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Local remote sensing opportunities with a lunar robotic telescope

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It has been suggested that the Moon is suitable site for robotic optical telescopes because it's nights are two weeks long and even longer effectively in some shielded high latitude craters. However several concerns are hindering the future development of robotic telescopes on the Moon, namely dust accumulation, micrometeoroids, moon quakes, maintenance etc, and so it appears unlikely that large aperture scopes would be sent before smaller aperture test-bed equipment. However the argument for sending smaller aperture equipment for astronomical research is also weak due to their smaller light collecting ability.

One solution to this dilemma is to send a small low cost aperture telescope (e.g. 1 m diameter) but with multiple science roles. Johnson et al. (2002) and others have suggested remote sensing studies of the Earth from the Moon. This of course would be supportive to existing Earth-orbit satellites, but not an entirely compelling reason to do this apart from the fact that no fuel needs to be used to maintain orientation, unlike Earth-based satellites. So it is suggested in this abstract that any future test-bed robotic telescope could also be utilized to generate exceedingly high resolution panoramic mosaics around the landing site of the equipment. One major problem of existing planetary robotic vehicles are that they cannot access easily targets beyond their driving capability e.g. up the side of a cliff. A telescope however would allow an imaging system to obtain mm to cm scale resolution imagery out to distances of tens of km.

Consider for an example an f/7 one metre aperture robotic telescope with say 10x10 micron sized pixels operating at a wavelength of 580 nm. At a distance of just 100 m the image scale would be 0.14 mm/pixel, and even at a distance of 50 km (in the realms of orbiter scale imagery), the image scale would still be 7 cm/pixel without approaching the diffraction limit of the telescope. Higher image resolutions and scales could be achieved by going to shorter wavelengths and using a higher f/No. For the above scenario, an unprecedented 4.3 million pixel wide by 0.4 million pixel high size image mosaic (1.4 terra bytes) could be constructed for say a 360 deg wide azimuth x 30 deg high altitude horizon sweep. The practicalities of achieving this would require many days of repeat imaging at specific illumination conditions in order to produce a seamless mosaic and does not take into account the use of different wavebands. Also the system would have to cope with the depth of focus of issues from close range ˜100m out to infinity, perhaps by moving the camera in the focal plane. Unlike an orbiter, though, because the robotic telescope would be static between exposures, various length exposures could be made of the scene in order to gain sufficient S/N quality images in numerous narrow wavebands suitable for mineralogical studies. Other surface applications could be to: 1) image calibration targets and stars, looking for displacements in the surface from quakes or meteoroid impacts, 2) polarimeter imaging of potential electrostatically levitate dust clouds on the horizon before sunrise.