A Fuzzy Neighborhood Based GA in Fuzzy Engineering Design

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Abstract

This article very briefly presents a new approach to model problems in the field of engineering design, by incorporating linguistic descriptions together with a variety of user-defined trade-off strategies. An interactive computer application was developed, using computational intelligence to solve the design task by producing a specially desired output under the given environmental conditions which are partly caused by the personal preferences of the engineer and by the expectations of a customer. It utilizes a binary- and integer-coded GA whose operators depend on fuzzy neighborhoods to generate and to optimize design solutions that are later identified by a clustering algorithm.

1 DEFINITIONS

A design problem is the specification of parameter settings in technical construction environments.

The design parameter space (*DPS*) is the set of all possible solutions of a design. Its elements are denoted $d := \lfloor d_1, \ldots, d_m \rfloor$ with $d_j \in X_j$, $j \in J \subset \mathbf{N}$ being an attribute that specifies a variable of a possible design. d_j is called a design variable (DV). X_j denotes any possible set.

The performance parameter space (*PPS*) is the set of all considered objectives that a possible design can achieve. Its elements are denoted $p = \lfloor p_1, \ldots, p_n \rfloor$ with $p_i \in Y_i$, $i \in I \subset \mathbf{N}$ being a particular considered objective that a possible design can achieve. p_i is called a performance variable (PV). Again Y_i notes any possible set.

The fuzzy preferences on DVs and on PVs are noted μ_{d_j}, $j \in J$ and μ_{p_i}, $i \in I$ respectively.

It is assumed that there exists a mapping $f_i\colon DPS \to PPS,\ d \mapsto p_i \quad \forall i \in I$ presented by some real world phenomena. (For details compare with the references.)

Under these notations the problem to be solved is:

Find all solutions $s^* \in DPS$ such that

$$c \cdot \left[\underset{j \in J,\, i \in I}{\mathrm{O}} \left(\mu_{d_j}\left(s_j^*\right) \circ \mu_{p_i}\left(f_i\left(s^*\right)\right)\right)\right] \geq \underset{j \in J,\, i \in I}{\mathrm{O}} \left(\mu_{d_j}\left(s_j\right) \circ \mu_{p_i}\left(f_i(s)\right)\right) \ \forall s \in DPS$$

whereby O and $\circ$ present suitable operators and $c \in \mathbf{R}^{\geq 1}$.

2 THE ALGORITHM

According to space limitations the algorithm is only illustrated by the flowchart below. For details refer to (Schleiffer).

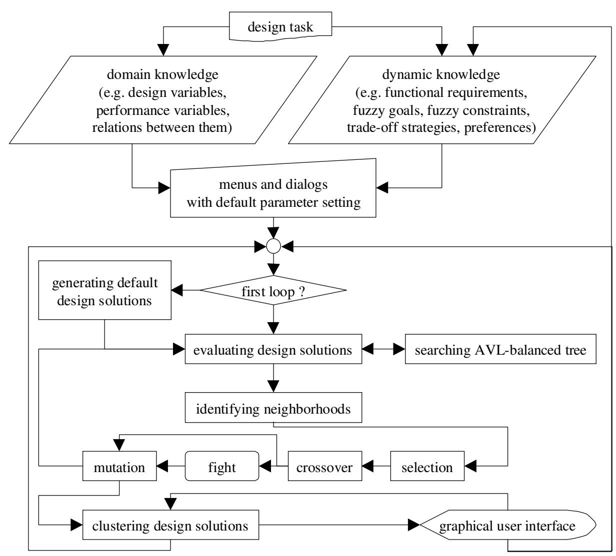

Figure 1: Flowchart of the Design Algorithm

References

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