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Automatic Detection and Classification of Boundary Crossings in Spacecraft in situ Data

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Planetary magnetospheres create multiple sharp boundaries, such as the bow shock, where the solar wind plasma is decelerated and compressed, or the magnetopause, a transition between solar wind field and planetary field.

We attempt to use convolutional neural networks (CNNs) to identify magnetospheric boundaries, i.e. planetary and interplanetary shocks crossings and magnetopause crossings in spacecraft in situ data. The boundaries are identified by a discontinuity in a magnetic field, plasma density, and in the spectrum of high-frequency waves. These measurements are available on many planetary missions. Data from Earth's missions Cluster and THEMIS are used for CNN training. We ultimately strive for successful classification of boundaries (shock, magnetopause, inbound, outbound) and the correct handling of multiple crossings.