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An automated pipeline for the photogrammetric analysis of high frequency terrestrial optical images : application to rock slope stability problems

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Digital passive sensors (i.e. sensors that operate in the visible light spectrum), such as Single Lens Reflex (SLR) cameras, are increasingly being used for ground-based geohazards monitoring (ice glaciers, volcano flanks, landslides) partly because of their low cost compared to expensive terrestrial laser scanner (TLS) or radar imaging (GB-InSAR) systems. Indeed, due to the large consumer market, sensor resolution is increasing rapidly; for example, inexpensive > 15 megapixel cameras are available allowing arrays of cameras to be set up in the field.

Passive optical sensors provide qualitative information (identification of changes in the surface morphology, weather conditions, presence and position of snow cover) and to quantitative 3D information using stereo-views (creation of Digital Surface Models, displacement monitoring, and tracking of changes of the surface states).
In the case of slope stability problems, most recent research has focused on the development of image correlation techniques to determine the average spatial shift by maximizing cross-correlation functions between at least a pair of stereo-images. This technique has proven its performance for characterizing the displacement fields of ice glaciers and slow-moving landslides at sub-pixel accuracy (1/10th pixels) and generates a pseudo-continuous map of the deformation. Other application consists in the documentation of changes in the morphology of rockfaces with the quantification of erosion rates or the detection of rockfalls scarps and accumulated debris. For the analysis of long time series, automated pipelines are needed to process the amount of data.

The objective of this work is to design, test and implement an automated image processing pipeline for the analysis of monoscopic and/or stereo-scopic image time series from fixed terrestrial optical cameras. The processing pipeline is based on the open-source photogrammetric library MicMac. It associates modules for the selection of the image sequences, tools for image stack registration and the correction of the camera movement, and tools for change detection.
The pipeline will be presented and its performance evaluated on the basis of two use cases, respectively the Sanières rockslide (Alpes-de-Haute-Provence, Ubaye, France) and the Rampe des Commères unstable rocky slopes (Isère, Romanche France).

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