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Rotational Push-broom Imaging from a Planetary Penetrator

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Abstract

Penetrators offer the potential to deliver scientific payloads to the surface and subsurface of solar system bodies at relatively low cost. An imaging regime during the delivery of the penetrator would provide valuable outreach, science and engineering data to complement data from any in situ penetrator experiments at bodies such as Earth's moon, Mars, and Europa. Visible images assist in the determination of landing site location, as well as the nature of the surface in that region. Multispectral and polarimetric imaging enhance the science potential by providing additional valuable compositional and structural information. Changes in imaging geometry throughout a penetrator's descent provide scale and three-dimensional information on the local terrain.

A concept will be presented for a rotational push-broom camera with multispectral and polarimetry capabilities for use on a penetrator. Scanning motion is to be provided by the penetrator's spin stabilisation, and wide angle optics imaging from nadir to horizon would permit a 360-degree field of regard with full surface coverage. An area array detector (CCD or CMOS) with a combination of multispectral and polarising filters oriented perpendicular to the scene's scan motion would allow the simultaneous capture of multiple images.

Imaging conditions change significantly throughout a penetrator's descent. Expected resolutions would obviously increase as the camera descends, whilst the imaging footprint would decrease, producing a sequence of nested multi-scale images. Optimum imaging heights and exposure times are a trade-off of desired surface coverage, resolution and signal requirements.