

PiAI Seminar Series: Physics informed AI in Plasma Science
9:30-10:30, 14 February 2022 (CET)
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Web Seminar

Unsupervised classification of simulated data

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Space physics is a very promising field for the application of techniques rooted in Machine Learning and Artificial Intelligence due to the huge quantity of data produced on a daily basis by observations and simulations of the heliospheric environment.

In this talk, we will present classification results obtained with an unsupervised classification method based on Self Organizing Maps, SOMs. The method is applied to the simulation, done with different approaches, of different heliospheric processes.

We will start with a simulation of the terrestrial magnetosphere, done with the MHD code OpenGGCM-CTIM-RCM. We will then proceed with a simulation of plasmoid instability, done with the fully kinetic, semi-implicit, energy conserving code ECSIM.

In both cases, notwithstanding the significant differences in terms of simulated process, scales of interest and numerical approach, we obtain classification results that match well with our a priori knowledge of the processes, not included in the training phase. Examining the SOM feature maps, the unified distance matrix and the distribution of node weight we unlock important information on the input data.

This classification strategy then emerges as a useful, relatively cheap and versatile technique for the analysis of simulated, and possibly observed, space physics data.

[1] Innocenti, M. E., Amaya, J., Raeder, J., Dupuis, R., Ferdousi, B., & Lapenta, G. (2021). Unsupervised classification of simulated magnetospheric regions. *Annales Geophysicae Discussions*, 1-28.

<https://angeo.copernicus.org/articles/39/861/2021/angeo-39-861-2021.pdf>