

## 1. Towards Generative Digital Twins: A Novel Paradigm for the Next Generation AI-driven IoT

Digital Twins (DTs) are software replicas that not only mirror physical entities but can also proactively predict, control, optimize and simulate their behavior. Born in the manufacturing sector, this concept after an initial hype stayed untouched for decades. The rise of Internet of Things (IoT) and Artificial Intelligence (AI) enabled DT, respectively, to exchange real-world data and to fully exploit it for fulfilling its own goals. Very recently, Generative AI (Gen-AI) methods started being sporadically applied to DT in different contexts and with different targets. In this talk, starting from our experiences on design, implementation and evaluation of DTs and, more recently, of Opportunistic DTs, we first provide a definition for the Generative DT (GDT) which embraces main distinctive aspects and potential of current and future Gen-AI-aided DTs.

In particular, we disclose the role of Gen-AI in conciliating the model- and the data-driven approach for the development of DTs. Then, we analyze the added value of main Gen-AI architectures and development methodologies for maximizing the effectiveness and the performance of DTs operating in the IoT domain and deployed in the edge-cloud continuum.

Finally, we illustrate the potential of a GDT in emblematic Smart City and Smart Manufacturing scenarios.

## 2. Embodied Edge Intelligence for the Next-generation IoT & Robotic Systems

Abstract:

The Edge Intelligence (EI) paradigm has emerged as a promising solution to overcome the inherent limitations of cloud computing (latency, autonomy, cost, etc.) in the development

and provision of next-generation Internet of Things (IoT) services. More recently, embodied EI refers to embedding intelligence into robotic systems, such as humanoid robots, and special-purpose machines to make them autonomous, proactive and social. Therefore, motivated by its increasing popularity, relevant research effort was and is being carried out in order to explore, from different perspectives and at different degrees of detail, the many facets of (embodied) EI.

In such a context, the aim of this seminar is first to analyze the wide landscape on EI by providing a systematic analysis of the state-of-the-art manuscripts in the form of a tertiary study

(i.e., a review of literature reviews, surveys, and mapping studies) and according to the guidelines of the PRISMA methodology. A comparison framework is, hence, provided and sound

research questions outlined, aimed at exploring (for the benefit of both experts and beginners)

the past, present, and future directions of the EI paradigm and its relationships with the IoT and the robotic computing systems.

We finally discuss the application of our embodied EI research in the context of the device-edge-cloud continuum paradigm developed in the Horizon Europe project "MLSysOps" and in the context of the humanoid robotic system developed in the PNRR "MUSIC4D" project.