SUB-PIXEL PRECISION IMAGE MATCHING FOR DISPLACEMENT MEASUREMENT OF MASS MOVEMENT USING NORMALISED CROSS-CORRELATION

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ABSTRACT:

This study evaluates the performance of two fundamentally different approaches to achieve sub-pixel precision of normalised cross-correlation when measuring surface displacements on mass movements from repeat optical images. In the first approach, image intensities are interpolated to a desired sub-pixel resolution using a bi-cubic interpolation scheme prior to the actual displacement matching. In the second approach, the image pairs are correlated at the original image resolution and the peaks of the correlation coefficient surface then located at the desired sub-pixel resolution using three techniques, namely bi-cubic interpolation, parabola fitting and Gaussian fitting. Both principal approaches are applied to three typical mass movement types: rockglacier creep, glacier flow and rock sliding. In addition, the influence of pixel resolution on the accuracies of displacements using image matching is evaluated using repeat images that were resampled to different spatial resolutions. Our results show that intensity interpolation using bi-cubic interpolation (first approach) performs best followed by bi-cubic interpolation of the correlation surface (second approach). Both Gaussian and parabolic peak locating perform weaker. By increasing the spatial resolution of the matched images by intensity interpolation using factors of 2 to 16, 40% to 80% reduction in mean error could be achieved. The study also quantifies how the mean error, the random error, the proportion of mismatches and the proportion of undetected movements increase with increasing pixel size (i.e. decreasing spatial resolution) for all of the three mass movement types investigated.

TOPIC: Change detection and process modelling
ALTERNATIVE TOPIC: Geometric modeling