Machine Learning for Automation in Data Selection onboard Space Missions

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Abstract

Turbulence in plasmas involves a complex cross-scale coupling of fields and distortions of particle velocity distributions, with the generation of non-thermal features. How the energy contained in the large-scale fluctuations cascades all the way down to the kinetic scales, and how such turbulence interacts with particles, remains one of the major unsolved problems in plasma physics. The heliosphere, characterized by nonlinear processes, such as the generation of shocks, waves, coherent structures, magnetic reconnection and particle acceleration, represents the best natural laboratory to study in-situ plasma turbulence. However, due to the limited capacity of the storage disks on board the spacecraft and of the data transmission speed to ground, it is necessary to perform a selection of data of scientific interest to be transmitted, while a massive part of information is irretrievably lost.

The proposed idea is to develop a strategy to make a significant step forward in overcoming this difficulty, making these operations automatic, through the use of machine learning algorithms. These algorithms need to be trained by using previous mission measurements and tested on numerical simulations. This proposed idea crosses different scientific areas, from solar and heliospheric physics to space weather.