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Very high resolution Martian topographic data processing and its application for virtual reality implementation

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The heritage of in-orbit high resolution imaging technology has been implemented in a series of Martian Missions, such as HiRISE (High Resolution Imaging Science Experiment) and CTX (Context Camera) onboard the MRO (Mars Reconnaissance Orbiter). In order to fully utilise the data derived from image systems carried on various Mars orbiters, the generalised algorithms of stereo image processing and photogrammetric Mars DTM extraction have been developed by Kim and Muller (2009). Due to the successful "from medium to high" control strategy performed during processing, stable horizontal and vertical photogrammetric accuracy of resultant Mars DTM was achievable when compared with MOLA (Mars Obiter Laser Altimeter) DTM. With the well verified geodetic quality and up to sub-meter scale spatial resolution based on robust image matching algorithm, the stereo topographic products are of great value for Martian Virtual Reality (VR) implementation replacing the field trip activities for the geomorphological interpretation. For this purpose, the DTMs and ortho-rectified imagery obtained from various stereo in-orbital imagery such as HRSC (High Resolution Stereo Camera) of Mars Express, CTX and HiRISE including potential future rovers landing site were processed. Then the topographic data were indigested into a powerful VR system which was provided by Korea Institute of Science and Technology Information (KISTI). As the VR system was established based on high speed parallel processors, high definition 3D display, control pointer and visualisation packages, a full-scale, seamless and real-time visualisation of Mars virtual environment was realised. Consequently the VR scheme implemented in this research will give great opportunities for the scientific researches in Martian geological and geomorphological explorations.

Two critical issues regarding the VR implementation scheme are further investigated. Firstly, it is found that the accommodation of a full topographic data set from the stereo processor is limited in most of the VR base software environment. Therefore, the employment of SEDRIS (Environmental Data Representation & Interchange http://www.sedris.org/) is proposed to construct indigenous environment replacing current commercial software. The merit of the SEDRIS is that all environment factors such as atmospheric factors, topographic blunders and any other possible situations will be able to synthetically interact with the photogrammetrically constructed topography. Secondly, for some VR applications, the 3D data with even higher resolution than current product is required. Since the stereo height point density has been reached to the technical limit, other technical possibilities such as the multi image shape from shading are explored. As described above, it is understood that the quality of topographic material is crucial factor for the successful VR implementation, hence we will continuously promote the development of a parallelised and high accuracy topographic processor.