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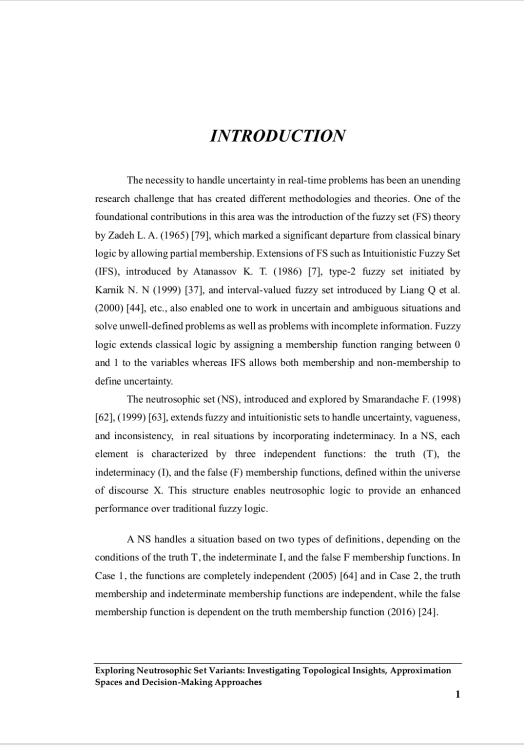

INTRODUCTION

The necessity to handle uncertainty in real-time problems has been an unending research challenge that has created different methodologies and theories. One of the foundational contributions in this area was the introduction of the fuzzy set (FS) theory by Zadeh L. A. (1965) [79], which marked a significant departure from classical binary logic by allowing partial membership. Extensions of FS such as Intuitionistic Fuzzy Set (IFS), introduced by Atanassov K. T. (1986) [7], type-2 fuzzy set initiated by Karnik N. N (1999) [37], and interval-valued fuzzy set introduced by Liang Q et al. (2000) [44], etc., also enabled one to work in uncertain and ambiguous situations and solve unwell-defined problems as well as problems with incomplete information. Fuzzy logic extends classical logic by assigning a membership function ranging between 0 and 1 to the variables whereas IFS allows both membership and non-membership to define uncertainty.

The neutrosophic set (NS), introduced and explored by Smarandache F. (1998) [62], (1999) [63], extends fuzzy and intuitionistic sets to handle uncertainty, vagueness, and inconsistency, in real situations by incorporating indeterminacy. In a NS, each element is characterized by three independent functions: the truth (T), the indeterminacy (I), and the false (F) membership functions, defined within the universe of discourse X. This structure enables neutrosophic logic to provide an enhanced performance over traditional fuzzy logic.

A NS handles a situation based on two types of definitions, depending on the conditions of the truth T, the indeterminate I, and the false F membership functions. In Case 1, the functions are completely independent (2005) [64] and in Case 2, the truth membership and indeterminate membership functions are independent, while the false membership function is dependent on the truth membership function (2016) [24].

Exploring Neutrosophic Set Variants: Investigating Topological Insights, Approximation Spaces and Decision-Making Approaches

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