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Novel 3D imaging techniques for improved understanding of planetary surface geomorphology.

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Understanding the role of different planetary surface formation processes within our Solar System is one of the fundamental goals of planetary science research. There has been a revolution in planetary surface observations over the past decade for Mars and the Moon, especially in 3D imaging of surface shape (down to resolutions of 75cm) and subsequent correction for terrain relief of imagery from orbiting and co-registration of lander and rover robotic images.

We present some of the recent highlights including 3D modelling of surface shape from the ESA Mars Express HRSC (High Resolution Stereo Camera), see [1], [2] at 30-100m grid-spacing; and then co-registered to HRSC using a resolution cascade of 20m DTMs from NASA MRO stereo-CTX and 0.75m DTMs from MRO stereo-HiRISE [3]. This has opened our eyes to the formation mechanisms of megaflooding events, such as the formation of Iani Vallis and the upstream blocky terrain, to crater lakes and receding valley cuts [4]. A comparable set of products is now available for the Moon from LROC-WA at 100m [5] and LROC-NA at 1m [6].

Recently, a very novel technique for the super-resolution restoration (SRR) of stacks of images has been developed at UCL [7]. First examples shown will be of the entire MER-A Spirit rover traverse taking a stack of 25cm HiRISE to generate a corridor of SRR images along the rover traverse of 5cm imagery of unresolved features such as rocks, created as a consequence of meteoritic bombardment, ridge and valley features. This SRR technique will allow us for $\approx$400 areas on Mars (where 5 or more HiRISE images have been captured) and similar numbers on the Moon to resolve sub-pixel features. Examples will be shown of how these SRR images can be employed to assist with the better understanding of surface geomorphology.

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