CIVIL AND ENVIRONMENTAL ENGINEERING

MUR DM 117/Digisky - Geomatics analysis techniques for monitoring road corridors and interfering hydrogeological instability phenomena

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] DIGISKY SRL [P.iva/CF:09535510011] Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	DABOVE PAOLO - paolo.dabove@polito.it
Contact	
Context of the research activity	This research proposal mainly focuses on the Geomatics research field to develop analysis techniques for monitoring road corridors and interfering with hydrogeological instability phenomena. Starting from remote sensing data and implementing deep learning techniques, spatial analysis, and high-resolution aerial surveying in collaboration with Digisky srl company, the goal is to produce reliable risk maps and provide useful information for decision-makers to implement effective risk reduction measures. Progetto finanziato nell'ambito del PNRR - DM 117/2023 - CUP E14D23001990004
	This research proposal aims to develop an integrated framework for risk assessment and management of natural hazards and hydrological systems based on remote sensing data, deep learning techniques, spatial analysis, and high-resolution aerial surveying in collaboration with Digisky srl company. The objective is to produce reliable risk maps and provide useful information for decision-makers to implement effective risk reduction measures. The framework will combine hydrological assessments and state-of-the-art deep learning techniques to capture the complex interactions between natural hazards (such as earthquakes, floods, and landslides) and hydrological systems. By applying deep learning technology to a data-driven approach to risk management, the framework will achieve high accuracy and detail in the results. Moreover, the framework will utilize high-resolution imagery that is triggered by available satellite imagery, which will enable the use of high-quality data with a lower environmental impact. The expected outcomes of this research will include the creation of precise risk maps and the delivery of actionable information for decision-makers involved in risk management, infrastructure planning, and disaster preparedness. The

Objectives	framework will leverage remote sensing data, deep learning techniques, and high-resolution aerial surveying to improve risk mitigation strategies and support sustainable practices. The proposed framework builds on the advances of geomatics techniques, such as remote sensing technologies and analysis for natural hazards assessment and control. Remote sensing data can provide timely and accurate information from the Earth's surface, vital for disaster preparedness, early warning, emergency management programs, and humanitarian responses. The framework will use different types of remote sensing data, such as synthetic aperture radar (SAR), optical, multispectral, hyperspectral, and LiDAR data, to monitor and model natural hazards and their impacts. The utility of remote sensing data in natural hazard assessments depends on factors such as scale, resolution, tonal or color contrast, coverage area, frequency, and data cost and availability. The proposed framework will employ deep learning techniques to analyze remote sensing data and extract relevant features for risk assessment. Deep learning is a branch of artificial intelligence that uses neural networks to learn from large amounts of data and perform complex tasks. Deep learning has great potential for natural hazards detection, classification, segmentation, change detection, damage assessment, and risk mapping. The framework will use different deep learning architectures, such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), generative adversarial networks (GANs), transformers, and neural graph networks (GNNs), to process remote sensing data and generate accurate and detailed results. Recently, the scale and availability of remote sensing data have increased significantly, making it necessary to use deep learning techniques to process the data into information. The proposed framework will also utilize spatial analysis and high-resolution aerial surveying to enhance the risk assessment and management process. Spatial analysis can help identify spatial patterns, relationships, trends, and hotspots of natural hazards and their impacts. High-resolution aerial surveying is a technique in that UAVs or aerial-borne platforms capture high-quality images of the Earth's surface. High-resolution aerial surveying can provide more detailed information than satellite imagery, especially in areas with cloud cover or complex terrain. The framework will use high-resolution aerial surveying triggered by available satellite imagery, reducing the cost and environmental impact of data acquisition. By employing these cutting-edge technologies and methodologies, the proposed framework can enhance risk mitigation strategies, support sustainable practices, and facilitate informed decision-making in risk management, infrastructure planning, and disaster preparedness.

Skills and competencies for the development of the activity	The candidate should demonstrate competencies in geomatics, data analysis and data processing of remote sensing data, development of deep learning techniques and algorithms and their implementation in a GIS environment, privileging open-source technologies. In this context, the candidate should demonstrate to be able to develop plugins and effective workflows oriented towards automatization.