AI-Driven Geospatial Data Integration and Hydrometeorological Modeling for Landslide Hazard Assessment

(Proposer: Prof. Filippo Catani)

Mountainous regions globally are experiencing a severe escalation in landslide events, driven by a complex interplay of natural hydro-meteorological extremes exacerbated by climate change and anthropogenic land-use alterations. Accurately assessing and predicting these hazards requires processing vast amounts of multi-dimensional environmental data. This PhD project aims to bridge the gap between advanced artificial intelligence (AI) methodologies and traditional physical modeling to create a robust, dynamic framework for landslide hazard assessment.

Embedded within the broader framework of the "NATURA: Assessing Natural and Anthropogenic Drivers of Landslide Risk in Mountainous Regions" project, this doctoral research will focus on the development and application of novel machine learning techniques. The candidate will integrate high-resolution geospatial datasets—including Earth observation data, satellite imagery, and digital elevation models—with dynamic hydro-meteorological models. The core objective is to identify critical thresholds and spatio-temporal patterns that trigger slope failures, ultimately moving the field beyond static susceptibility maps toward dynamic, real-time hazard forecasting.

The methodology will encompass large-scale data curation, AI model training (such as deep learning networks or ensemble methods), and the rigorous calibration of physically-based models. This approach will significantly improve the accuracy of soil moisture and slope stability predictions under rapidly evolving environmental scenarios.

Scientific Collaborations and Logistics: This project offers a highly interdisciplinary research environment, capitalizing on strong institutional synergies. The research will be conducted as a joint collaboration between the University of Padua (UniPD) and the National Institute of Oceanography and Applied Geophysics (OGS). To facilitate a seamless workflow and maximize integration within both expert research groups.

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