Advances in landslide mapping and monitoring combining optical and SAR data in an Artificial Intelligence framework

(Proposer: Prof. Mario Floris)

Landslides are one of the most frequent and widespread natural hazards, causing numerous socioeconomic losses. Optical and radar remote sensing techniques have proven to be the most effective method in the identification, mapping, monitoring, and early warning of large-scale landslides, which are crucial for the assessment and mitigation of geohazards. Among those techniques, high spatial and temporal resolution optical images can detect mass movement and provide historical changes of the land cover. Synthetic aperture radar (SAR) images work as a supplement to optical images to identify and measure ground deformations in any weather condition. The multi-temporal interferometric SAR (MT-InSAR) techniques can capture historical land surface displacement of slow-moving active and reactive landslides with an accuracy of millimeters, which is beneficial for understanding the spatio-temporal evolution of landslides and investigating their triggering factors, e.g., rainfall, earthquake, or anthropogenic activities. Recently, the development of artificial intelligence has promoted the capability of remote sensing in mapping and monitoring landslides. However, both optical and radar images have limitations. In some extreme weather or climate conditions, e.g., heavy rainfall or storm, and some complex geomorphological environments, optical data can have limitations due to the presence of the cloud cover. The main limitations of the MT-InSAR techniques are the large noise of the SAR images, geometric distortions, and the low coherence of the interferograms in the vegetation area where landslides usually occur.

The main purposes of this research are to explore the combination of optical and SAR data in the artificial intelligence framework to map landslides and investigate advanced InSAR techniques for monitoring. Based on this research, the following results are expected: (1) an artificial intelligence landslide monitoring framework, (2) an inventory of rapid- and slow-moving landslides at different scales, and (3) an innovative methodology for mapping and monitoring landslides combining optical and SAR data.