



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF ARCHITECTURE

Biomimetic Optimization Techniques and their Effect on Parametric Architectural Design

A thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Architecture

By

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
"وَقُلْ رَبِّ زِدْنِي عِلْمًا"

(طه: ١١٤)

صدق الله العظيم

*To my Mom, Dad, Wife &
Brother's family; for all your
support and unconditional love*

Statement

This thesis is submitted as a partial fulfillment of the Master of Science degree in Architecture, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Computer aided design (CAD) systems have evolved and opened the door to a new era of research and study that correlates architectural design, computation, as well as generative principles opening the door to the exploration of open-ended design solutions, producing a solution space whose boundaries are the constraints. This exploration process can be formulated as an optimization problem. This study presents a thorough explanation of biomimetic optimization, focusing on evolutionary optimization methods; the basics of the most famous common algorithms as well as a brief history about the application of evolutionary computation in architectural practice. This study also presents a comprehensive review of some significant research studies applying evolutionary optimization methods to various building design problems. A total of 83 studies are investigated and classified according to the application of different evolutionary algorithms in 17 different key fields. The most dominant optimization method was the genetic algorithm (GA). Almost 66% of the works (55 publications) used single-criterion optimization whilst nearly 41 % (34 publications) used multi-criteria and weighted sum optimization methods.

Keywords

Biomimicry, Building design optimization, Biomimetic or Nature-inspired optimization, Evolutionary algorithms, Evolutionary strategies, Evolutionary programming, Genetic algorithms, Genetic programming.