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Hyperspectral and thermal methodologies applied to landslide monitoring

Michela Vellico (1), Paolo Sterzai (1), Carla Pietrapertosa (2), Paolo Mora (3), Matteo Berti (3), Alessandro Corsini (4), Francesco Ronchetti (4), Luciano Giannini (5), and Orlando Vaselli (5)

(1) Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS, GDL - GEOD, Sgonico (TS), Italy (mvellico@ogs.trieste.it, psterzai@ogs.trieste.it / +39 040327307), (2) CNR – Istituto di Metodologie per l'Analisi Ambientale (IMAA), Tito Scalo (PZ), Italy (pietra@imaa.cnr.it), (3) Dipartimento di Scienze della Terra e Geologico-Ambientali, Università di Bologna, Bologna (BO), Italy (paolo.mora@unibo.it, matteo.berti@unibo.it), (4) Dipartimento di Scienze della Terra, Università di Modena e Reggio Emilia, Modena (MO), Italy (allecors@unimore.it, francesco.ronchetti@unimore.it), (5) Dipartimento di Scienze della Terra, Università degli Studi di Firenze, Firenze (FI), Italy (orlando.vaselli@unifi.it, luciano.giannini@unifi.it)

Landslide monitoring is a very actual topic. Landslides are a widespread phenomenon over the European territory and these phenomena have been responsible of huge economic losses.
The aim of the WISELAND research project (Integrated Airborne and Wireless Sensor Network systems for Landslide Monitoring), funded by the Italian Government, is to test new monitoring techniques capable to rapidly and successfully characterize large landslides in fine soils. Two active earthflows in the Northern Italian Appenines have been chosen as test sites and investigated: Silla (Bologna Province) and Valoria (Modena Province).
The project implies the use of remote sensing methodologies, with particular focus on the joint use of airborne Lidar, hyperspectral and thermal systems. These innovative techniques give promising results, since they allow to detect the principal landslide components and to evaluate the spatial distribution of parameters relevant to landslide dynamics such as surface water content and roughness.
In this paper we put the attention on the response of the terrain related to the use of a hyperspectral system and its integration with the complementary information obtained using a thermal sensor.
The potentiality of a hyperspectral dataset acquired in the VNIR (Visible Near Infrared field) and of the spectral response of the terrain could be high since they give important information both on the soil and on the vegetation status. Several significant indexes can be calculated, such as NDVI, obtained considering a band in the Red field and a band in the Infrared field; it gives information on the vegetation health and indirectly on the water content of soils. This is a key point that bridges hyperspectral and thermal datasets.
Thermal infrared data are closely related to soil moisture, one of the most important parameter affecting surface stability in soil slopes. Effective stresses and shear strength in unsaturated soils are directly related to water content, and even pre-failure deformations are largely controlled by this parameter. Preliminary terrestrial and aerial surveys using thermal infrared imaging cameras suggest that obtained data can be useful to map areas characterised by different soil moisture
Hyperspectral data are, then, deeply involved in the landslide components characterization. PCA component analysis is a potential interpretative method that helps identifying the toe, the head and the track zones and allows an accurate landslide mapping. Moreover PCA results can be tightly correlated to the terrain roughness, derived from Lidar data interpretation, as already experimented at the early stage of the WISELAND project
The final purpose of this innovative and experimental project is to identify and widely test the proper methodologies for landslide characterization, trying to perform a powerful solution to rapidly and efficiently monitor wide areas and so being of great help in risk prevention.