

Politecnico di Torino – DIST Research Group
Digital Twins and Earth Observation for Smart Cities and Sustainable Energy Systems

The research group at DIST of Politecnico di Torino is engaged in cutting-edge research at the intersection of Earth observation, geospatial technologies, and urban digital transformation. The team plays a key role in supporting the **exploitation phase of space-based systems and services**, with a focus on high-impact applications in urban management, infrastructure maintenance, and the energy transition.

At the core of its activities is the development of **Urban Digital Twins**—dynamic, high-resolution 3D models of the city of Torino built upon a unique aerial dataset (5 cm GSD) and dense LiDAR scanning (30–40 pts/m²). These datasets have been processed to produce **true orthophotos**, **3D point clouds**, and **photorealistic meshes**, forming a comprehensive virtual replica of the urban environment. The Digital Twin platform is designed using open-source technologies, ensuring modularity, accessibility, and scalability.

The group's work contributes to **urban resilience and sustainability** through a variety of use cases:

- **Energy transition:** The Digital Twin enables detailed **solar potential analysis**, identifying optimal surfaces for photovoltaic systems. It also supports **building energy performance assessments** and **real-time simulations** of energy demand and supply, helping improve efficiency and inform urban energy policy.
- **Urban asset management:** The platform supports **predictive maintenance** of critical infrastructure such as roads and green spaces, using spatial analytics and remote sensing data to enhance decision-making and reduce operational costs.
- **Environmental monitoring:** Through the integration of space-borne and in-situ data, the system can support air quality analysis, surface temperature mapping, and climate adaptation planning.

By combining **geomatics**, **Earth observation**, **AI-driven analysis**, and **city-scale modelling**, the research group provides advanced digital solutions to public authorities and utilities. These tools not only improve service delivery and resource management but also strengthen Torino's role as a European leader in digital innovation and green transition.

Through ongoing collaboration with universities, municipalities, and industrial partners, the team contributes to the development of the **space economy downstream sector**, translating space data into actionable urban intelligence.