# Evolutionary algorithms for building energy efficiency and end-use energy resources management

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The first step for a rational use of energy in the building sector is to incorporate building performance concerns since the early design stage. This requires evaluation and exploration of alternative solutions. However, designers are unable to manually produce more than 2 or 3 solutions. Therefore, the combined use of computer generative methods, optimization techniques, and building performance simulation tools may help overcome this issue. Generative methods produce large number of solutions allowing designers to compare and select the most promising ones. By coupling dynamic simulation tools and optimization techniques, it is possible to assess and improve the generated solutions, thus helping building practitioners in the decision making process. In this work, an evolutionary algorithm that couples an evolution strategy and local search technique is presented to generate alternative floor plan designs according to the user preferences and requirements. After generation, alternative solutions are assessed, ranked, and optimized to minimize human thermal discomfort in every building room [1].

Besides the design of more energy efficient buildings, the adequate use of energy resources and inclusion of renewable energy generation during the building lifespan is also fundamental for the promotion of a more sustainable and environmental friendly society. However, the variability and the mismatch between generation and demand raises some issues that need to be resolved. Considering the residential sector as a target to achieve a smarter use of electricity, due to the existence of a certain degree of dissociation between electricity consumption and the usage of energy services, adequate algorithms should be designed to help end-users to take the most adequate decisions regarding the optimized management of energy resources. For this purpose, a tailored evolutionary algorithm to optimize the integrated usage of multiple residential energy resources considering a large set of management strategies. Customized solution encoding and operators are developed for different groups of loads. The multiobjective model considers as objective functions the minimization of the energy cost and the minimization of end-user's dissatisfaction associated with management strategies. Results have shown that significant savings can be achieved mainly through demand response actions implemented over thermostatically [2].

**Keywords:** Generative building design; Building performance optimization; End-use energy resources management; Evolutionary algorithms

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