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Monitoring Gravel Volume Change by Very High Resolution Satellite Image Stereopairs

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Taiwan is located on the convergent boundary of the Philippine Sea Plate and the Eurasian Plate. Due to the active orogenic movement, the rock formations are fragmented and the weak joints are developed. In recent years, heavy rainfall accompanied with the occurrence of river surges carry a large amount of broken sand and gravel to the downstream. The accumulation of a large amount of sand and gravel in the river may threaten the safety along the river bank, such as channel diversion and flooding. Therefore, the river channel needs to be dredged regularly to reduce the risk to the residents and properties. Because the dredging area is scattered and difficult to reach, on-site measurement has become a time-consuming and labor-intensive method. With the improvement of satellite technology, it is feasible to use efficient remote sensing technology to generate point clouds and a surface elevation model (DSM) for monitoring purposes. However, several problems still exist in this technology, including the scatteredness of control points and feature points, instability of the platform, varying imaging conditions, and time differences in the matching process. To solve the DSM errors caused by these problems, this study uses 3-D point cloud registration method to align the horizontal and vertical directions and tries to reduce elevation system error due to the failure of co-registration. First, feature description, extraction, and feature matching are performed. Second, the iterative closest point algorithm (ICP) is used to closely match two sets of point clouds after coarse alignment. Finally, elevation difference between two dets of DSM is verified with ground measurement data and the accuracy of the point cloud registration is assessed. We use a dredging area in Laonong River, Taiwan, as an example to monitor gravel volume change in river channel by high resolution Pléiades images and UAV in different time periods. Our preliminary results show that the spaceborne technology could achieve submeter level accuracy in monitoring height changes in each transect.