Fuzzy Inf. Eng. (2017) 9: 67–91

Available online at www.sciencedirect.com
ScienceDirect
Fuzzy Information and Engineering
http://www.elsevier.com/locate/fiae

ORIGINAL ARTICLE

Bell-shaped Fuzzy Soft Sets and Their Application in Medical Diagnosis

Palash Dutta · Bulendra Limboo

Received: May 14, 2015 / Revised: Feb 11, 2016/
Accepted: Jul 31, 2016 /

Abstract A soft set theory is a new general mathematical tool to dealing with imprecision. The theory differs from traditional mathematical tools to dealing with uncertainties in which many mathematical theories failed. In this paper, we proposed the concept of Bell shaped fuzzy soft set and its application in medical diagnosis using arithmetic operations of discrete- Gaussian fuzzy number, triangular-Cauchy fuzzy number and Gaussian-Cauchy fuzzy number. As an integral part of this paper, we discuss the parametric form of Gaussian membership function is discussed with some important properties.

Keywords Fuzzy soft set · Bell-shaped fuzzy soft set · Gaussian fuzzy number · Cauchy fuzzy number

1. Introduction

Most of our real life problems in engineering, medical science, economics, environment etc. involve non-specific information and their solutions requires the use

Bulendra Limboo (✉)
Department of Mathematics, Dibrugarh University, Dibrugarh-786004, Assam, India
email: sylow1989@gmail.com
Palash Dutta
email: palash.dtt@gmail.com
palashdutta@dibru.ac.in
Department of Mathematics, Dibrugarh University, Dibrugarh-786004, Assam, India
Peer review under responsibility of Fuzzy Information and Engineering Branch of the Operations Research Society of China.

http://dx.doi.org/10.1016/j.fiae.2017.03.004

of mathematical principles based on uncertainty and impression. To tackling such uncertainties, a number of theories have been proposed. Some of these are probability theory, fuzzy set theory, intuitionistic fuzzy set theory, interval mathematics and rough set theory etc. All the existing theories have inherent limitations, which is inadequacy of the parameterization tool associated with these theories. In order to overcome these limitations, Russian researcher D. Molodtsov proposed the concept of soft set in 1999 [20]. Soft set theory is a potential mathematical tool for dealing with uncertainty, different from other existing mathematical tools. Molodtsov [20] has successfully applied the soft set theory in several directions such as smoothness of functions, game theory, operations research, Riemann-integration, Perron integration, theory of probability, theory of measurement and so on.

In recent years, the researchers have contributed a lot to fuzzification of a soft set theory. Maji et al. [14, 15] first gave some preliminary terms about soft set with illustrative examples and defined soft binary operations AND, OR, union and intersection of fuzzy soft sets. They verified a number of results including De Morgan's laws. Ali et al. [3] also pointed out several assertions in [17] which are not true in general by counter examples. They defined some new operations such as restricted union, restricted intersection, restricted difference and extended intersection. Moreover, they improved the notion of complement of a soft set and applied newly defined operation to prove De Morgan's laws in a soft set theory. Ahmad & Kharal [1, 2] revised the results found in [12] and defined arbitrary fuzzy soft union, intersection and proved De Morgan's Inclusions and De Morgan's Laws in a fuzzy soft set theory. They introduced the notion of mapping on soft classes and studied the several properties of fuzzy soft images and fuzzy soft inverse images of fuzzy soft sets with examples. Majumdar and Samanta [17] introduced the idea of soft mapping and studied some of its properties. They also defined the image, inverse image of a soft set under soft mapping and studied some of their properties. They applied the soft mapping in medical diagnosis and remarked that the model used in the diagnosis was very preliminary and may be improved by incorporating detailed disease- symptom information and clinical results.

In the process of medical diagnosis, the earliest work is proposed by Sanchez. In continuation of Sanchez's work, Saikia et al. [27] have extended the Sanchez's method by using Intuitionistic fuzzy soft set theory. Chetia and Das [5] extended Sanchez's approach for medical diagnosis using interval-valued fuzzy soft sets and exhibited the technique with a hypothetical case study. Majumdar and Samanta [16] initiated another important notion of fuzzy soft set, known as generalized fuzzy soft set and proposed a way to find the similarity of two generalized fuzzy soft sets and successfully applied the same problem in medical diagnosis with a case study.

Meenakshi & Kaliraja [19] have provided the techniques to study Sanchez's approach in medical diagnosis using interval valued fuzzy matrices. Neog and Sut [24, 25] have reintroduced the notion of complement of a fuzzy soft set and introduced a matrix representation of fuzzy soft set and extended Sanchez's approach for medical diagnosis using fuzzy soft complement. Çelik and Yamak [4] used fuzzy soft set through familiar Sanchez's approach for medical diagnosis using arithmetic operations of triangular fuzzy numbers and exhibited the result by hypothetical case study.