GEOMETRIC IMPROVEMENT FOR EARTH OBSERVATION APPLICATIONS

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1. ABSTRACT

Since SPOT1, the French national space center (CNES) has worked on improving the geometry of Earth observation spacecrafts. The accuracy of sensor calibration is one of the main key points for any Earth observation application such as orthorectification, DEM generation or surface change detection [6]. Two families of methods have been developed by CNES for twenty years: absolute methods and relative methods. These methods are used to characterize a pushbroom acquisition along the detector line and the time line. By this way, the viewing directions are measured and the residual of the spacecraft's attitude angles (not restituted by the AOCS) are estimated. This information can complete the geometric model of all the scenes acquired by the instrument and is used in all geometric applications. We will first consider the absolute methods and then the relative methods.

Since early 1999, CNES has worked on defining, equipping and imaging so-called ground "geometric supersites", for its needs in image quality assessment [1], [2], [3], [4]. Various criteria guided the definition of these supersites, involving the characteristics of high resolution Earth observation satellites and the image quality assessment methods. The main goal of a supersite is to provide absolute high resolution geometric references. The accuracy of sensor calibration that can be obtained using image matching techniques depends both on the planimetric and altimetric accuracy of the references. In order to produce this kind of reference, very high resolution aerial images are used (10cm ground sampling distance). This kind of reference is used to calibrate space-based sensors like SPOT and Pleiades. In this paper, we show how to build an absolute geometric supersite as a reference and use it for sensor calibration.

Example : The geometric supersite of Salon de Provence

The relative methods consist in comparing two or more sensors [5]. The accuracy of the calibration depends on the accuracy of the sensor used as a reference. In this context, a supersite can be considered as an existing sensor. Some examples will also be presented in this paper comparing SPOT5 and Kompsat2. The two sensors compared may also be on the same platform. Staggered array is the standard for high resolution Earth observing systems, particularly for panchromatic/multispectral acquisition. Due to the shifts of linear arrays in the telescope focal plane along the satellite velocity direction, the registration performance are sensitive to both terrain elevation and high frequency disturbances of the platform [7]. This paper also shows how this sensitivity may become a twofold asset. It allows to retrieve the high frequency of attitude disturbances ranging above the gyros cutoff frequency and to refine the viewing directions.

At last, other methods taking advantage of the agility of new systems (like Pléiades) allow to calibrate an Earth observation system by itself.

All these methods completing the auxiliary data of an acquisition are necessary to improve the geometric model. These improvements allow a registration accuracy near 0.1 pixel, which is a requirement for most Earth observation applications.

2. REFERENCES

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