanning many orders of magnitude. The solar wind is an ideal environment in which to measure turbulence, but multi-point observations with spacecraft separations spanning these scales are needed to simultaneously characterize structure and cross-scale couplings. In this work, we use synthetic multi-point spacecraft data extracted from numerical simulations to demonstrate the utility of multi-point, multi-scale measurements, in preparation for data from future multi-spacecraft observatories. We use the baseline orbit design for the HelioSwarm mission concept to explore the effects of different inter-spacecraft separations and geometries on the accuracy of reconstructed magnetic fields, cascade rates, and correlation functions using well-established analysis techniques.

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