Simulation

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# Special issue on Simulation for Architecture and Urban Design

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This special issue celebrates five annual SimAUD (Simulation for Architecture and Urban Design) Symposia held as part of the SpringSim conferences. Nine original articles are included in this special issue, covering a broad spectrum of theory and case studies of simulation applied to the built environment. The authors, researchers and practitioners, as well as architects and engineers, were selected from among the top contributors of SimAUD. Their papers are on the cusp of leading research and practice in the field of simulation for architecture and urban design.

Modeling and simulation have the potential to provide tremendous insight into how complex systems will perform throughout their life cycle. Instead of relying purely on design precedent or common sense, simulation allows us to quantify a whole host of design solutions until we reach one that satisfies a multitude of hard and soft constraints. Simulation allows us to visualize the complex interactions between people, the built environment and the natural environment in an effort to approach a sustainable and symbiotic solution. Perhaps one of the most powerful facets of simulation is the ability to integrate the knowledge of thousands of researchers—from heat and mass transfer to material and human behavior—into a single toolbox at the convenience of designers.

One of the emerging trends in simulation research spans both the micro and macro scales of the building. Four of the articles in this issue address urban-scale issues. These authors recognize that good building design extends well beyond the individual building to effect comfort, airflow, human mobility and pollution dispersion. Minella et al. apply a combination of measurements and simulation to understand the outdoor thermal comfort in an urban renewal area in Geneva. The considerable risk of heat stress in the summer could be greatly remedied through the use of vegetation and manipulation of building form. Peng and Elwan investigate the coupling of indoor and outdoor comfort modeling through several case studies of neighborhoods and communities, and they further quantify the effect of future climate change scenarios on comfort. Yazid et al. perform a comprehensive literature review on the topic of simulating pollution dispersion in urban areas. They reveal the power of simulation in those studies but also address the major gaps. Last, on the topic of urban-scale simulation, Ge et al. present an impressive undertaking to simulate the mobility and interaction between people in a city. Their methodology includes demographics and daily activities. The authors propose that Virtual City could be applied to problems such as emergency response and disease spread. Finally, Gerber and Lin propose a simulation-based building design solution that appeals to both engineers and architects. A hybrid of parametric analysis and formal optimization is used to demonstrate a workflow that results in optimal building performance but also architectural considerations and function.

At the other end of the scale is the understanding of how humans and buildings interact. Yang et al. describe the implementation of a sensor network in an academic building to form a greater understanding of occupants and to improve the estimation of indoor environmental parameters and occupancy. Their conclusion is that a 20% reduction in energy use would be possible if heating, cooling and ventilation were controlled based on occupancy. Karagkouni et al. demonstrate that computational fluid dynamics and optimization can be combined to support the design of facades to improve occupant comfort through natural ventilation.

Sher et al. employ simulation techniques to demonstrate the potential of adaptive structural systems. While the concept is tested on a canopy supported by three active members, the authors suggest the concept could be extended to dynamic facades and structural components that adapt to occupants or weather conditions.

An article by Brown et al. outlines the whole field of research and demonstrates the potential of simulation in investigating a murder case. These researchers were tasked

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with developing a calibrated building simulation model to estimate when a murder occurred in a house. Aside from the unique application, the authors provide an elegant calibration case study.

In conclusion, we would like to acknowledge the editors of *SIMULATION* for accepting this special issue on Simulation for Architecture and Urban Design. Furthermore, we thank the reviewers for their valuable feedback and the continued support of authors and organizers of SimAUD. Finally, we encourage all interested researchers to submit papers to SimAUD 2015 in Washington, DC.

## Guest editor profiles

**Ramtin Attar** MArch, MRAIC, is a principal research scientist at Autodesk Research and a founding member of SimAUD: the Symposium on Simulation for Architecture and Urban Design. He currently holds an honorary research professorship from the School of Architecture at Carleton University, where is deeply invested in a number of projects that deal with community revitalization, sustainability and life-cycle assessment of built environment. Ramtin is also the founder of Imagine My City, a non-profit organization that he is working to grow by helping important regional issues through collective leadership coupled with tools of imagination.

**Liam (William) O'Brien** holds a Master's of Applied Science in aerospace engineering and a PhD in building engineering. He is an assistant professor at Carleton University and the principal investigator of the Human Building Interaction Laboratory—a team of researchers that are investigating occupant behavior and energy efficient building design and operation.

**Lira Nikolovska** is an architect and user experience architect working at Autodesk, Inc. She holds a PhD in computation from the Massachusetts Institute of Technology School of Architecture and has previously worked at Philips Research Labs in New York and Philips Design in the Netherlands.

**Azam Khan** is the head of the Environment & Ergonomics Research Group at Autodesk Research. He is the founder of the Parametric Human Project Consortium, SimAUD: the Symposium on Simulation for Architecture and Urban Design, and the CHI Sustainability Community. He received his BSc and MSc in computer science at the University of Toronto and has co-authored over 50 articles in simulation, human-computer interaction, architectural design, sensor networks and sustainability.