New Technological Developments and Requirements for Imaging the Moon from Orbit and On-Ground

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A major task for lunar exploration is to determine the structure and physical state of its surface. Surface features with particular morphology and the topography have frozen in the action and effects of processes and forces shaping the Moon as a planetary body throughout its history. In order to extract detailed and quantitative information and to enable scientists to interpret the imagery satisfactorily, a laterally and vertically resolved portray of the surface at high resolution is required. The only way to obtain this kind of information is imaging from orbit at high spatial resolution, preferably also in stereo and in color. The existing imagery from Lunar Orbiter, Apollo, and Clementine provides global coverage at about 100m spatial resolution while the upcoming missions SMART-1 and Selene are aiming to obtain images with a spatial resolution of down to 10m. Thus, future lunar imaging from orbit will concentrate in solving the many still open scientific questions as well as engineering tasks which both require detailed information down to the meter range.

In orbit, the camera replaces the human eye and provides a birds-eye perspective of the lunar surface and of its environment. On ground, however, from landers and rovers, a camera enables scientists to analyze the surroundings and to put all other measurements in a broader context. But the high value of camera instruments for lunar missions is not only due to the science aspects but also stems from an engineering and programmatic point of view. Images play a key role for the navigation of spacecraft and provide the required reconnaissance data for the preparation, planning, and conduct of future Moon missions. A successful lander mission needs detailed a priori knowledge of the landing site at high spatial resolution. Any mobile surface activities can only be performed on the basis of appropriate reconnaissance information from previous orbital imaging and some kind of visual presence on-site. Last but not least, images provide the type of science information, which can be easily accessed by the general public. Camera experiments therefore have an enormous potential to raise public interest and to promote the exploration of the Moon by documenting and monitoring mission progress and achievements.

An overview of new developments in sensor technologies and optics will be given, which have enabled the design of small and light-weight camera instruments. For example, the super-resolution channel of the HRSC experiment on Mars Express which is actually being built, would yield a spatial resolution of < 1m/pixel at 100 km altitude. Based on instruments developed for the Rosetta Lander, the prototype of a panoramic lander camera providing color and stereo capability is actually being assembled. Thus, a variety of camera experiments is available to meet the imaging requirements and constraints of future lunar missions.