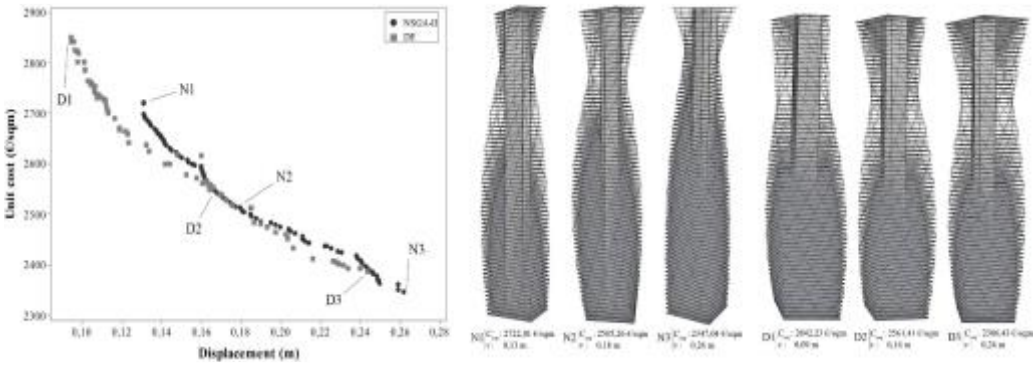
Computational Intelligence for Design Decisions: A Case Study for High-Rise Buildings

Keywords: Algorithmic Modeling, Performance Based Design, Computational Intelligence, Multi-Objective Optimization, High-Rise Buildings

Architectural Engineering + Technology Department (/Design Informatics)

Area of Research: Computation & Performance



Research Summary: Architectural design is considered as one of the most complex tasks due requirements for fulfillment of multiple objectives that are inherently conflicting. More, these very objectives strongly influence how final solutions for architectural design are shaped. Starting from the conceptual phase, the ultimate role of the architect, therefore, is to satisfy all vital design aspects by means of maximizing the advantages and minimizing the disadvantages. In the field of architecture, high-rise buildings could be the best example of the most complex structures to design and construct. Besides their complexity, urbanized cities are expected to require high-rise building alternatives to cope with the dense population in limited urban areas. Moreover, the World population is expected to reach to level of nine billion inhabitants by 2050. This suggests an increasing demand to high-rise buildings, which will play a significant role for future urbanization. Therefore, form-finding problem of high-rise buildings must be considered attentively starting from the conceptual design phase; hence, the form of proposed design strongly influences pivotal performance measures. Accordingly, the aim of this research is to develop a tool that is capable to serve at the conceptual design phase, based on computational intelligence methods in order to deal with complex design problems by considering high-rise buildings.

Research Methodology: This research, which adopts an interdisciplinary approach between "Computational Intelligence" and "Architecture", can be structured in three phases: The first phase addresses to conduct an extensive literature review on performance driven conceptual design process, computational intelligence method applications, and high-rise building optimization studies. The second phase, where the core is set, is focusing on to develop the computational intelligence method tool, test the tool with benchmark problems, and analyze the results based on computational performance metrics. Finally, yet importantly, the third phase will concentration on form finding problem of a high-rise generative model by formulating objective functions and constraints for different cases and testing of hypotheses by comparing the set of alternatives achieved by developed tool.

Key Publications:

B.Ekici, I.Chatzikonstantinou, I.S.Sariyildiz, M.F.Tasgetiren, Q.K.Pan, A Multi-Objective Self-Adaptive Differential Evolution Algorithm for Conceptual High-Rise Building Design. World Congress on Computational Intelligence 2016, 2272-2279.

B.Ekici, S.Kutucu, I.S.Sariyildiz, M.F.Tasgetiren, Addressing the High-Rise Form Finding Problem by Evolutionary Computation, IEEE Congress on Evolutionary Computation 2015, 2253-2260.

Berk Ekici

PhD started in: 2016

Master of Science 2014

Bachelor of Architecture 2011

Promoter(s):
Prof.Dr.Ir. I. Sevil Sariyildiz

Daily Supervisor(s):
Assist.Prof.Dr. Michela Turrin

Email: b.ekici-1@tudelft.nl

Phone: 0090 555 399 37 29

Main Question:

How can the final set of solutions generated by computational intelligence methods be improved?

Deliverables: *Developing a tool based on computational intelligence methods that will present several nature-inspired algorithms to architects in the digital environment.*

Link(s)

Updated: February 16, 2017