Identifying optimal working conditions for close-up imagining during the ExoMars rover mission

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A Close-Up Imager named CLUPI is one of the instruments that will be onboard the Rosalind Franklin rover, a robot that will explore the surface of Mars in the framework of the ESA/Roscosmos ExoMars mission. CLUPI will be principally used for acquiring close-up images of rock textures and sedimentary structures, identifying ma- terials that may record information about the hypothetical existence of past microbial life. Although the technical specifications of CLUPI are well known, it is not possible to readily translate such specifications in terms of feasibility to recognize ”textures of interest” at a given distance under specific light conditions on Mars. Accurate predictions are important for making fast and informed decisions during the daily tactical planning of the rover. Here, we describe the results of some mission-preparation activities, during which a commercial camera that allows for producing images analogue to those of CLUPI has been used to photograph rock samples in an indoor facility (i.e., the Marslabor of the University of Basel) that has been built ad hoc for simulating a Martian land- scape. By varying the working distance and light conditions it has been possible to perform a preliminary assessment of the minimal-working-distance required for interpreting rock textures and sedimentary structures that are potentially present on Mars, including textures that allow for differentiating sedimentary rocks from igneous rocks, grains that allow for classifying sedimentary rocks based on their granulometry, and stromatolitic laminations representing morphological biosignatures. In general, the results suggest that rock textures tend to be recognizable even from distances that exceed those one would predict based on the resolution of the instrument and the size of the structure or particles that defines the rock texture or sedimentary structure. We also show that the angle between the illumination axis (i.e., the direction of incident light) and the target surface plays a sig- nificant role for the recognition of textural and compositional heterogeneities within the acquired images. The produced data represents a first step in identifying ideal CLUPI working-distances and illumination, and in pre- paring an image database that will be of help for optimizing rover operations and the scientific return of CLUPI during the ExoMars mission.

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