ONE POINT CALIBRATION IN INTERFEROMETRIC RADIOMETERS: ERROR ASSESSMENT

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1. INTRODUCTION

This presentation is devoted to assess the estimated performance of an alternative new method to calibrate the amplitude of the interferometric correlations based on a combination of internal an external reference signals [1]. This so-called "one point" calibration makes use of deep sky views as single external calibration target. A performance assessment of this method will be undertaken during the commissioning phase of the MIRAS (Microwave Imaging Radiometer with Aperture Synthesis) instrument, the single payload of the ESA-SMOS mission [2] [3], which is foreseen by the end of 2009.

The MIRAS consists of a Y-shape interferometric radiometer basically formed by 63 receivers called LICEF (Lightweight Cost Effective Front End) placed along the three arms. Cross-correlation of the signals collected by each receiver pairs "k,j" give the samples of the so-called visibility function, V_{kj}, which develops into a brightness temperature map by means of a Fourier synthesis technique. Amplitude calibration has a major impact in the final performance of an interferometric radiometers devoted to Earth observation since random amplitude errors in the visibility samples are directly translated into image distortion (the so-called pixel bias) through this Fourier synthesis process.

2. CALIBRATION BASICS

MIRAS normalized correlations are measured by means of 1-bit digital correlators. A Noise Injection Radiometer (NIR) placed in the hub, measures the scene mean temperature [4]. It also acts as reference radiometer to calibrate the PMS (Power Measuring System) in each LICEF, when switched to the internal Noise Distribution Network (NDN) at LICEF port C. The visibility samples are corrected from instrumental errors and denormalized according to:

$$V_{kj} = \frac{\sqrt{T_{sys_{Ak}} T_{sys_{Aj}}}}{G_{kj}} M_{kj} \ , \ T_{sys_{Ak}} = \frac{v_{Ak} - v_{offk}}{G_k^A}$$

Computation of normalized correlations M_{kj} and the Fringe Wash term G_{kj} is thoroughly detailed in [5]. $LICEF_k$ system temperature referred to the antenna plane, T_{sysAk} (A=V,H), is obtained from PMS_k voltage reading . The PMS amplitude at the antenna plane G_k^A and offset v_{offk} are calibrated by means of the so-called *two-level four-point method* [6,7]. The calibration procedure makes use of two-level (HOT and WARM) noise sources that injected the signals to the LICEF C port by means of a noise distribution network. A switch placed at the LICEF front end is used to select the measurement mode.

2. ONE POINT CALIBRATION METHOD

The one-point calibration method will be tested during MIRAS commissioning phase in order to assess its capability to remove the effects of the noise distribution netowork. This would provide and enhanced performance of the instrument by reducing systematic errors in the imaging process (image distortion), the so-called pixel bias.

This work reviews the theoretical background of the one-point calibration approach and presents a comprehensive error budget assessment. Some encouraging results from the tests performed by EADS-CASA-Espacio, Spain at ESA anechoic chamber in Noordwijk in the framework of the MIRAS Instrument Flight Tests are also reviewed.

11. REFERENCES

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