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G. Kovacs

The Calibration of a Spacecraft Camera

The Dawn spacecraft was launched Sept 27 2007 as part of a joint mission of NASA and ESA. Its target is the asteroid belt, and during its nine years long mission, the device will study the asteroid Vesta and the dwarf planet Ceres. The mission is supposed to reveal information about the early solar system and the processes that dominated its formation. Among the several scientific instruments, the spacecraft carries two framing cameras (FC) for scientific imaging and navigation purposes. These functional eyes will support spacecraft maneuvers, orbit insertion and maintenance at the target asteroids. These cameras were developed and assembled by the Max Planck Institute for Solar System Research (MPS), and the German Aerospace Center (DLR). The cameras were calibrated by the Department of Mechatronics, Optics and Engineering Informatics of the Budapest University of Technology and Economics. The following presentation describes the main steps of the calibration process.

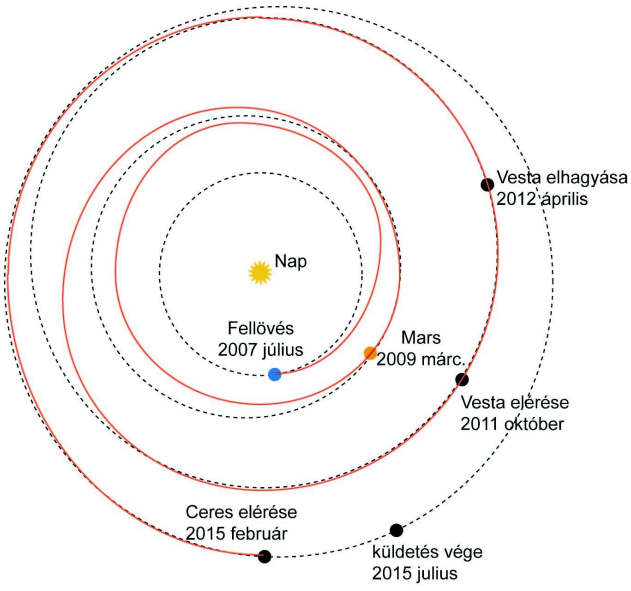

Figure 1. The orbit of the Dawn spacecraft

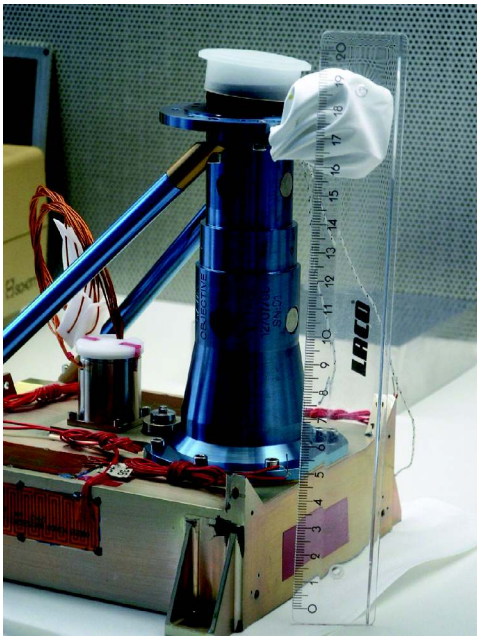

Figure 2. The experimental camera

The optical calibration of the FC focused on the imaging properties of the integrated device, including the lens system, baffle, filters, the CCD and the electronics. Several combinations of CCD exposures and spectral bands were tested to gain as much information as possible on the resolution, contrast, homogeneity and irradiation properties. The measurements were carried out in four main categories.

PSF: the actual focal position and the image resolution were determined by the Point Spread Function (PSF) measurement.

MTF: The Modulation Transfer Function (MTF) measurement shows the contrast ratio of the FC. Different spatial resolutions on a USAF target were imaged by the optical system up to the CCD's Nyquist frequency. The contrast values at the various spatial frequencies provided the modulation transfer function which had to be in line with the optical specifications.

RAD: The cameras spectral response and the whole system's quantum efficiency were determined by the RAD tests. The exit slit of a high resolution monochromator was imaged by a collimator and the camera to the CCD.

FLAT: A large integrating sphere was used to test the light energy distribution homogeneity over the detectors surface.

The optical calibration of the FCs successfully demonstrated that the design requirements are fulfilled by the cameras' performance. The measurement data analysis showed that the focal position is well defined; the contrast ratios are as required. The FLAT and illumination energy measurements provide the necessary data for the image data reduction pipeline.

References:

[1] James Janesick: Scientific Charge Coupled Devices, SPIE Press 2001
[2] W. Romanishin: An Introduction to Astronomical Photometry Using CCDs, University of Oklahoma 2006
[3] Glenn E. Healey, Raghava Kondepudy: Radiometric CCD camera calibration and noise estimation, IEEE Transactions on Pattern Analysys Vol 16 No 3.
[4] http://www-ssc.igpp.ucla.edu/dawn
[5] http://neo.jpl.nasa.gov/missions/dawn.html

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