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Title: Shaping Reality Through Digital Twins: Earth, Cities and Heritage in the Virtual World – the Garisenda tower in Bologna

Abstract: Digital Twins are revolutionizing how we understand and interact with physical systems, blending real-time data and advanced modeling to create virtual replicas of real-world objects. Highlighting the importance of the High-Performance Computing (HPC) resources, , such as the Leonardo supercomputer of the EuroHPC initiative, this presentation introduces the some exaples of Digital Twins in the safety and environment sector, including the groundbreaking Destination Earth initiative, which aims to model the entire planet to address global environmental challenges. Focusing on cultural heritage safety and preservation, the talk highlights the case of the Garisenda Tower, a famous medieval structure in Bologna, Italy. With its characteristic 4-degree tilt, the Garisenda Tower requires meticulous monitoring to ensure its safety and stability. In 2023, unusual movements signalled an increased risk of collapse, prompting an innovative response. Through a collaboration involving the Municipality of Bologna, the University of Bologna, and CINECA, a comprehensive Digital Twin of the tower was created using NVIDIA Omniverse. This presentation will delve into how Digital Twin technologies, powered by HPC, are shaping preservation and safety strategies for cultural landmarks, bridging the gap between advanced technology and historical conservation.

Bio Sketch: Dr. Gabriella Scipione leads the "HPC Data Management and Data Analytics" division within the High Performance Computing department at CINECA. Her work focuses on high-performance computing (HPC), big data management in cloud environments, data analysis using HPC resources, and the development of custom applications for scientific data visualization. She has served as a technical lead and coordinator for numerous European HPC scientific projects spanning fields such as weather, climate, environmental sciences, life sciences and digital humanities. Gabriella played a pivotal role as the coordinator of the Leonardo EuroHPC supercomputer proposal, securing Italy's successful bid to host the pre-exascale EuroHPC system at the Tecnopolo di Bologna. Her expertise extends to implementing digital twins across diverse sectors, including weather and climate, biodiversity, cities, and cultural heritage preservation. Currently, she actively contributes to Leonardo HPC initiatives at CINECA and serves as Principal Investigator for several projects and contracts, including those related to Destination Earth and digital twins such as GLORI (Global to Regional ICON Digital Twin). Recently, she began coordinating the CINECA team supporting the AI and large language model (LLM) research communities, while also overseeing AI for Science activities. Since 2024, Gabriella has been a member of the EuroHPC Infrastructural Advisory Board, contributing her expertise to shaping Europe's HPC infrastructure.