Computational Approaches to Enable Smart and Sustainable Urban Systems

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The special collection on Computational Approaches to Enable Smart and Sustainable Urban Systems is available in the ASCE Library (https://ascelibrary.org/jccee5/computational_smart_sustainable_urban_systems).

The world is rapidly urbanizing. By 2050, more than 66% of the world's population will reside in cities (United Nations 2014). As civil engineers, we will play a crucial role in providing access to reliable, clean, and sustainable sources of water, energy, and air to this next generation of urban citizens. Recent advances in sensing and computing technologies and the rise of the smart city movement have led to the rapid availability of new data streams on everything from energy usage to infrastructure health to human activity. However, major challenges exist on how such data can be utilized and leveraged to design, operate, and manage smarter and more sustainable urban systems.

Within the academic community, there is a growing body of researchers tackling challenges and developing new computational and data-driven methods for enabling smart and sustainable urban systems. The purpose of this special collection is to publish a curated set of articles representative of this growing community of scholars. We would like to thank the editor in chief (Professor Raymond Issa) and associate editors (Professor Fernanda Leite and Professor Vineet Kamat) of the ASCE *Journal of Computing in Civil Engineering* for supporting this effort and stewarding the peer review process. We are also grateful to the academic community for their strong response to our call for papers and hope that this collection will help encourage new collaborations and synergies across the broad interests of researchers interested in smart and sustainable urban systems.

Special Collection Editorial Process

The call for papers of this special collection was announced by Editor in Chief Issa at the 2017 International Workshop on Computing in Civil Engineering (IWCCE 2017) that took place June 25–27, 2017, in Seattle, Washington. In response to this call for papers, we received 41 extended abstract submissions. The large number of abstract submissions further underscored the strong interest from the computing in civil engineering community in smart and sustainable urban systems. Each extended abstract was carefully assessed using a 2-step process for its contribution to the computing in civil engineering discipline as well as its relevance to the theme of the special collection. First, we assessed each extended abstract independently and reconciled assessments to reach a decision. Second, we consulted a small group of the journal's associate editors to provide additional assessments for those extended abstracts whose initial assessment did not yield a clear decision. After completing this process, we invited 14 extended abstracts to submit full manuscripts to the journal for consideration. Nine full manuscripts were submitted and were subsequently placed into the peer review and revision process in accordance with ASCE guidelines.

Featured Papers

This special collection of the *Journal of Computing in Civil Engineering* presents four pieces of research resulting from the special collection editorial process. We are excited by the diversity of the topics and urban systems challenges addressed in this special collection. A highlight of each of the four featured papers is provided below.

Sensor Data Interpretation for Urban Systems Asset Management

This first paper in this collection is Proverbio et al. (2018). The authors propose a new methodology for interpreting sensor data so help inform decision-making regarding asset management of urban systems. Using two case study bridges in Exeter, UK, and Singapore, the authors demonstrate how the proposed bipartite-modularity optimization (BMO) outperforms classical clustering methods such as k-means in terms of accuracy, interpretation, and visualization of results. The BMO method also enables active interactions with the clustering framework by engineers to provide additional knowledge that is pertinent in several stages of the infrastructure management decision-making process.

Data Integration Framework for Urban Systems

Gupta et al. (2019) introduce an urban data integration (UDI) framework for integrating heterogeneous urban systems data through a series of novel proximity relationship learning algorithms. The UDI framework was validated and tested on a case study of a midsize city in the United States, with results demonstrating that UDI can provide easier and more computationally efficient querying of urban data than traditional methods using relational databases. This framework is also extensible to different types of urban systems and scalable to different volumes of data streams.

Rethinking Open Spaces in Cities

Islam et al. (2019) investigate the financial and quality of life tradeoffs associated with the distribution of urban spaces. By combining a spatial interaction index with hedonic pricing analysis, the authors find that a scattered design of urban open spaces can result in better long-term financial returns for municipalities and more equitable access to open green spaces. In the end, the authors aim to encourage the rethinking of how open space is distributed in urban areas such that they enhance municipal financial sustainability and increase equitable access to green spaces.

Challenges of Information Interoperability in Urban Systems

The final paper is Costin and Eastman (2019). The authors present a holistic review and analysis of principles, methods, and requirements needed to achieve information exchange and interoperability across urban systems. Their review and analysis elucidates the promise of ontologies like the Semantic Web as mechanisms to enhance interoperability, and highlights major challenges to enabling interoperability of smart and sustainable urban systems in the areas of definition formalization, information exchange, automation, Internet of things (IoT), incentives, and standardization.

In conclusion, we hope that this special collection serves as a catalyzing mechanism for encouraging deeper explorations into data-driven approaches and for spawning new research ideas in the burgeoning area of smart and sustainable urban systems. As the world continues to urbanize, the computing in civil engineering research community has a significant opportunity to contribute to the smart and sustainable development, management, and operation of our current and future cities.

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