Hyperparametric design tools. Analysis of compositional contexts using neural networks.

mgr inż. arch. Tomasz Dzieduszyński

Abstract

The doctoral dissertation titled "Hyperparametric design tools. Analysis of compositional contexts using neural networks," explores the possibilities and limitations of utilizing neural networks in architecture and urban planning. The research focuses on spatial composition processing and automatic recognition and analysis of focal compositional points in urban spaces.

The theoretical part begins with an introductory chapter that defines the research problem, methodology, as well as research goals and questions. The second chapter describes the current state of the art, including the development of parametric architecture and its evolution towards hyperparametric architecture, which introduces deep learning into architectural practice. This chapter also presents application of neural networks at various design scales: urban, architectural and detail. In response to the identified research gap concerning the neural processing of compositional contexts, the author examines the issue of main focal points based on classical spatial composition theories. The analysis considers the geometric aspects, the formation process of these points, their scale, as well as their significance in social, symbolic and economic contexts. The chapter concludes with the identification of deep learning-based tools that can be used for the analysis of spatial compositions in computer-aided architectural design.

The experimental part, which forms the third chapter of the dissertation, consists of two experiments: preliminary and main. In the subchapter describing the preliminary experiment, various approaches to neural processing of synthetic, complex spatial compositions are tested. The experiences gained from the preliminary experiment lead to the development of a more advanced algorithm in the main experiment. The created prototype, based on generative adversarial networks, serves to recognize main focal points and guiding axes in urban tissue.

The conclusion discusses the results of the experiments and theoretical studies, as well as the limitations stemming from the applied methods and the current state of the art. The author considers the potential benefits of introducing deep machine learning into architectural practice, assesses the practical applicability of such tools, and outlines possible directions for further development of the field.

Keywords

Computer-aided architectural design, focal points, spatial composition, deep learning, neural networks, hyperparametric design

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TOMASZ DZIEDUSZYŃSKI