Editorial

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Prompt and effective data acquisition and management in the real built environment is of great importance in effectively managing existing infrastructure. In this regard, information technology and computing can play a key role in meeting the operational challenges of the architecture, engineering, construction and facility management (AEC/FM) industry. Among several emerging technologies, building information modelling (BIM) and digital twins have been or are progressively being adopted in several infrastructure management applications. A digital twin is a virtual model of a structure that incorporates real-world information and ideally replicates every detail of the real structure and any processes taking place in its components. The digital twin is continuously fed with information from multiple sources and gradually gains valuable insight about the structure arrangement, operation and performance. Indicative applications include facility management assistance and performance optimisation in real-time, efficient energy management, prevention of potential system failures and, with regard to the current briefing, data monitoring and exchange among stakeholders involved in a structure, especially in the aim of synchronising as-built information and as-designed models.

While building information modeling and digital twins can highly advance the way of digitally understanding and simulating the performance of the built environment, the steps forward to this goal are rather long and challenging. There are some good reasons explaining the current limitations and providing motivation for further research and development in the area. First, we are still away from fully automated digitisation of real-life structures relying upon point clouds. Next, there is still difficulty in translating information to a common language that can be aligned with different computer applications and exchanged among professionals from diverse disciplines and disparate requirements within the AEC/FM industry. A third reason is that construction is unique in the sense that every project retains distinct characteristics, thus requiring specific treatment. It appears then that, until we reach a global representation and modelling status of actual structures and processes, we will still need to focus and analyse specific particles of the construction world towards the unification of processes in the quest of digital twinning.

Although research and development efforts are intensified in recent years, there are still several steps to be made forward. The 2019 European Conference on Computing in Construction (2019 EC³) has provided a forum of presenting and sharing information about the latest developments in all aspects related to computing in construction and, in particular, to digital representation and modelling of real-life construction assets. Likewise, *Smart*

Infrastructure and Construction aims at publishing high-quality contributions and a learned forum for documenting changes caused by the global adoption of emerging digital technologies in the design, construction and management of infrastructure. The official cooperation of the two bodies has resulted in recruiting some of the relevant top conference papers, which, after substantial enhancement and thorough peer review by distinguished international experts, have come to fill the current themed issue, focusing on ways that can promote digital twinning for a wide range of structures and applications.

The first paper in this issue aims at designing, implementing and benchmarking a framework for automating the process of geometric digital twinning of primary concrete bridge elements (Lu and Brilakis, 2019). The problem addressed is that when getting into real-world point clouds (collected with laser scanners) and attempting to meet the various exchange information requirements, there is still the need for manual intervention for generating shapes (particularly non-standardised ones or resulting from skews or imperfections). In this work, the entire workflow of geometric digital twinning for bridges is investigated and a new framework is proposed to auto-generate bridge objects without the need to generate low-level surface primitives. Experiments with several highway reinforced-concrete slab and beam-and-slab bridge point clouds have demonstrated the ability of the proposed framework to twin geometric bridge concrete elements rapidly (with 95% time saving) and effectively in terms of twinning quality (spatial accuracy).

The second paper deals with automating the process of comparing and updating technical drawings with information of real-life built railway infrastructure elements by utilising machine learning concepts (Vilgertshofer *et al.*, 2019). Such types of infrastructure present high variety in technological level and archived technical drawings of its components, inconsistency between drawing and real-world data, and difficulty in interpreting the various symbols in available digital images in order to create semantically rich digital twins. The presented work focuses on two aspects: the analysis of technical drawings to locate plan symbols and the recognition of infrastructure elements in video data of railway lines. Convolutional neural networks are employed in analysing images from video data and technical drawings to automatically detect the location of railway infrastructure elements. Although the method accuracy is at a level of 90%, indicating that human interference is still essential, the proposed approach helps in reducing the manual effort for checking the accuracy of technical drawings and provides significant support in building up a digital twin of railway infrastructure.

The last paper concerns the digitisation of complex geometry in heritage structures and the information exchange in a controlled manner to ensure efficient collaboration among relevant stakeholders – a challenging application due to the uniqueness and diversity of geometric characteristics of such monuments (Bonduel *et al.*, 2019). Existing BIM applications and industry foundation class schemas present certain limitations in developing rich representation of non-regular three-dimensional geometries of heritage structures and in providing reliable data exchange among stakeholders. Based on Linked Data principles, the research work examines the applicability of resource description framework (RDF) literals for including a wide variety of existing geometry schemas in a built heritage context. The effectiveness of the entire data structure is demonstrated in a medieval church case study, in which a variety of geometry schemas are assembled and included in a Linked Data context. The information exchange analysis reveals that the receiving stakeholder party is able

to successfully create a coordinated view on shared, but disparate, RDF data sets containing geometry descriptions.

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