Computational Intelligence for Sustainable Architectural Design

Sustainability is a topical concern in building design for various reasons, spanning from ecological to monetary value concerns. This entails that the sustainability concept is not merely a matter of computing the energy consumption of a building, but it also concerns factors like comfort, functionality, ease of maintenance and recyclability. That is, sustainability is a complex and vague concept. Treatment of these issues requires advanced computational means. In this work bio-inspired information processing systems that are based on methods from the paradigm known as computational intelligence are employed for this purpose. The results are computation of sustainability performance with precision, and ensuring with certainty maximal sustainability of solutions.

One example of an application of this approach is determining the sustainability value of buildings and neighborhoods using a neuro-fuzzy modeling approach as shown in figure 1a and 1b. Another example is using multi-objective evolutionary algorithm (MOEA) to generate solutions with maximal sustainability performance, while the amount of possible solutions is excessively large. This is shown in figures 2a and 2b.

Fig 1a. A Neuro-fuzzy model to compute sustainability performance of buildings

Fig 1b. An urban design subject to sustainability analysis

Fig 2a. Multi-objective evolutionary algorithm (MOEA) based layout design

Fig 2b. Adaptive Pareto front formation in MOEA

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