Contributed Talk

Splinter HiRes

Autonomous data reduction for the space-borne spectropolarimeter PHI

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ESA's next mission for solar science, the Solar Orbiter, will carry the Polarimetric and Helioseismic Imager (PHI). The spacecraft will orbit the Sun in highly elliptical orbits, gradually leaving the ecliptic plane. This unique orbit design makes PHI the first solar spectropolarimeter to be subjected to such dynamic environment, under highly restricted operational conditions.

Leaving Earth orbit Solar Orbiter provides as little as 50 Gbits/orbit temeletry for PHI, while the desired high resolution spectropolarimetric data with the necessary accuracy is 2 Gbits/dataset. Due to this restriction PHI implements on-board data analysis as a sophisticated data compression strategy, inverting the radiative transfer equation before downloading the data.

The pre-calibration of the raw science images is consequently done on-board too. The data necessary for the pre-calibration is partly obtained from ground calibration campaigns, and partly measured in flight, enforced by the large environmental changes and instrument ageing (e.g. the dark and flat field).

Due to the lack of dedicated calibration equipment on-board we have designed and tested methods that estimate the calibration data from images taken of the Sun. The most significant challenge in their implementation is the low communication rate with the satellite. This imposes full autonomy in collecting the calibration data, processing it, then applying it to the science data. For all the steps we analysed potential faults, designed detection

algorithms, and introduced correction or management strategies.