Chapter 6
Some Hybrid Soft Sets and Their Application in Decision Making

Pinaki Majumdar
M. U. C. Women’s College, India

ABSTRACT

In this chapter the notions of two hybrid soft sets, namely fuzzy parameterized soft sets and vague soft sets has been discussed and some operations on them are defined. Some properties of these two hybrid soft sets under these operations are also studied. Application of fuzzy parameterized soft sets and vague soft sets in decision making has also been shown. Then the notion of similarity measure between two hybrid soft sets has been introduced and their basic properties are studied. Applications of these similarity measures in various problems like medical diagnosis and decision making have been shown. The idea of entropy of a fuzzy parameterized soft set has been introduced.

INTRODUCTION

There are several techniques to handle various types of uncertainties prevailing in this physical world. There are theories namely theory of probability, theory of fuzzy sets (Zadeh, 1965), theory of multisets, theory of rough sets (Pawlak, 1982), theory of vague sets (Gau & Buehrer,1993) etc. which can handle uncertainties of various types. In 1999, Molodtsoy (1999) initiated the theory soft sets as a new mathematical tool for dealing with uncertainties which traditional mathematical tools cannot handle. He has shown several applications of this theory in solving many practical problems in economics, engineering, social science, medical science, etc. Later other authors like Maji, Biswas and Roy (2003) have further studied the theory of soft sets and used this theory to solve some decision making problems (Maji & Roy, 2002). They have also introduced the concept of fuzzy soft set, a more generalised concept, which is a combination of fuzzy set and soft set and studied its properties (Maji, Biswas & Roy, 2001). Recently, Wei, Xu., et. al. (2010) has coined the idea of vague soft sets which are combinations of vague set and soft sets. Vague soft sets are capable of having more strength to handle uncertain information. Feng et. al. (2010), Kong et. al. (2008, 2009) and many other authors has defined several hybrid versions of soft sets and applied them in decision making. Currently research work in soft set theory is progressing very

DOI: 10.4018/978-1-4666-9798-0.ch006
Some Hybrid Soft Sets and Their Application in Decision Making

rapidly and works in many directions like algebraic structures (Aktas & Cagman, 2007), Aygunoglu &
mapping (Majumdar & Samanta, 2010), similarity measure (Majumdar & Samanta (2008, 2011), Ma-
umdar (2011), Pappis & Karacapilidis, (1993)) etc. are being done. Here we have presented two types
of hybrid soft sets namely fuzzy parameter set and vague soft set. On the other hand similarity has been
a key concept in a number of domains, such as linguistics, physiology, computational intelligence, pat-
tern recognition, decision making etc. In several problems it is often needed to compare two sets. The
sets may be fuzzy, may be vague etc. We often interested to know whether two patterns or images are
identical or approximately identical or at least to what degree they are identical. Several researchers like
the problem of similarity measurement between fuzzy sets, fuzzy numbers and vague sets. In the paper
by Grzegorzewski (2004), several types of distances between intutionistic fuzzy sets have been given.
Majumdar & Samanta (2008, 2010, 2011) have studied the techniques of similarity measurement between
two soft sets, fuzzy soft sets and intutionistic fuzzy soft sets. We have extended this concept of similarity
in vague soft sets. Again decision making is a problem involving the determination of optimal strategies
when a decision maker is faced with many alternatives regarding the uncertainty of some future event.
Recently many authors have used soft sets and fuzzy soft sets for decision making. In 2009, Chaudhuri
et al. have used fuzzy soft relations in decision making. Feng Feng et. al. (2010) has also studied fuzzy
soft sets based decision making. Also fuzzy soft set based forecasting method and certain flood alarm
models (Kalayathankal & Singh, (2010), Maji & Roy, (2002)) etc. has been designed by many authors.
Majumdar & Samanta (2008, 2010, 2011) have used similarity measurement techniques for detection
of diseases.

In next few sections we present the theory and applications of each of these soft sets independently.
But at first a preliminary section has been given.

PRELIMINARIES

In this section some definitions, results and examples regarding fuzzy and soft sets are given which will
be used in rest of this chapter. Fuzzy sets have been introduced by Zadeh in 1965 as an extension of the
classical characteristic function of set.

Definition 1.0 (Zadeh,1965): If X is a collection of objects then a fuzzy set A in X is a set of ordered
pairs: \( A = \{ (x, \mu_A(x)) : x \in X \} \), where \( \mu_A(x) \) is called the membership function of \( x \) in A which
maps \( X \) to the membership space \([0,1]\). i.e., \( \mu_A(x) : X \rightarrow [0,1] \).

Let \( A \) and \( B \) be fuzzy sets on a universal set \( X \), with the grade of membership of \( x \) in \( A \) and \( B \) denoted
by \( \mu_A \) and \( \mu_B \) respectively. Zadeh (1965) defined the following relations and operations.