

COMPUTER AND CONTROL ENGINEERING

Digital twin, presence & interaction in metaverses

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Context of the research activity	In a not too far future, the metaverses, immersive, interconnected 3D worlds created by Extended Reality (XR) may become the place where we perform many daily life activities. Metaverses build onto several core concepts. Virtual presence, for instance, is key, as it is meant to let people feel present in a place having just their digital representation transferred there. Digital twinning, in turn, implies the creation of digital replicas of things or people which will populate the virtual worlds. Lastly, the ability to reproduce social interactions mediated by digital interconnections will be essential. The aim of this proposal is to contribute to the research in this field, devising methods for making the metaverse experiences ever more compelling and helpful, thanks to high levels of realism, interaction, immersion, and presence.
Objectives	The research will start by exploring ways to effectively enable the realization of the digital experiences mentioned above. Virtual presence and digital twinning require the generation of 3D assets and the implementation of control/interaction logics that are often very specific to the particular application scenario. Unfortunately, existing authoring tools, either for commercial metaverses or for dedicated XR applications, are not flexible enough, requesting to “reinvent the wheel” almost every time. The first objective will consist in identifying a methodology, supported by a proper development environment, to ease the creation of such experiences through, e.g., the adoption of new user interfaces and the introduction of novel automatic generative processes powered, e.g., by AI paradigms. Still considering the reconstruction of the environment, a second objective will consider the (real time) transfer of information required to interact with local physical assets from remote, by operating on their digital copies. Aspects concerning, among others, sensor capabilities, network dependability aspects, intelligibility/usability of virtual replicas, will need to be addressed. A third objective will be to investigate means for boosting the level of realism of digital contents that populate virtual environments. Ways to leverage offline and online digital reconstructions obtained by combining 3D modeling, photogrammetry, laser scanning, motion capture, etc., will be explored.

Particular attention will be devoted to the reconstruction of humans, as their role will get increasingly relevant in the metaverses and other collaborative XR experiences. A fourth, and last, objective will focus on making virtual user interaction (both synchronous and asynchronous) as much faithful as possible. New ways to enhance the fidelity in reproducing sensory stimulation, transferring emotions and improve digital relationships mediated by available technology.

Skills and competencies for the development of the activity

Competences and possible prior experience concerning technologies for digital twinning, virtual presence, interaction and metaverses.