Ordered Intuitionistic Fuzzy Soft Sets and Its Application in Decision Making Problem

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ABSTRACT
In this article, some new basic operations and results of Ordered Intuitionistic Fuzzy Soft (OIFS) sets, such as equality, complement, subset, union, intersection, OR, and AND operators along with several examples are investigated. Further, based on the analysis of several operations on OIFS sets, numerous algebraic properties and famous De Morgans inclusions and De Morgans laws are established. Finally, using the notions of OIFS sets, an algorithm is developed and implemented in a numerical example.

KEYWORDS
Fuzzy Soft Sets, Intuitionistic Fuzzy Soft Sets, Ordered Intuitionistic Fuzzy Soft Sets, Soft Sets

1. INTRODUCTION

Molodtsov (1999, 2004) initiated the concept of soft set theory as a new mathematical tool for dealing with uncertainties which are free from these constraints. Maji et al. (2003) have done research on soft set theory and they defined the operations of AND, OR, union, intersection, and complement. Maji et al. (2001) introduced some properties regarding fuzzy soft union, intersection, complement, and De Morgan’s law. These results are further revised and improved by Ahmad and Kharal (2009). Maji et al. (2001, 2004) has developed the concept of Intuitionistic Fuzzy Soft (IFS) sets using Intuitionistic Fuzzy (IF) sets introduced by Atanassov (1986).

Yang et al. (2007, 2009) extended this theory to fuzzy soft set theory and discussed some of its applications. Further, Kharal and Ahmad (2009) introduced the notion of a mapping on the classes of fuzzy soft sets which is a vital idea of the advanced development of any innovative area of the mathematical sciences. Kong et al. (2009) mentioned on a fuzzy soft set theoretic approach to decision making problems. Xiao et al. (2009) discussed a combined forecasting approach based on the fuzzy soft sets. Majumdar and Samanta (2010) gave an idea of soft mappings and some of their properties. Further, an application of soft mapping in medical diagnosis has been shown. Majumdar et al. (2011) established generalized fuzzy soft sets and proposed a new student ranking system based on this theory. Cagman et al. (2010, 2012, 2013) initiated the notion of soft groups, soft matrix theory, Fuzzy Soft Matrix, Fuzzy parameterized fuzzy soft set and uni-int decision making problems in soft set theory. Further, they defined four types of distances between two IFSSs and proposed similarity measures of two IFSSs. Also construct a decision method which is applied to a medical diagnosis problem that is

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based on similarity measures of IFSSs. Majumdar et al. (2008, 2010) established similarity measure between two generalized fuzzy soft sets and applied in the medical diagnosis problem.

Xu et al. (2010) and Cagman et al. (2013) introduced intuitionistic fuzzy soft set using the notion of fuzzy soft set defined by Yang et al. (2008). The concept of possibility fuzzy soft set and full soft sets with decision systems are reported by Alkhazaleh et al. (2011) and Yong key kim et al. (2014) respectively. Yong Yang et al. (2011) followed the same concept and introduced a matrix representation of a fuzzy soft set. Majundar and Samanta (2010) introduced the concept of generalized fuzzy soft sets and successfully applied in decision making problems. Sunny et al. (2011) introduced the concept of OIFS set, which is a generalization of intuitionistic fuzzy soft sets and applied OIFS set for making decision in flood alarm model. Sunny et al. (2012) also investigate ordered ideal intuitionistic fuzzy (OIIF) sets and establish some results on them. Further, they studied similarity measures between ordered ideal intuitionistic fuzzy sets and applied these similarity measures to five selected states of Kerala, India to predict potential flood. Babitha and Sunil (2010) introduced the concept of soft set relation and function and discussed many related concepts such as the equivalence soft set relation, partition of soft sets, ordering on soft sets. Babitha and Sunil (2013) introduced soft multi sets and their application in decision making problems.


1.1. Motivation and Proposed Work

The majority of the decision-making problems depends only on the membership and non-membership function of the parameters. But the concept of OIFS depends not only on the membership and non-membership function of the relevant parameters, also on the weighted indices of the objects on the universe. The significance of these parameters is different for different situations. Here, by considering weighted indices, a more accurate decision can be obtained. This motivates an extensive study of decision making problems through OIFS sets.

For example, to identify the city which shows the highest possibility of air pollution, if one parameter, like thermal power plant, is important for one situation, but it may be unimportant for another situation. So, the important parameters for each location are termed as weighted indices. Therefore, the proposed technique facilitates to give better results in the decision-making problems. Consequently, this study introduced OIFS set which is a generalization of intuitionistic fuzzy soft sets. The membership and non-membership degrees are designed from a prolonged study of available data. The parameterization tools of OIFS set theory enhance the flexibility of its applications. Hence, the decisions are more reliable, dependable, and also more consistent.

In this paper, some new basic operations and results of Ordered Intuitionistic Fuzzy Soft (OIFS) sets, such as equality, complement, subset, union, intersection, OR, and AND operators along with several examples are studied. Further, based on the analysis of several operations on OIFS sets, numerous algebraic properties and famous De Morgan’s inclusions and De Morgan’s laws are established. Finally, using the notions of OIFS sets, an algorithm is developed and implemented in air pollution prediction model. It is concluded by finding the city which shows the highest possibility of air pollution based on the results.
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