CHRIS/PROBA TOOLBOX FOR HYPERSPECTRAL AND MULTIANGULAR DATA EXPLOITATIONS

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ABSTRACT

The ESA Project for On-Board Autonomy (PROBA) is a technology demonstration experiment to take advantage of autonomous pointing capabilities of a generic platform suitable for Earth Observation purposes. The PROBA instrument payload includes the Compact High Resolution Imaging Spectrometer (CHRIS). The CHRIS/PROBA system [1] has been operating since 2002. It provides high spatial resolution hyperspectral/multiangular optical data, which constitutes a new generation of remote sensing information to be processed and exploited.

On one hand, the PROBA platform provides pointing in both across- and along-track directions. In this way, the CHRIS/PROBA system has multiangular capabilities, acquiring up to 5 consecutive images from 5 different view angles in the same satellite overpass. Each imaged target has an associated "fly-by" position, i.e. the position on the ground track when the platform zenith angle, as seen from the target, is a minimum. The platform acquires the images at times when the zenith angle of the platform with respect to the fly-by position is equal to a set of fly-by zenith angles: ±0°, ±36° or ±55°. Negative angles correspond to acquisition geometries in which the satellite has already flown over the target position.

On the other hand, CHRIS measures over the visible and near-infrared (VNIR) spectral region from 400 nm to 1050 nm. Because of limits in the on-board storage, CHRIS operates under different application-driven acquisition modes. Those reflect a necessary compromise between spatial coverage, spatial resolution and number of spectral channels. The CHRIS swath at nadir is about 14 km, the nominal ground sampling distance at nadir ranges from 17 to 34 m, and the VNIR spectral window can be registered with up to 62 spectral channels in the hyperspectral mode.

The number of users and applications of the CHRIS/PROBA hyperspectral and multiangular data is constantly growing along the mission lifetime. However, CHRIS/PROBA data are delivered as Level 1b top-of-atmosphere radiance data, while a geometrically-corrected reflectance product is normally required as a starting point for the subsequent development of scientific and commercial remote sensing applications. Difficulties in the complex CHRIS/PROBA data pre-processing were reported by a number of users as the main obstacle for the exploitation of the data. ESA responded to this need by supporting the implementation of a set of CHRIS/PROBA-specific pre-processing tools in the Basic ERS & Envisat (A)ATSR and Meris

(BEAM) toolbox [2]. BEAM is an open source user-friendly software for the exploitation of Earth Observation data. The set of developed CHRIS/PROBA tools in BEAM consists of four independent modules: noise reduction [3], cloud screening [4], geometric correction [5] and atmospheric correction [6]. In short, the noise reduction module corrects for dead and bad pixels and for vertical striping; the cloud screening module derives a probabilistic cloud mask making use of spectral and spatial cloud features; the geometric correction module enables the co-registration of the 5 acquisition angles and the projection onto a reference cartographic system; the atmospheric correction module performs the surface reflectance retrieval after compensation of atmospheric effects. The modules are implemented to work either independently or in a sequential way in which the output of each module is used as an input by the next one in order to complete a consistent processing chain. The theoretical background of each of those modules, sample validation results, and an overall description of their implementation in the BEAM environment will be presented in this contribution.

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