Session on

Digital Twin City (C)

Tuesday, October 15th 2024

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Milan Time	Beijing Time	Agendas
14:00	20:00	**C-1** Information Systems in the Built Environment: Driving Climate Action and Meaningful Transformation through AI and Data-Driven Technologies Bige TUNÇER
14:30	20:30	**C-2** Automated analysis of infrastructure policies using natural language processing (NLP) Wei-Ting HONG
15:00	21:00	**C-3** Smart Evacuation Systems Using digital twin and AI in Building Fires Yuxin ZHANG
15:30	21:30	**C-4** From urban modelling to city digital twins – Some reflections Li WAN
16:00	22:00	**C-5** Integrating Digital Twin Technology for Sustainable Urban Development: A Focus on Transit-Oriented Development Qian XU
16:30	22:30	**C-6** Data-Driven Energy Performance Analysis: Insights from London's Residential Buildings Cuicheng ZHANG
17:00	23:00	**C-7** Research for the construction of digital twins for the knowledge and maintenance of historical architectural heritage Cecilia BOLOGNESI

Digital Twin City (C)

Chair

Cecilia BOLOGNESI

Professor,
Politecnico di Milano (Italy)

Co-Chair

Qian-Cheng WANG

PhD Candidate,
University of Cambridge (UK)

Xuan LIU

Doctoral Candidate,
Eindhoven University of Technology (Netherlands)

Digital Twin City (C-1)

Bige TUNÇER

Professor,
Eindhoven University of Technology (Netherlands)

Title:

Information Systems in the Built Environment: Driving Climate Action and Meaningful Transformation through AI and Data-Driven Technologies

Abstract

This talk explores how information systems in the built environment can drive climate action and transformative change through AI and data-driven technologies. It highlights the role of multi-source, multi-scale, and multi-time data on built environment parameters, user patterns and opinions, and sensible environmental characteristics can yield actionable insights and socio-technical solutions for big issues. The talk will present methodologies for creating intelligent design support tools, showcase case studies, and discuss the potential of data-driven strategies and AI to foster climate resilience, enhance user experience, and support decision-making for a more sustainable built environment.

Digital Twin City (C-2)

Wei-Ting HONG

Research Associate,
University of Sydney (Australia)

Title:

Automated analysis of infrastructure policies using natural language processing (NLP)

Abstract

This study presents an NLP-driven framework for analysing infrastructure policy trends over time to support policymaking. By leveraging NLP techniques, the framework identifies and classifies key infrastructure policies, offering strategic insights and flexibility for further statistical analysis. The proposed infrastructure policy strategic map categorises policies based on trends and frequency of mentions, providing an efficient tool for policymakers. A case study of New South Wales (NSW) infrastructure policymaking highlights shifts in policy priorities. This scalable framework can be applied to other jurisdictions, enabling efficient analysis of large volumes of infrastructure policy data.

Digital Twin City (C-3)

Yuxin ZHANG

Research Assistant Professor,
The Hong Kong Polytechnic University (China)

Title:

Smart Evacuation Systems Using digital twin and AI in Building Fires

Abstract

The development of real-time smart evacuation systems is vital for enhancing public safety during building fires, providing a crucial societal benefit. This study introduces an intelligent Emergency Digital Twin (EDiT) system enabling real-time tracking, speed estimation, and privacy protection of evacuees. Achieving detection success rates of 100% for individuals and 93% for multiple objects, the system significantly improves evacuation efficiency. Moreover, the creation of the Human Behaviour Detection Dataset (HBSet) enhances the ability to identify vulnerable groups, such as the elderly and disabled, ensuring they receive necessary assistance during emergencies. Additionally, a novel multi-camera tracking system is introduced, offering seamless monitoring across complex buildings. The integration of AI and digital twin technology in emergency management not only optimizes evacuation strategies but also contributes to a safer, more resilient urban environment. This advancement aids authorities in making informed, timely decisions, ultimately reducing casualties and property damage in fire scenarios, representing a critical societal safeguard.

Digital Twin City (C-4)

Li WAN

Associate Professor,
University of Cambridge (UK)

Title:

From urban modelling to city digital twins – Some reflections

Abstract

The fast advancement of digital twins (DTs) in engineering and manufacturing is now driving an economy-wide technological revolution. The success of DT applications in manufacturing demonstrates the power of data and machine learning techniques in unlocking significant performance improvements and efficiency gains. Upscaling engineering DTs to city digital twins (CDTs), however, faces several inherent challenges. DTs are most useful when the problem and solution space resemble a well-definable, closed engineering system. Unfortunately, most societal challenges do not fit this description. Existing big data sources for cities, despite unprecedented in terms of their volume and velocity, may still be 'tiny' relative to the sheer complexity of urban systems and processes. The effectiveness of a purely data-driven approach in CDT development might thus be overstated. Given the substantial knowledge gap in understanding how cities function and rising concerns about data privacy and AI ethics, it is thus questionable to assume that CDTs can and should pursue the same level of analytical and automation capability seen in engineering and manufacturing sectors. Enhancing a positive feedback loop between data and CDT models, particularly by informing data collection through theory-driven model calibration and validation, seems a promising way to advance CDT models.

Digital Twin City (C-5)

Qian XU

Lecturer (Assistant Professor),
University of Lincoln (UK)

Title:

Integrating Digital Twin Technology for Sustainable Urban Development: A Focus on Transit-Oriented Development

Abstract

The rise of Digital Twin technology offers significant potential for enhancing sustainability in urban development, particularly in the context of Transit-Oriented Development (TOD) and compact city frameworks. This presentation introduces a novel approach that integrates Digital Twin systems into the Node-Place-Ecology (NPE) model to simulate, monitor, and optimize TOD sustainability across urban environments. By creating real-time digital replicas of TOD station areas, the model facilitates a dynamic and accurate analysis of transportation, land use, and ecological factors.

Utilizing the Tokyo Metropolitan Area as a case study, this research demonstrates how Digital Twin technology enables continuous monitoring and real-time updates of urban development, enhancing the ability to address challenges such as shifting population densities, economic changes, and environmental impacts. The integration of Digital Twin allows for precise tracking of TOD performance, helping urban planners and policymakers simulate future scenarios and develop data-driven strategies to improve sustainability outcomes.

This presentation will explore how the combination of Digital Twin and the NPE model creates a comprehensive framework for managing the complexities of modern cities, ensuring long-term resilience and adaptability in the face of rapid urbanization and environmental change.

Digital Twin City (C-6)

Cuicheng ZHANG

PhD Researcher,
University of Oxford (UK)

Title:

Data-Driven Energy Performance Analysis: Insights from London's Residential Buildings

Abstract

This research leverages digital twin technology to examine the relationship between socio-demographic factors and building attributes on energy efficiency and environmental impacts in London's residential buildings from 2011 to 2021. By utilizing Energy Performance Certificates (EPCs) and socio-demographic data, it integrates complexity science and data-driven methodologies, including machine learning models like GLM and XGBoost. The study reveals that factors such as income, employment, and cultural diversity significantly affect energy efficiency. Through the digital twin framework, the research suggests digital twin oriented adaptive energy policies that account for socio-demographic changes, aiming to guide sustainable urban development and enhance environmental outcomes.

Digital Twin City (C-7)

Cecilia BOLOGNESI

Professor,
Politecnico di Milano (Italy)

Title:

Research for the construction of digital twins for the knowledge and maintenance of historical architectural heritage

Abstract

The issue of the maintenance of Italy's valuable historical built heritage often must reckon with the size of publicly owned assets or those of religious bodies. In cases such as these, the construction of management models useful for maintenance with efficient processes passes obligatorily through the digitisation of the heritage first and the construction of automatisms proper to the digital twin. In this presentation, we will touch upon three nodal points of this theme: the use of a collaborative environment for multi-user sharing of synchronically annotated information, monitoring of the influx of people with feedback in the digital model, structural monitoring and automatic quantification of materials and works for maintenance.