

Grouped frequent sequential patterns derived from terrestrial image time series to monitor landslide behaviour – Application to the dynamics of the Sanières/Roche Plombée rockslide.

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Image time series acquired with remote sensing methods based on optical terrestrial photogrammetry have great potential for understanding and monitoring the Earth surface dynamics at local scale, and are particularly interesting for landslide monitoring. Image correlation techniques can be applied to calculate the displacement fields, in either the image geometry or the terrain geometry if orthorectification procedures are applied. The resulting products are times series of displacement vectors for each epoch in which knowledge extraction techniques can be applied to discover relevant movement patterns in space and time.

We used an unsupervised method (Grouped Frequent Sequential patterns / GFS-patterns) based on the mining of the displacement field. The method was originally developed for the analysis of time series of satellite images. It involves the extraction of trends / sub-trends affecting each pixel covering at least a minimum surface area and sufficiently connected to each other.

The results of the mining are presented in spatio-temporal location maps (STL-map) of each GFS-pattern. In these maps, the spatial information is given by the pixel locations and the time information is displayed using a color ramp.

The method is tested on a time series of 36 optical terrestrial images of the Sanières/Roche Plombée rockslide (South East French Alps) from 28 of July to 1 September 2014. From this series 35 2D displacement fields were calculated for epochs of three days, and the time series of vector magnitude and direction were analysed with GFS-patterns / STL-map.

The method allowed identifying several patterns corresponding to different kinematical behaviour of the rockslide (long-term creep at the top of the slope, surficial movement of the debris at the base of the slope).

The unsupervised knowledge extraction method GFS-pattern / STL-map, originally developed to analyse time series of satellite images showed in this study real possibilities of use for documenting the behaviour of landslides from optical photographs.