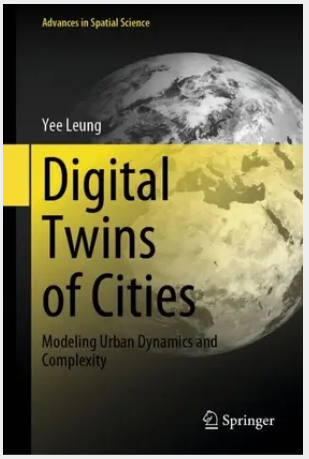
Leung

Digital Twins of Cities

Modeling Urban Dynamics and Complexity



As cities evolve at unprecedented speed and scale, traditional digital twins—virtual models of physical urban systems—fall short in capturing the dynamic and complex nature of urban life. This book bridges the gap between digital urban representations and the dynamic processes that shape our cities.

Moving beyond conventional data and technological infrastructure, this work formulates a comprehensive framework for embedding urban dynamics and complexity into digital twins. It reimagines them as living systems that adapt, learn and evolve in real time, near real time and over the long horizon. Through integrated feedback loops between data, physical infrastructure, high-dimensional models and reduced-order approximations, digital twins are transformed into powerful tools for the modeling, simulation, prediction and proactive management of urban development.

This book presents cutting-edge methods to learn, simplify and encode urban dynamics and complexity into digital twins—whether or not the underlying mechanisms are fully understood. It also addresses critical challenges such as scalability, uncertainty propagation, network sensing and data quality, and demonstrates how dynamic digital twins can be continually refined through new information and emerging insights.

At the intersection of urban theory, artificial intelligence, machine learning and big spatiotemporal data, this book charts a new course for the modeling and governance of cities. It is a vital resource for researchers, practitioners and decision-makers across disciplines—inviting collaboration between academia, industry, government and professionals working on the frontlines of our ever-changing urban environments.

Explore a bold vision for cities that can think, adapt and respond—one where digital twins become not just mirrors, but engines of transformation.

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