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REAL-TIME GPS LANDSLIDE MONITORING UNDER POOR SATELLITE VISIBILITY

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Among the available technologies such as cables and lasers, GPS is being increasingly used for automated continuous monitoring of landslides or avalanches. The timely identification of precursory movements of landslides could save lives and minimise collateral damage.

Carrier phase observations from more than four GPS satellites allow relative displacements to be measured with centimetre accuracy. However, signals from four satellites with good geometry are not always guaranteed, as the landslide sites are often located along mountain slopes, which are subject to poor satellite visibility. Such landslide locations may, therefore, experience several minutes to hours of positioning discontinuity for some periods of the day. The effect of the availability of satellite signals is greater for sites located on north-facing slopes due to GPS orbit characteristics.

We have investigated a method for detecting a displacement of the order of millimetres under poor satellite visibility. We estimated the displacement without differentiating the positioning results, supposing that a landslide occurs along the slope in the direction of maximum inclination (this assumption could be later replaced with a landslide outbreak model for a particular site).

In this paper, we discuss our algorithms permitting continuous landslide monitoring for low visibility observations and some results of field tests. We discuss our investigations using field data simulating landslides: 1) estimation of displacement supposing a priori knowledge on the antenna location at the monitoring site, 2) necessary time of observations for detecting the landslides and 3) number of necessary observation epochs (sampling intervals and period of observation).