EDITORIAL

Interdisciplinary Data-integrated Approaches

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Rapid urbanization with the associated land cover and land use change, as well as resource depletion, contribute to the degradation of ecosystems and biodiversity and have a negative impact on human health and well-being. Societal calls for responses and results pose a significant challenge for research and education in the various fields concerned with the environment. Alongside the current environmental crisis there is a pressing need for developing 'green solutions' for the built environment with the help of data-driven methods, workflows and tools.

In view these developments, a shift from narrow disciplinary and domain-specific approaches towards broader interdisciplinary, multi-domain and multi-scalar strategies is required. This includes data-acquisition, data-sharing and data-integration, as well as data-driven modelling to enable the complexity of sustainability problems arising from rapid urbanization to be tackled. While there have been efforts to address the challenges of multi-domain approaches, for instance in the fields of sustainability, the urban and architectural sciences, as well as the interoperability of methods and tools, the actual problem goes deeper, requiring interdisciplinary knowledge exchange to develop adequate shared paradigms, concepts, methods and tools.

Cyber-physical Architecture (CpA) issue 5 addresses these challenges by engaging with experts from a range of disciplines involved in environmental concerns while utilizing data-acquisition, data-sharing and integration, and data-driven modelling in a discourse that identifies modalities for a broader interdisciplinary, multi-domain and multi-scalar approach.

Nicholson et al. present an integrated ecological perspective that recognizes the importance of knowledge exchange in tackling the complexity of urban environments. Projects drawn from MIT Senseable City Lab and CRA-Carlo Ratti Associati demonstrate how data can be used as a tool in developing ecological design solutions. Sensors, data and networks link the artificial and natural elements of urban environments to connect citizens and decision makers and to integrate ecological solutions into the built environment.

Sunguroglu Hensel et al. pursue the development of an interdisciplinary approach, computational framework, and related workflows for multi-domain and trans-scalar modelling that integrate planning on a territorial scale with design on an architectural scale. They outline two lines of research, the first focusing on understanding environments for the purpose of discovering, recovering and adapting land knowledge to different conditions and contexts, the second on designing environments while developing computational workflows for data-integrated planning and design. Finally, the convergence of analytical and generative data-driven computational workflows is discussed with the aim of integrating architectures and environments.

Van Ameide presents an approach to monitoring people's location data, movement and activity patterns aimed at enabling analysis of user behaviours to inform the planning of evidence-based urban developments. This paper focuses on a series of experiments that serve to develop user-driven generative design processes and to explore new computational tools for site analysis and monitoring that can enable data-driven urban place studies.

Oskam et al. describe a specific data-driven design approach that provides microclimatic modulation in support of biodiversity and social accessibility of leftover spaces. By introducing small-scale urban interventions existing and new life is supported. These interventions were developed by means of Design-to-Robotic-Production and -Operation (D2RP&O). This approach links computational design to robotic production and Artificial Intelligence (AI) supported operation processes to establish a bio-cyber-physical feedback loop.

Alavi et al. discuss their approach to predicting and preventing high concentrations of air pollutants in indoor environments that can have adverse impact on health and well-being, cognitive performance and productivity. This approach is based on algorithmic AI-enabled methods. The article outlines design implications and presents design proposals and interactive solutions for preventing high concentrations of indoor air pollutants.

Papers published in this issue were originally presented at the Adaptive Environments symposium on 9-10 September 2021 organized by Michael Hensel (TU Vienna), Henriette Bier (TU Delft), Margherita Pillan (PoliMi), and Keith Green (Cornell) and have been single-blind reviewed. They reflect the engagement of an international network of researchers investigating modalities for a data-driven, interdisciplinary, multi-domain and multi-scalar approach aimed at addressing environmental concerns.

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