A New Ranking Approach for Interval Valued Intuitionistic Fuzzy Sets and its Application in Decision Making

Pranjal Talukdar, Dibrugarh University, Dibrugarh, India
Palash Dutta, Dibrugarh University, Dibrugarh, India

ABSTRACT

Ranking of interval valued intuitionistic fuzzy sets (IVIFSs) plays an important role because of its attraction and applicability to model uncertainty in real life problems. In this article, an attempt has been made to devise a new method for ranking of IVIFSs based on exponential function. The significance of the method is illustrated with the help of some numerical examples and the results are compared with other existing methods. Furthermore, a multi criteria decision making method is presented here to evaluate the final ranking of the alternatives using the proposed ranking method and discussed the consistency of so obtained results.

KEYWORDS

Accuracy Function, Interval Valued Intuitionistic Fuzzy Sets, Multi Criteria Decision Making Method, Ranking Method

1. INTRODUCTION

Atanassov (1986) developed the theory of Intuitionistic fuzzy set (IFS), a generalised notion of fuzzy set theory (FST). In FST, to each element of the universe of discourse a degree of membership between 0 and 1 is assigned and the degree of non-membership is considered as complement to one of the membership degree. On the other hand, IFS does not imply that the non-membership degree is always the complement of the membership degree. Instead, it characterised some hesitation degree between membership and non-membership degrees. Nowadays, IFS theory is being paid more attention for the uncertainty modelling problem and applied in a wide range of areas, such as, decision making, medical diagnosis, fuzzy optimization, pattern recognition, etc. Gau and Buehrer (1993) studied the notion of vague set, which is also a generalization of fuzzy sets. Bustince and Burillo (1996) established that the concept vague set is also equivalent to IFS theory. In modern years, intuitionistic fuzzy sets theory has been broadly used in decision-making theory. The notion of interval-valued fuzzy sets (IVFSs) was studied by Turksen (1986) and Gorzaleczany (1987). Atanassov and Gargov (1989) presented that the interval valued intuitionistic fuzzy set is a generalization concept of the IFS theory. The used of aggregation operators and the ranking methods of interval valued intuitionistic fuzzy numbers plays an important role concerning intuitionistic fuzzy decision-making problems. Real number set is the well-ordered set that is linearly ordered by ≥ or ≤; but these inequalities cannot work here as in real numbers. Thus, a clear comparison is not possible among the fuzzy numbers as...
fuzzy numbers (FNs) are represented with the help of distribution and overlapping of the fuzzy numbers occurred with each other. A general order ranking of the fuzzy numbers is defined as a ranking function \( f : F \rightarrow R \), where \( F \) represents the set of all fuzzy numbers. Thus, a precise ranking process is necessary for fuzzy numbers in fuzzy decision-making problems. Hence, ranking of fuzzy numbers and intuitionistic fuzzy numbers (IFNs) came into picture as a core problem in fuzzy set theory and a lot of effort is made for an efficient ranking process.

### 1.1. Related Works

The first ranking method of fuzzy numbers is studied by Jain (1976). Yager (1981) developed the ordering of fuzzy numbers by defining for indices. Kaufman et al. (1988) proposed a ranking method for fuzzy numbers. Chen and Tan (1994) developed a score degree function for IFSs based on the membership degree and non-membership degree functions, which was later improved by Hong and Choi (2000). Mitchell (2004) and Nayagam et al. (2008) discussed the ranking procedure of interval valued intuitionistic fuzzy sets (IVIFSs). Xu (2007) and Xu and Chen (2007) developed the score function and accuracy function for ranking of IVIFSs. Ye (2009) established an accuracy function for IVIFSs by taking into consideration the hesitancy degree of IVIFSs and developed a multi criteria decision making method based on it. Meng et al. (2009) analysed the limitations and deficiencies of existing score functions of vague set and proposed a new accuracy functions. Wang et al. (2009) introduced the membership uncertainty index and the hesitation uncertainty index orderly, and finally developed a method for comparing any two IVIFSs. Li (2010) developed two ranking method, one is ratio based ranking method and another is based on value and ambiguity of triangular intuitionistic fuzzy numbers (TIFNs) and successfully applied to MADM problems. Li (2011) again developed score function for IFSs and ranking method based on non-linear programming for IVIFSs. Nayagam et al. (2011) made a comparison of the accuracy functions proposed by Xu, Chen (2010) presented the optimistic and pessimistic score functions based on point operators to measure evaluations of the alternative with respect to each criterion. Wang et al. (2012) proposed a score function regarding the ranking of IVIFSs based on prospect value function. Wan and Dong (2014) developed possibility degree method for ranking of IVIFSs. Nayagam et al. (2014) defined an axiomatic complete ranking for incomplete information. Wang and Wang (2014) proposed a total ranking process for all the set of fuzzy numbers. Li and Wan (2014), Li (2015, 2016) discussed heterogeneous MCDM problems with fuzzy linear programming, difference index based ranking method for trapezoidal intuitionistic fuzzy numbers and ranking method based on linear programming models respectively. Nayagam et al. (2016) proposed a new ranking method for IVIFSs using upper lower dense sequence. Garg (2016) considered a new generalized improved score function of IVIFSs and applications in expert systems. An et al. (2017) proposed a weighted mean area ranking method for IFNs. Hao and Chen (2017) defined a ranking method for IVIFSs and applied it to solve MADM problems.

### 1.2. Problems Statement

IVIFSs have a large used in multi criteria decision making method. IVIFSs are used to represent the linguistic variables or decision makers’ attribute values of various conflicting criteria to model the multi criteria decision making problems. Hence, proper ranking method is very important for decision making problems. Though, many ranking methods for IVIFSs have been developed and have used in decision making problems but still there is no common method to rank all IVIFSs effectively.

### 1.3. Motivation

In the process of multi criteria decision making methods with intuitionistic fuzzy information, many times, it is more appropriate to express the attribute values in the form of IFSs and the information regarding the attribute weights are partially known or entirely unknown. With such information to designing the decision making problem under intuitionistic fuzzy environment it is preferable to
Secure Baseband Techniques for Generic Transceiver Architecture for Software-Defined Radio
Nikhil Kumar Marriwala, Om Prakash Sahu and Anil Vohra (2017). Handbook of Research on Recent Developments in Intelligent Communication Application (pp. 96-117).
www.igi-global.com/chapter/secure-baseband-techniques-for-generic-transceiver-architecture-for-software-defined-radio/173241?camid=4v1a

Complex Event Refinement by Statistical Augmentation Model
www.igi-global.com/article/complex-event-refinement-by-statistical-augmentation-model/135906?camid=4v1a