V Reunión de Ciencias Planetarias y Exploración del Sistema Solar (CPESS5)

ANGULAR RESPONSITY CALIBRATION OF RADIOMETERS FOR PLANETARY EXPLORATION MISSIONS

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A calibration technique to obtain the angular response function for planetary multi-radiometer instruments is presented. The technique has been employed for the angular calibration of the DREAMS-SIS sensor. The sensor is a miniaturized multiradiometer designed to take part as one of the EXOMARS 2016 payloads for Mars planetary exploration[1]. The procedure established during DREAMS-SIS angular calibration will be used for the angular calibration in the RDS and SIS'20 Exomars sensors.
The experience during the angular calibration of MetSIS instrument [2] (the precursor instrument of DREAMS-SIS instruments) shows the angular response behavior for the optical channels doesn't follow the cosine response and it is non-symmetrical. Hence, the four-quadrant calibration performed with typical radiometers [3], increase the uncertainty in the final responsivity of the instrument. In order to minimize the sources of error, the solution applied since DREAMS-SIS, it has been to map the FOV of the sensor. Next, by using 2-D spatial techniques a surface can be generated. For that reason, an experimental opto-mechanical setup has been developed to map the complete angular response function in any angle. Experimental data are interpolated using Kriging [4] and Delaunay mathematical tools. In addition, the error sources are analyzed to evaluate the performance of the technique.
The angular response function is verified to calculate the irradiance of a different light source (solar simulator) used during the angular calibration.

The angular calibration set up facility has been designed to provide an automated calibration. For the angular rotation, two axes have been used.

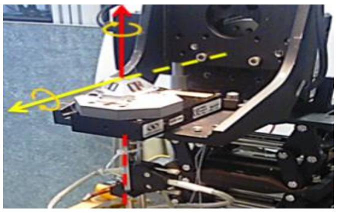

Figure 1: DREAMS-SIS optical axis and rotation axis.

The measurements has been done with a Xenon lamp. The stability of the Xenon lamp was measured continuously with a monitored system based on the same detector technology that Dream-SIS instrument along the 5 hours that take place the calibration was below than 1%.

The experimental grid data (see example in Figure 1) has been chosen to optimize the mathematical fitting procedure and to provide dense sampling data to characterize each facet for each optical sensor, see Figure 2. In the case of DREAMS-SIS the calibration included a total of grid between 2500 and 3200 points.

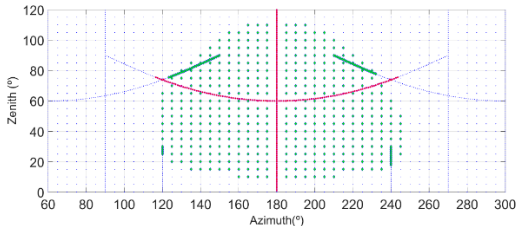

Figure 2: Example of sample measured data for NIR channel.

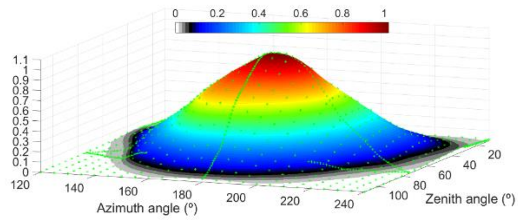

Figure 3: Fitted data from Figure 1 using kriging

[1] V. Apestigue, J.J. Jiménez et al "DREAMS-SIS: A Miniature Instrument for the Measurement of Atmospheric Optical Depth on ExoMars 2016 EDM". International Workshop on Instrumentation for Planetary Missions, Greenblet, Maryland (IPM-2014).
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[4] Luis Miguel Sanchez-Brea, E. Bernabeu. "Determination of the optimum sampling frequency of noisy images by spatial statistics". Applied Optics, Vol. 44, No.16, June 2005.