SUCCESS CRITERIA TOOL IN EMC TESTS FOR INTERFEROMETRIC RADIOMETERS

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1. INTRODUCTION

The Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) [1] is the single payload of the SMOS (Soil Moisture and Ocean Salinity) mission by the European Space Agency (ESA), to be launched by the end of 2008 [2]. MIRAS performance was successfully tested during spring 2007 by the prime contractor, EADS-CASA Espacio Spain, at ESA premises in ESTEC, The Netherlands. Specific tests were designed to evaluate the impact on system performance of a number of possible operating conditions and/or perturbations.

The MIRAS instrument is compounded of 63 receivers equally distributed in the arms of a “Y” shape array. Other 9 receivers are also used as reference real aperture radiometers and/or redundancy. Cross-correlation of the signals collected by each receiver pairs “k,j” give the samples of the so-called visibility function, \( V_{kj} \). The set of visibility samples develops into a brightness temperature map by means of a Fourier synthesis technique. MIRAS uses 1-bit digital correlators, which measure normalized correlations. Therefore, in addition to the correlator unit, each receiver includes a PMS (Power Measurement System) devoted to denormalize the correlations by means of an estimation of system temperature [3].

A major problem to easily assess the impact of any perturbation is the large number of measurements to deal with: each acquisition (1.2 s) generates 72 voltages from the PMS and 2556 complex correlations from all possible receiver pairs.

This work presents the success criteria tool that has been designed to easily assess the impact of any perturbation on MIRAS system performance. The tool is illustrated by showing some of the main results obtained during the MIRAS system performance tests.

2. THE SUCCESS CRITERIA TOOL

The success criteria tool has been designed to comply with a number of requirements:

- Must deal with random magnitudes: PMS voltage readings and correlator outputs
- Must deal with a large number of measurements: each acquisition yields 72 voltages and 2556 complex correlations.
- Must clearly identify small perturbations, embedded in noise, that may affect only a few PMS and/or correlations
- Must give the results in a simple format: a few plots showing overall system performance
- Due to the reduced testing time available at ESTEC premises, measurement time must be kept to a minimum. At each configuration usually only 100 consecutive acquisitions (1 epoch=1.2 s) are available

There are several tests aimed at assessing the impact on system performance of different instrument/set up configurations: EMC, X-Band transmitter, stability, heater, power supply,… In all of them, the tool compares the statistic properties (mean and standard deviation) of the nominal measurement (PMS voltages, complex correlations, reference radiometers outputs) with those of measurements under perturbation. Variations in the statistics of the two sets of measurements (nominal and perturbation) must be below a certain threshold defined as the success criteria.

This tool is based in the results provided by the MIRAS fast processing tool [4], a specific software designed to read and process the data provided by MIRAS. It accepts as input the raw binary files received by the Electronic Ground Support Equipment (EGSE) from the X-band transmitter of the payload module (PLM). These files consist of sequential packets containing all the telemetry acquired by the instrument during operation, including digital correlator counts, detector diodes
voltages, temperature sensors readouts, control flags .... The software classifies the input data and applies the calibration procedure described in [3] to provide level 1A data (calibrated visibility) and level 1B data (brightness temperature). Most of the intermediate results are saved in files for further analysis and processing. These intermediate results are those used by the success criteria tool.

As an example, the plot below shows the impact of the X-Band link on the correlation samples. The blue line is the success criteria, whereas the red dots are estimations of the standard deviation of each correlation computed out of 100 samples. As shown, in this test the effect of the X-band is marginal and affects just a few correlations. These correlations are identified and listed in an Excel file. These allows the engineers to focus on the receivers affected and correct the problem if required.

![Example of output provided by the success criteria tool](image)

**Figure 1.** Example of output provided by the success criteria tool: effect of X-band link on normalized correlations: criterion for the standard deviations in dual H mode (blue line) in correlator units (1 cu=10^-4).

3. CONCLUSIONS

The success criteria tool has been extensively used during MIRAS system performance tests performed by EADS-CASA Espacio at ESA premises. It has shown that the payload presents a very robust performance in front of EM perturbations and/or extreme operating conditions.

11. REFERENCES


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