CIVIL AND ENVIRONMENTAL ENGINEERING

DIATI/CNR-IRPI - Fluvial Ecomorphodynamics

Funded By	C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE [P.iva/CF:02118311006] Dipartimento DIATI
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Context of the research activity	River ecomorphodynamics is a multidisciplinary field that explores the dynamic interactions between rivers, their ecosystems, and the surrounding environment. It combines principles from ecology, geomorphology, hydrology, and sedimentology to study how physical processes shape river habitats and how ecological communities respond to these changes over time. Natural processes such as floods, erosion, and sediment deposition continuously shape the river's form and function, affecting the distribution of habitats and the diversity of species.
Objectives	This PhD program aims to explore and understand river ecosystems using a comprehensive approach that combines river survey techniques, data analysis of LiDAR datasets, hydraulic modeling, and the development of a new sensor for bathymetric detection. By integrating these cutting-edge methodologies, we aim to gain deeper insights into the complex interactions between rivers, their morphology, and the ecosystems they support. Research Objectives: 1. River Survey Techniques: Conducting field surveys to collect high-resolution data on river morphology, sediment distribution, and vegetation patterns. Advanced surveying tools, such as Total Station and RTK GPS, will be employed to obtain precise information on channel geometry and bank characteristics. 2. LiDAR Data Analysis: Utilizing Light Detection and Ranging (LiDAR) datasets to generate highly accurate and detailed digital elevation models (DEMs) of river landscapes. The analysis will focus on understanding river evolution, identifying sediment deposition and erosion patterns, and quantifying habitat changes over time. 3. Hydraulic Modeling: Implementing numerical hydraulic models, such as 2D and 3D computational fluid dynamics (CFD) simulations, to assess flow patterns, velocity distribution, and sediment transport dynamics within the river system. These models will provide valuable information on how hydraulic forces influence river morphology and ecological habitats. 4. Development of a New Sensor for Bathymetric Detection: Designing and prototyping a novel sensor system capable of accurately measuring riverbed bathymetry. The sensor will utilize advanced technologies such as acoustic or optical methods, enabling non-intrusive, high-resolution data collection in

	both shallow and deep river sections. Expected Outcomes: • A comprehensive understanding of river ecomorphodynamics, including how physical processes shape habitats and ecological communities. • High-resolution DEMs and hydraulic models that provide valuable insights into river behavior and sediment dynamics. • A novel sensor system for accurate bathymetric detection, with potential applications in environmental monitoring beyond the project scope. • Scientific publications and presentations at conferences to disseminate research findings. Conclusion: This PhD program presents a unique opportunity to investigate river ecosystems through an interdisciplinary lens, combining river survey techniques, LiDAR data analysis, hydraulic modeling, and the development of a state-of-the-art bathymetric sensor. The research outcomes will contribute significantly to river management, environmental conservation, and our broader understanding of complex riverine systems.

Skills and competencies for the development of the activity	Use of GNSS systems. Data analysis and interpretation of LiDAR dataset. BAsic knowledge in hydraulics and hydrology. Background in physical processes of climate change and carbon cycle.