Multi-objective optimization via fuzzy-evolution method

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Abstract

The purpose of this paper is to address the multi-objective optimization via combined fuzzy satisfied method and evolution programming (E.P.) method. The concept of non-inferiority is employed to characterize a solution of the multi-objective problem. Then, a fuzzy satisfied method based on evolutionary programming is introduced to determine the optimal solution. As a result, the objective functions of the optimization problem are modeled with fuzzy sets to represent their imprecise nature. That also enables us to reduce the inaccuracies in decision-makers' judgments. A time-sharing computer program is implemented, and an application to a multi-objective operation problem in feeder reconfiguration in electric power systems is demonstrated along with the computer outputs. In conclusion, the proposed

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solution algorithm allows for a more realistic problem formulation efficiently obtained the optimal solution for the tested system with a large search space.

1. Introduction

The work presented here is to address the multi-objective optimization via combined fuzzy satisfied method and evolution programming (E.P.) method. In recent years, customers have placed more stringent requirements on service utilities [1]. Decision-makers planning a system are typically confronted with multiple objective functions and these objective functions are generally of distinct types. Moreover, these objective functions are often non-commensurable. It is well known that many kind of methods to solve these problems have been proposed from different points of view [2-10]. One conceivable approach is to convert a multi-objective problem into a single objective problem by assigning distinct weights to each objective. However, this scheme is not totally satisfactory since distinct objectives cannot be evaluated under a common measure and there is no rational basis of determining adequate weights.

This paper presents the method that the objective functions of the optimization problems are modelled with fuzzy sets. Fuzzy sets were first introduced by Zadeh [11] as an effective means of solving non-probabilistic problems. Fuzzy sets are generally represented by a lower and upper boundary with a membership function. The higher the value of a membership function implies a greater satisfaction with the solution. The different objectives are easily integrated because all the membership function values of these objectives are in the same range [0,1]. Moreover, this paper also develops a fuzzy satisfied method by using the evolutionary programming (EP) to solve the constrained multi-objective problem since EP can readily achieve the global optimal solution [12].

The proposed approach is implemented in a software package. Also, an application to an optimal operation of the feeder reconfiguration in electrical distribution power systems is presented. It is found that the effectiveness of the proposed solution algorithm is verified through numerical examples on the feeder reconfiguration of electrical distribution power systems. In conclusion, the proposed solution algorithm allows a more realistic problem formulation and obtains the optimal solution for the tested system with a large search space.

2. Multi-objective optimization problems

The multi-objective optimization can be stated as