

# Complex multi-fuzzy soft set: Its entropy and similarity measure

## Abstract

We develop a novel mathematical tool known as complex multi-fuzzy soft set (*CMFSS*) which has the ability to handle uncertainties, imprecision and vagueness of information that are inherent in the data by considering the amplitude and phase terms of the complex numbers simultaneously. This *CMFSS* constitutes of a hybrid structure of multi-fuzzy set and soft set which are defined in a complex setting. The structure is flexible as it allows for a greater range of values for the membership function by extending them to the unit circle in a complex plane through modification of the multi-fuzzy soft set by the inclusion of an additional term called the phase term in order to take into account of the periodic nature of the data. Accordingly, the novelty of this work lies in the complex multi-membership functions which consider more range of values while handling the uncertainty of the periodic data. In this research paper, the concept of complex multi-fuzzy soft set is introduced. We then define its basic operations of complement, union and intersection and study some related properties, with supporting proofs. Subsequently, by means of level soft sets, we present an algorithm to solve a *CMFSSs* decision making problem, to illustrate the effectiveness and practicality of the proposed concept. Finally, we introduce axiomatic definitions of entropy and similarity measure for *CMFSSs*, and some formulas have also been put forward to calculate them. Numerical examples are given to demonstrate that the proposed entropy measure for *CMFSSs* is an important concept for measuring uncertainty in the information/data. Furthermore, some theorems are proposed showing how the entropy of *CMFSS* can be found from the similarity measure of *CMFSS*.

**Keywords:** Complex multi-fuzzy set, decision making, fuzzy set, multi-fuzzy set, soft set, uncertain information.

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