IRIS a new powerful tool for Geohazards Assessment by PhotoMonitoring

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Abstract. PhotoMonitoring is based on the concept of "digital image processing", i.e. the manipulation of digital images to obtain data and information. Analyses can be carried out on datasets of images acquired from the same type of platform, on the same area of interest, at different times, and can be carried out by specific algorithms that make it possible to assess any variation in radiometric characteristics (Change Detection) and/or the shift that has occurred in the time interval covered by the acquisition of the images (Digital Image Correlation). Through these applications it is possible to analyze the evolution and significant changes over the observed scenario. By Earth Observation data, PhotoMonitoring allow to better map geological and hydrogeological hazards and understanding the evolution and causes of the processes in place. Different digital approaches can be used to analyze and manipulate the available images and different types of information can be extracted depending on the type of image processing chosen [1].

Basically, digital image processing techniques are based on extracting information about changes by comparing different types of images (e.g., satellite, aerial or terrestrial images) collected at different times over the same area and scene [2]. For image analysis several unsupervised and supervised analytical methods have been proposed to assess the changes and displacements that occur over time, however most of them fail to accurately identify the changes and displacements perceived at the level of human vision. This technique is affected by environmental effects caused by different atmospheric and illumination conditions, different temperatures and sensor-specific characteristics. Using high resolution, accurately positioned and aligned images, it is possible, through DIC, to identify differences, deformations and changes in the observed scenarios with high precision. Recently, several authors have presented interesting results derived from the application of DIC analysis with satellite imagery for landslide displacement monitoring [3,5] [6]. The use of these data processing procedures is currently not very widespread, although there is a wide availability of images coming from different remote sensing sensors (Optical, Radar, Laser), and from different platforms developed for infrastructure and natural hazards monitoring (Satellites, Drones, ground platforms).

NHAZCA S.r.l., a Startup of Sapienza University of Rome, has developed IRIS, an innovative software designed for PhotoMonitoring applications. The software provides different types of processing approaches for remote sensing images, collected from any

platforms (satellite, aerial, terrestrial etc.) and different sensors (Radar, optical, MS/HS) allowing to carry out Change Detection and Displacement Analysis.
The implemented Change Detection method makes use of the Structural Similarity Index, an algorithm originally developed to evaluate the perceived quality of digital television and film images in which the measurement of image quality is based on an initial image taken as a reference. The method here is used on a local scale, iteratively assessing image similarity over a small subset of image pixels using a sliding window approach, allowing for the automatic identification of portions of the scene where changes occurred.
The implemented Displacement Analysis method makes use of different types of algorithms that exploit different analysis techniques (Feature Tracking; Template Matching, Phase Correlation Algorithm [7]).
In this paper are presented and discussed the results obtained from the analysis carried out on different study cases that show the full potential of IRIS with Earth Observation images for the monitoring and study of the impact of Geohazards such as earthquakes, landslides, floods (Fig. 1).

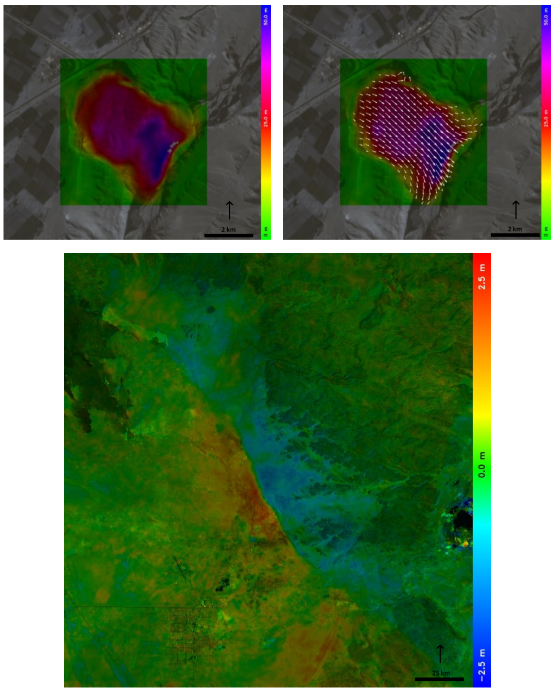

Fig. 1. Examples of IRIS outputs for the analysis, mapping and monitoring of different types of GeoHazard such as the Arequipa Landslides occurred in Perù on 16 December 2020 (top image) or post-earthquake deformations occurred in Ridgecrest, California, M 7.1 on July 6, 2019 (bottom image).

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