Final dissertation: Master of Science in Geotechnologies for Archaeology

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Mapping Times: GIS Tools to integrate UAV Data, Historical Photos and Satellite Imagery

Internship at Istituto Centrale per l'Archeologia

This thesis explores the integration of heterogeneous remote sensing data within a Geographic Information System (GIS) framework to support archaeological research and heritage management. By combining UAV-derived imagery, historical aerial photographs, and satellite data, the study investigates how multi-temporal spatial datasets can be structured, standardized, and analyzed to reconstruct landscape transformations over time.

The research addresses both methodological and epistemological challenges related to data interoperability, metadata standardization, and long-term digital preservation. Particular attention is given to the role of metadata in ensuring scientific reproducibility, data traceability, and compliance with FAIR principles. Within this framework, the thesis examines current standards adopted by the Italian National Geoportal for Archaeology (GNA) and proposes an enhanced metadata structure for UAV-based documentation, aligned with MODI 4.0 standards. The methodological approach is tested through a case study in the Valle della Caffarella (Rome), where historical RAF aerial imagery, modern UAV surveys, and satellite data are integrated to analyze diachronic landscape changes and archaeological visibility. The results demonstrate that the quality of archaeological interpretation depends not only on image resolution but on the systematic documentation of acquisition parameters, processing workflows, and data provenance. Ultimately, the thesis argues that GIS is not merely a technical tool but a critical infrastructure for constructing digital archaeological memory, enabling the transformation of ephemeral landscape traces into structured, interoperable, and sustainable heritage data.

Dr. Maria Rita Paffetti

Multidisciplinary approaches to the study of the Roman site of Paduline in Castiglione della Pescaia: drones and geophysical surveys supporting archaeology

Internship at ATS srl

This dissertation examines the Roman site of Paduline, located in the territory of Castiglione della Pescaia, through a multidisciplinary approach aimed at identifying buried archaeological evidence and reconstructing the relationship between settlement and ancient landscape. The study area lies within the alluvial plain of the Bruna River, a geomorphologically complex environment shaped by sedimentary processes, lagoon dynamics and long-term hydraulic transformations.

The research is based on the integration of non-invasive methods, combining drone survey through RGB, thermal and multispectral sensors with ground-based geophysical prospection, namely magnetometry and ground-penetrating radar (GPR). The main objective is to assess the effectiveness of a multi-sensor approach in detecting anomalies related to buried structures, reconstructing the layout of the Roman villa and clarifying its relationship with the wider Vetulonian territory.

The results show that the integration of heterogeneous datasets significantly improves the interpretative potential of archaeological mapping, overcoming the limits of each individual method. The acquired data have contributed to a better understanding of the extent of the complex, its internal organisation and its placement within a broader settlement and infrastructural system closely connected to the landscape of the ancient lacus Prilis and to the economic dynamics of the territory.

The study confirms the value of non-invasive methodologies in landscape archaeology and preventive archaeology, especially in coastal alluvial contexts where subsurface complexity and modern transformations hinder the direct reading of archaeological evidence. The dissertation therefore proposes a replicable methodological model based on the synergy between archaeology, Earth sciences and digital technologies, useful both for advancing historical knowledge and for the sustainable protection and management of archaeological heritage.