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 \(d = [d_1, \ldots, d_m] \) with \(d_j \in \mathbb{X}_j, j \in J \subseteq \mathbb{N} \) being an attribute that specifies a variable of a possible design. \(d_j\) is called a design variable (DV). \(\mathbb{X}_j\) 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 \(p = [p_1, \ldots, p_n] \) with \(p_i \in \mathbb{Y}_i, i \in I \subseteq \mathbb{N} \) being a particular considered objective that a possible design can achieve. \(p_i\) is called a performance variable (PV). Again \(\mathbb{Y}_i\) notes any possible set.

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

It is assumed that there exists a mapping \(f: DPS \rightarrow PPS, d \mapsto p_i \forall i \in I\) 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

\[
f \left( \bigotimes_{i \in I} \left( \mu_{p_i}(c_i) \cdot \mu_{p_i}(f(c_i)) \right) \bigotimes_{j \in J} \left( \mu_{d_j}(c_j) \cdot \mu_{d_j}(f(d_j)) \right) \right) \forall s \in DPS
\]

whereby \(\bigotimes\) and \(\bigodot\) present suitable operators and \(c \in \mathbb{R}^m\).

2 THE ALGORITHM

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

![Flowchart of the Design Algorithm](image)

References

