Titolo: Debris flow monitoring by photonic sensors: new frontiers of DAS technology (DEBRIS PHOS)

Codice Progetto: 2022HFWMPC

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Coordinatore nazionale: Consiglio Nazionale delle Ricerche

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Budget totale progetto: 366.189,00 €

Budget UNIPD: 105.506,00 €

Abstract del progetto: The expected increase in extreme meteorological events and related natural hazards is impelling our Society to explore and develop new strategies and technologies to effectively face and manage the associated risks. Among the more active natural hazards threatening the civil society, landslides and debris flows are for sure the most frequent and dangerous ones in mountainous regions, affecting millions of people and causing heavy damages worldwide. Despite this, many scientists feel that landslide hazard is generally neglected, more emphasis being given to other type of hazards such as seismic and volcanic which can be considered as predisposing and triggering factors. Therefore, the investigation on the role of internal and external causal factors on slope stability can be considered a good approach to disaster risk reduction. Moreover, among the four Priority Actions introduced by Sendai Framework for Disaster Risk Reduction 2015-2030, special emphasis has been given to managing the underlying drivers of disaster risk by means of enhancing the comprehension of natural hazards, investing in new technologies for more effective and reliable EWSs.

In the Alpine chain, debris flow represents one of the most hazardous instability phenomena because of its high speeds and the strong destructive power of its flow. In the context of hazard assessment, land-use and civil protection planning, mitigation measures design, and emergency response, debris flow monitoring is therefore crucial. This type of process is monitored for many years and a broad scientific literature has been produced so far. However, traditional monitoring instrumentation such as ultrasonic sensors, tripwires, geophones, and other technical solutions are hampered by limitations, such as inadequate spatial resolution and sensitivity, reduced robustness, and powering and cabling issues. These limitations can be surpassed using optical fiber sensors, which are gaining increasing interest by the scientific and stakeholder communities.

In this perspective, project “DEBRIS PHOS” aims at developing novel fiber optic sensors (FOS) for debris flows monitoring, that could eventually be used to prevent disasters and manage the related emergency. In particular, the project will be focused on Distributed Acoustic Sensing (DAS) technology going well beyond the state-of-the-art, by implementing a sensor able to monitor the ground vibrations caused by the propagation of the solid-fluid mixture, providing useful information to infer, by means of ML techniques, the rheological characteristic of the flow beside velocity and process dynamics. The complementary competences needed to succeed in this goal are well represented by the proponent team, made of one unit with experience in debris flow hazard assessment and risk mitigation and management (CNR-IRPI, Padova), one unit with experience in FOSs (University of Padova) and one unit with expertise in data analysis (University of Salerno).

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