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METHODOLOGIES AND APPLICATION

# Fuzzy multicriteria decision making method based on the improved accuracy function for interval-valued intuitionistic fuzzy sets

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**Abstract** A new accuracy function for the theory of interval-valued intuitionistic fuzzy set, which overcomes some difficulties arising in the existing methods for determining rank of interval-valued intuitionistic fuzzy numbers, is proposed by taking into account the hesitancy degree of interval-valued intuitionistic fuzzy sets. By comparing it with several proposed accuracy functions, the necessity and efficiency of our accuracy function are provided by giving related examples. A fuzzy multicriteria decision making method is established to select the best alternative in multicriteria decision making process which is taken as interval-valued intuitionistic fuzzy set of criterion values for alternatives. While aggregating the interval-valued intuitionistic fuzzy information corresponding to each alternative, we utilize the interval-valued intuitionistic fuzzy weighted aggregation operators. Then the accuracy degree of the aggregated interval-valued intuitionistic fuzzy information is computed via the new proposed accuracy function. Thus, we can rank all the alternatives according to the accuracy function and choose the optimal one(s). Finally, an illustrative example is given to demonstrate the practicality and effectiveness of the proposed approach.

**Keywords** Interval-valued intuitionistic fuzzy sets · Aggregation operators · Accuracy function · Fuzzy multicriteria decision making

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## 1 Introduction

Most of the problems in engineering, medical science, economics and environment have various uncertainties. When the uncertainty is highly complicated and difficult to characterize, the classical mathematical approaches may not be successfully used to solve them. Zadeh (1965) initiated the concept of fuzzy set theory as a mathematical tool for dealing with uncertainties. Turksen (1986) and Gorzaleczany (1987) extended the fuzzy set to the concept of interval-valued fuzzy set. Gau and Buehrer (1993) proposed the vague sets and discussed some of their properties. Atanassov (1983, 1986) introduced the concept of intuitionistic fuzzy sets (IFSs) characterized by a membership function and a non-membership function, which is a generalization of Zadeh's fuzzy sets Zadeh (1965). But Bustine and Burillo (1996) point out that the vague sets are intuitionistic fuzzy sets. Later, Atanassov (1994) and Atanassov and Gargov (1989) introduced the interval-valued intuitionistic fuzzy sets (IVIFSs), which are a further generalization of the IFSs. The fundamental characteristic of the IVIFS is that the values of its membership function and non-membership function are intervals rather than exact numbers.

Multicriteria decision making method plays an important role to select the optimal one(s) among a finite number of feasible alternatives evaluated according to multiple criteria in real-life decision making problems including uncertainty. In order to select a desirable alternative, since the preference information proved by decision maker may be numerical values, such as exact values, interval values and fuzzy numbers, the classical approaches are not conducive to overcome the difficulties in the processing of this information under many conditions. Therefore, human judgments corresponding to preference information are provided easier with intuitionistic fuzzy information or interval-valued intu-

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