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LOW COST OPTICAL IMAGING SYSTEMS FOR FUTURE PLANETARY MISSIONS

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When we talk about planetary exploration missions most people think spontaneously about fascinating images from other planets or close-up pictures of small planetary bodies such as asteroids and comets. Such images come in most cases from VIS/NIR- imaging- systems, simply called 'cameras', which have typically been built by scientific institutes in collaboration with space-industry. They consist of silicon CCD or CMOS-image sensors, sophisticated electronics and optical subsystems.
They are usually part of the high-priority payload of planetary missions and they are often the most expensive instruments of the scientific payload.

The question is, can we design and build low cost imagers that are compatible with the challenges of future planetary missions? How, if at all, could they be built for less money without compromising performance, reliability and scientific output.

The exploration of Mars is ongoing. NASA and ESA are planning future missions to the outer planets such as the icy Jovian moons. Exploration of asteroids and comets are at the focus of several recent and future missions. Furthermore, the detection and characterization of exo-planets will keep the science community busy for the next generations.

The paper discusses the challenges and visions of imaging systems for future planetary exploration missions and possibilities for cost reduction. The focus of the talk is about VIS/NIR- imagers for planetary landers and rovers.

The basic design layout of descent- lander and rover cameras is shown in Figure 1. The key-components are optics, a silicon detector array, and a readout-electronics. In many cases, some colour- or spectral filters are used passively or actively to gain colour and spectral information of the scientific targets.
The object light is projected by the lens on the detector array that converts the optical-information into an electrical signal which is then further processed before transmission to Earth. The detector dominates the electro-optical performance of the imager and it has a major impact on the dimensions and cost of the optical subsystem. Furthermore, in most lander cameras, the detector is the most expensive component and can be regarded as the cost driver. Therefore, we concentrate on the detector as one of the key components in the cost reduction exercise.

The paper will provide an overview about some past, existing and future scientific imagers in planetary space missions from a detector point of view.
Two examples will be presented in more detail: The MASCOT camera for Hyabusa -2and the ExoMars-PANCAM. Some recommendations will be derived for future missions.