New Methods for Urban Analysis and Simulation with Grasshopper

Using DeCodingSpaces-Toolbox

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This workshop presents a collection of methods that supports the creation of urban masterplans. These methods are also used for evaluating the performance of the generated plans using advanced performance analysis tools as well as design exploration tools. During a one-day-workshop, the participants will practice using these tools in three parts; Street Network Generation, Synthesis of urban morphology, and Design-Space-Exploration. All the tools are integrated in one library called DeCodingSpaces-Toolbox for the parametric modelling environment Grasshopper.

Keywords: Urban Generation and Analysis, Urban Simulation, Design Space Exploration

\textbf{Introduction}

In this workshop, the participants will learn how to generate urban fabric variants, perform quantitative analysis on it, as well as optimize the generated variants and explore the corresponding solution space. For this purpose, they will be introduced to various components from the DeCodingSpaces Toolbox for Rhino/GH. They will learn how to analyse Street Networks effectively to compute real life phenomena such as the distribution of functions in a city or the movement patterns of citizens. Moreover, they will be introduced to the various methods for the synthesis of urban morphology (street networks, plots, and buildings) and how they could connected to the analysis methods. Finally, the participants will also be introduced to design space exploration tool for being able to compare the generated solution systematically.

\textbf{DeCodingSpaces-Toolbox}

The presented DeCodingSpaces-Toolbox for Grasshopper is a collection of analytical and generative components for algorithmic architectural and urban planning. The toolbox is free software (1) released by the Computational Planning Group (CPlan) (Koenig, Treyer, & Schmitt 2013; Koenig 2015; Fuchkina 2016; Koenig et al. 2017; Konieva et al. 2018). It integrates established urban analysis methods, ex-
tends them with new features and introduces new methods for the analysis and synthesis of urban morphology.

**Workshop**
The workshop will be in three main parts.

In the first part of the workshop, the participants will learn to use the street network analysis components and how the computed quantities relate to real-life phenomena such as the distribution of functions in a city or the movement patterns of citizens as in figure 1a.

In the second part, we will demonstrate functions of the DeCodingSpaces-Toolbox for the synthesis of urban morphology (street networks, plots, and buildings), which is directly connected to the analysis and the simulation parts as in figure 1b.

In the last part, we use a Design-Space-Exploration tool (DSE) that presents the generated solutions in various ways as in figure 1c.

**Schedule**
**Part 1**
Street Network Generation.

**Part 2**
Dynamic Urban Simulation.

**Part 3**
Design-Space-Exploration.

**Skills**
- Intermediate experience in Grasshopper
Outcome

During this one-day-workshop the participants will be introduced to the various methods for the analysis, synthesis and exploration of urban morphology with the focus on street networks. They will learn how to analyse Street Networks effectively to compute real life phenomena, as well as, how to compare the generated designs systematically. We will be using DecodingSpaces Toolbox in Grasshopper, and Design-Space-Exploration tool.

Biographies

Reinhard Koenig

Reinhard is Professor for Computational Architecture at Bauhaus-University Weimar and a Principal Scientist at the Smart and Resilient Cities competence unit at the Austrian Institute of Technology (AIT) in Vienna. In addition, he acts as Co-PI in the Big Data Informed Urban Design and Governance group at the Future Cities Laboratory at the Singapore ETH Centre. After studying architecture and urban planning in Munich and Kaiserslautern Reinhard König completed his PhD thesis in 2009 at the University of Karlsruhe. From 2007 - 2012 Reinhard worked as a research assistant and appointed Interim Professor of the Chair for Computer Science in Architecture at Bauhaus-University Weimar. From 2013 - 2016 Reinhard König worked as senior researcher at the Chair of Information Architecture, ETH Zurich. In 2014 Reinhard was guest professor at the Technical University Munich.

Martin Beilik

Martin is a research assistant at the Chair of Computer Science in Architecture at the Bauhaus-University Weimar in Germany and co-founder of the DecodingSpaces GbR. He graduated in architecture and urban planning in 2011 at the Faculty of Architecture, Slovak University of Technology. Since 2012, he worked at the Bauhaus University Weimar. His main research interest is computational analysis and simulation of urban systems and application of these methods in planning process. As associate investigator at Emerging Cities Lab in Addis Ababa, he positions his research in context of rapid urbanization.

Katja Knecht

Katja is a researcher in Cognitive Design Computing with the Big Data-Informed Urban Design project at Future Cities Laboratory at the Singapore-ETH Centre. With a background in media, architecture, and computing, her research interests are interdisciplinary in nature and include interaction and user experience design, cognitive and design computing, as well as artificial intelligence techniques. In the past, her work has ranged from the development of generative and media-based tools to support architectural and urban design processes to the creation of wearable devices and tangible user interfaces for mediated spatial experiences.

Abdulmalik Abdulmawla

Abdulmalik is a lecturer and research assistant at the Chair of Computer Science in Architecture at the Bauhaus-University Weimar in Germany. He graduated in architecture and urban planning in 2013 at Dessau International Architecture Graduate School (DIA), Germany. Since 2016, he has been working at the Bauhaus University Weimar. His main research interest is computational analysis and simulation of urban systems with focus on the patterns of microeconomic aspects of the local urban settings of the city. He is also the Project Coordinator of Discovering Cities project in Amman Jordan.

Ekaterina Fuchkina

Ekaterina is a lecturer and research assistant at the Chair of Computer Science in Architecture at the Bauhaus-University Weimar in Germany. She graduated in Computer Science and Media in 2017 at Bauhaus-University Weimar. Her main research interest is design and developing of computational analysis approaches in architecture with focus on spatial analysis and design space exploration systems.

REFERENCES


[1] decodingspaces-toolbox.org