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SMOS L1PP Performance Analysis with MIRAS Data from Validation Campaigns

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Deimos Engenharia has been involved in the SMOS mission since 2003 and has played an important role in the project since then. The two main software packages that Deimos Engenharia has maintained during the past years are a) the Level 1 Processor Prototype (L1PP), where the scientific algorithms are implemented and verified; and b) the SMOS End-to-end Performance Simulator - Ground Segment (SEPS-GS), derived from the original simulator from the Universitat Politécnica de Catalunya (UPC) but with emphasis on Ground Segment capabilities. These tools have been widely used by the scientific community, as well as by the Deimos Engenharia's SMOS team, in preparation for the operational period of the SMOS mission.

In May/June 2007, Image Validation Tests (IVT) were conducted in the Maxwell Anechoic Chamber at ESA/ESTEC, in Noordwijck. This campaign provided the first set of data available measured by the MIRAS instrument itself, instead of being generated by the SEPS-GS simulator. This data has now been extensively analysed by Deimos Engenharia, and several studies have been performed and released, aiming at the validation and improvement of the L1PP. The results have shown to be in good agreement with the theoretical expectations, confirming that the L1PP is well prepared for the upcoming commissioning phase.
The IVT data analysis was mainly based on the study of reconstructed flat scenes obtained in the Maxwell chamber. This allowed the test of several optional calibration algorithms and alternative methods for image reconstruction and foreign sources removal.

The L1PP was adapted specifically for the analysis of IVT data, through the implementation of a Near Field reconstruction algorithm. The Level 1 processing has then been evaluated with real data taken with MIRAS. The results have been consistently better than expected, since the theoretically predicted value for the radiometric accuracy (or pixel bias) of an averaged flat scene is estimated to be roughly 1 K and the value currently obtained with the latest version of the L1PP is of the order of 0.8 K (maximum value obtained). In terms of the performance of correction algorithms, it has been demonstrated that the Flat Target Transformation removes some biases introduced by the in the Image Reconstruction process, in particular outside the alias-free field of view.
The impact of cross-polarisation contamination in the reconstruction of Brightness Temperatures has also been analysed, showing that the usage of all blocks of the System Response G-Matrix is not significantly different from the usage of simply the co-polar blocks, in terms of the final reconstructed temperatures map. Both in H- and in V-polarisations, the differences observed between using or not cross-polarisation correction are of the order of 0.01 K.
The data from full polarimetric mode has provided the basis for the study of the Stokes parameters, expected emission and leakage of the instrument. For example, with the probe emitting radiation in H-polarisation, MIRAS detected roughly 0.08% of radiation in V-polarisation.
Data from the probes has also been used to assess the impact of using either the complete G-matrix or only its co-polar parts in the reconstruction of the third and fourth Stokes parameters (T3 and T4). The differences between the usage of the co-polar and complete G-matrix results are 0.08% and 0.32% for the third and fourth Stokes components, respectively.

At the moment Deimos Engenharia is preparing for support activities to be performed during the SMOS

Commissioning Phase. This includes the development of a low resolution L-Band Galaxy Map generator to be used with data acquired by MIRAS in external pointing mode. Results and analysis from these preparation activities will also be shown.