Evolution for Architecture: An Exploration of Evolutionary Computation for Architectural Design

Keywords: Evolutionary computation, Design Theory, AI in design, Computational layout design

Architecture Department / Computation & Performance Research Programme

Area of Research: Evolutionary computation in architectural design

Research Summary: While human-machine cooperation in design fields has become commonplace through CAD, a more improved collaboration and better support appear possible only through artificial design agents that are sensitive to human perception of affairs. Research program of this quest will be called Automated / Autonomous / Artificial Design (AD). Design involves complicated, multi-faceted, and ill-defined situations requiring situated and interpretative intelligence, which brings design problems amongst the hardest Artificial Intelligence problems. Therefore, the short-term aim of AD will be more developed CAD through new design tools (weak-AD), while the theoretical and intellectual aim will remain a better understanding of design intelligence, for the long-term goal of autonomous artificial design agents (strong-AD). This study explores the potentials of Evolutionary Computation (EC) in this pursuit by examining the problems, challenges, requirements, and potentials concerning EC-based architectural design agents, through both theoretical investigations and practical applications. The applications are based on a draft-generating functionality, which appears as a viable starting point, in not requiring a human-level intelligence. The basic outputs of the study are the considerations of a research program for AD, a complex evolutionary algorithm, and an architectural layout design assistant, together with the methods devised for this assistant. Theoretical considerations on computational design and applications, with conceptual mappings, frameworks, etc., should also be mentioned as outputs. These laid down a series of threads towards future studies.

Research Methodology: The research has been shaped as a parallel investigation of three main threads, which are, (1) theoretical discussions and speculations with regard to both existing literature, and proposals and applications of the thesis, (2) proposals for descriptive and prescriptive models, mappings, illustrations, task structures, decomposition schemes, and integrative frameworks; and (3) experimental evolutionary applications of these proposals. These three threads have been interwoven along several levels, moving from a more general level to specific applications. Each level has its own questions, methods, proposals, and products.


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Main Question: How can evolutionary computation be utilized for the development of computational supports for architectural design, with an overall orientation towards automation?

Deliverables: A complex evolutionary algorithm (Interleaved EA) and an architectural layout design assistant (design_proxy.layout).

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