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Comet Interceptor's EnVisS Camera: Multispectral and Polarimetric Full-sky Imager for a Comet Flyby

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Abstract

Comet Interceptor is a proposed ESA F-Class mission to study a dynamically new comet with an instrument suite incuding, amongst other thing, several cameras. Here, the details and expected data of one of its imagers, EnVisS, will be presented. Using push-broom scanning, EnVisS is designed to capture the entire visible sky both spectrally and polarimetrically as the spacecraft traverses the comet's environment.

1. Introduction

Push-broom scan imaging allows fast acquisition of large coverage images in several spectral ranges simultaneously. It is extensively used for surface imaging from orbital platforms with high performance cameras and a linear scan motion [1-3]. Fast moving spin stabilised platforms such as flyby probes and planetary penetrators offer valuable imaging opportunities for short-lived events such as descents, landings and small body rendezvous. However, the high rate of translational and rotational motion relative to the scene, the short duration of the imaging opportunity and the mass and size constraints imposed on spacecraft payloads precludes the use of instruments of the types discussed in references 1-3. Rotational push-broom imaging, an adaptation of the traditionally linear scanning method, uses the spin of the spacecraft as the camera's scanning action to overcome high scene motion and allow multispectral imaging with detector-bonded filters. This facilitates the capture of scientifically valuable images with large angular coverage from a compact, low mass and low complexity camera.

2. The EnViSs Camera

It is intended that Comet Interceptor, a proposed F-Class mission to perform a flyby of a dynamically new comet [4], will employ this method of imaging with its EnVisS (Entire Visible Sky) camera. It will image through wide angle optics, covering a field of view of 180°, whilst continuously and repeatedly scanning through a field of regard of 360° as the spacecraft spins. This allows the acquisition of images covering the full 4π steradians of the sky as seen by the spacecraft during its flyby, capturing the comet's coma, dust jets and nucleus (Figure 1). Images captured throughout the flyby will give views from a wide range of phase angles, and record the evolution of the dust environment. A CMOS sensor with spectral and polarising strip filters mounted over the focal plane assembly will measure light in multiple spectral ranges and polarisation orientations, allowing multispectral and polarimetric analysis of the coma constituents.

The use of scan rather than frame imaging allows data to be collected through multiple different optical filters simultaneously, without the need for a filter wheel. This elimination of mechanical parts simplifies the instrument's operation, avoids the challenges involved with filter changes during a rapid flyby, and is conducive to a compact, low mass instrument.

The instrument's full sky coverage will provide information on the comet's entire environment, whilst the photogrammetry permitted by the spacecraft's changing perspective will allow the study of the neutral gas, dust and plasma components of the coma's three dimensional structure. The series of all-sky images that would be captured over the course of a flyby constitute a low frame rate video documenting the encounter. Each individual frame can be viewed in interactive panorama viewers, and virtual reality setups, allowing the comet to be visualised in a unique manner that is of value to both science and outreach. The camera has the opportunity to view a diverse range of scenes as the spacecraft approaches, enters, traverses and departs the comet's environment.

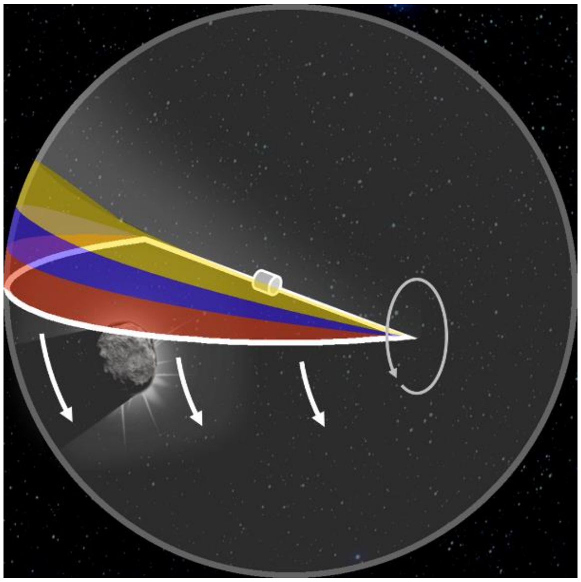

Figure 1: Illustration of EnVisS' full-sky spin scanning. Coloured strips represent the instrument's multiple scan lines which build up full sky images as the spacecraft rotates.

Previous work to simulate the performance of, and data products and analysis from a rotational push-broom camera aboard a planetary penetrator [5] has been extended to estimate EnVisS' capabilities, and simulate the images it would return from a comet flyby (Figure 2). Techniques such as selective binning of pixels and co-addition of consecutive frames will allow the camera to collect sufficient signal of gas and dust structures to permit quantitative analysis, whilst also keeping data rates within Comet Interceptor's limits.

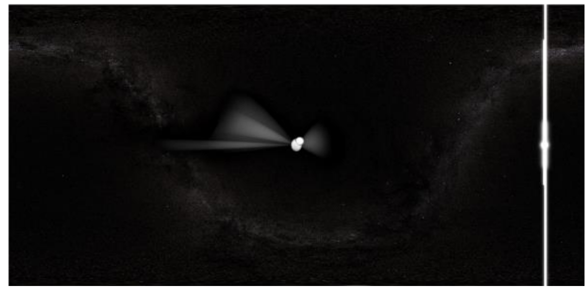

Figure 2: Example radiometrically simulated EnVisS image of comet nucleus and dust jets during flyby. The image's x and y axes cover 360° and 180° respectively, capturing the entire visible sky. Saturation of detector columns viewing the Sun is also simulated.

Image simulation software is being developed to produce radiometrically representative simulations of the camera's images. These simulated data will allow mock analysis in order to model the instrument's science products, and prepare bespoke analysis techniques for its images.

References

[1] McEwen A. S. et al.: Mars Reconnaissance Orbiter's High Resolution Imaging Science Experiment (HiRISE). J. Geophys. Res., Vol. 112, pp. 2124-2139, 2007.

[2] Jaumann R. et al.: The High Resolution Stereo Camera (HRSC) experiment on Mars Express: Instrument aspects and experiment conduct from interplanetary cruise through nominal mission. *Plan. and Space Sci.,* Vol. 55, pp. 928-957, 2007.

[3] Robinson M. S. et al.: Lunar Reconnaissance Orbiter Camera (LROC) Instrument Overview. *Space Sci. Rev.,* Vol. 150, pp. 81-124, 2010.

[4] Jones G. H. et al.: this meeting.

[5] Brydon G. and Jones G.: Rotational Push-broom Imaging from a Planetary Penetrator, EPSC 2018.