SCHEMA REDAZIONE PROGETTO DI RICERCA

CONCORSO PER L'ASSEGNAZIONE DI BORSE DI STUDIO DI DOTTORATO DI RICERCA

A VALERE SUI FONDI PNRR DI CUI AL D.M. 117 del 2 marzo 2023

Anno Accademico 2023/2024 Ciclo XXXIX

Dottorato di Ricerca in RESEARCH METHODS IN SCIENCE AND TECHNOLOGY
Tematica vincolata PNRR funded thematic scholarships (Ministerial Decree 117/2023) Mission 4, Component 2, Investment 3.3 "Introduction of innovative doctorates that respond to the innovation needs of companies and promote the recruitment of researchers from companies"

FRANCESCO OTTAVIANI

TITOLO DEL PROGETTO: New methodologies for the monitoring and analysis of landslides. (Nhazca S.r.l.)

RICERCA PROPOSTA (attenersi a quanto indicato nell'allegato A del bando)

Landslides and floodings are a real problem in the world, for the deaths that are related to them (the average is 1010 deaths every year between 2010 and 2019, according to the website www.ourworldindata.org, the double for the floods) and for the economic losses. The actual studies are concentrated in landslide reactivation prediction, basing the prediction on the velocity parameter or on the rain precipitation intensity-duration threshold for the new landslides (T. Bogaard and R. Greco, 2018). The landslides prediction is based on the monitoring systems and remote sensing surveys, for example, using machine learning to predict landslide using remote sensing survey in slope stability (He Lingfeng et al., 2021). The monitoring is a point that need to be improved because it is the only that can provide sufficient data to create prediction models. Using these models, it will be possible predict landslides that occur and alert the population, saving lives and reducing the economic losses. It's fundamental improve the monitoring techniques and provide innovative analysis methods for the data. In a context of climate change like the one that we are living, these new technologies will be fundamental. In Italy we have a landslide emergency, continuous. Let's think to the Ischia landslide 2022 or to the recent Emilia-Romagna flooding that caused a lot of new landslides in the Appennines, new monitoring and analysis techniques can improve the prevention and mitigation of these phenomena.

In the hydrogeology risk study field, there is a need to improve the risk assessment strategy. To do this, I propose to join Nhazca S.r.l. company (Natural HAZards Control and Assessment), Startup of Sapienza University of Rome, to improve my skills in monitoring and to collect data. Nahzca S.r.l. is a world leader in the monitoring using innovative technology like Terrestrial Interferometry SAR (TInSAR) and satellites (DInSAR & A-DInSAR). Those solutions allow to measure the surface movements of terrain and structures with millimetric precision. Nhazca company developed the PhotoMonitoring technology that allow to monitor the changes and the movements of structures and terrain using images. Those images can be captured by a variety of platform (from land, drone, satellite) and sensors (optic, multispectral, infrared, radar). The digital innovation is a PNRR's key points and in the hydrogeology risk field those innovative technology can really help the improvement of risk management strategies. This project matches the mission number 1 of the PNRR (Digitalization, innovation, competitivity, culture and tourism). The data extracted by use those techniques it will be integrate with new techniques on analysis and numerical modelling to prevent future effect of deformation, related to the climate changes. It will be developed new methodology to storage and data management following the principles of

"Open science" and "FAIR Data". 3D models can be done with FLAC3D software that use finite differences method, even though this software has his own code language it's possible use phyton to program the operations, others software can be used as well as FLAC3D, during my thesis project I'm using this software to model a complex landslide. I will develop the analysis and modelling part in the University of Urbino and during the period abroad, using finite elements method, finite differences method and machine learning. In this part it will be fundamental work a side of Professor Francioni. I will spend the period abroad in a University like University of Exeter or University of Rijeka to improve the acknowledgements on monitoring of the territory and its protection and to the digital transition.

The expected results of this research project include the improve of methodologies for surveying, monitoring and analysing of hydrogeologic hazard, improve the surveys data future use and the risk assessment and spatial planning analysis, improve the integration techniques between monitoring and stability analysis to improve the gravitational phenomena behaviour prediction. It will be possible improve the prediction modelling and find new constitutive model that can describe better the landslides.

Bibliography

Bogaard T. and Greco R., 2018, "Invited perspectives: Hydrological perspectives on precipitation intensity-duration thresholds for landslide initiation: proposing hydro-meteorological thresholds", Nat. Hazards Earth Syst. Sci., 18, 31–39, https://doi.org/10.5194/nhess-18-31-2018.

He Lingfeng, John Coggan, Mirko Francioni, and Matthew Eyre. 2021. "Maximizing Impacts of Remote Sensing Surveys in Slope Stability—A Novel Method to Incorporate Discontinuities into Machine Learning Landslide Prediction" ISPRS International Journal of Geo-Information 10, no. 4: 232. https://doi.org/10.3390/ijgi10040232.

ABSTRACT

In the hydrogeologic risk field, an improvement of the risk management strategies is needed. The present project aims to develop new technologies for monitoring, investigation, data analysis to improve the study of gravitative phenomena occurring in slopes and to propose a new and improved way of using monitoring data. This will contribute to landslide forecasting, risk management and territorial planning. In this project it will be developed and tested new methodologies to use photo monitoring techniques and terrestrial InSAR to improve the slopes monitoring procedures. This part will be done in Nhazca company. Afterwards the data will be elaborated in University of Urbino with Professor Mirko Francioni and during the period abroad using new analysis techniques and numerical modelling.