Chapter 21
Bipolar Neutrosophic Cubic Graphs and Its Applications

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ABSTRACT

The authors introduce neutrosophic cubic graphs and single-valued netrosophic Cubic graphs in bipolar setting and discuss some of their algebraic properties such as Cartesian product, composition, m-union, n-union, m-join, n-join. They also present a real time application of the defined model which depicts the main advantage of the same. Finally, the authors define a score function and present minimum spanning tree algorithm of an undirected bipolar single valued neutrosophic cubic graph with a numerical example.

INTRODUCTION

Most of the real time problems encounter one or the other forms of imprecise data. To deal with such types of data many authors have proposed various mathematical tools. And to name a few of these tools we have fuzzy sets, intuitionistic fuzzy sets, soft sets, vague set theory and so on. Though the fuzzy sets and intuitionistic fuzzy sets considered the hesitant degree along with membership and non-membership degree simultaneously, hesitant value cannot be a specific number always. Hence the development and generalization of fuzzy sets was not enough to deal with all types of uncertainties in real physical problems. Therefore, some more theories were required.

Neutrosophy, a newly born science, studies the origin, nature and scope of indeterminacies and their relations with various ideational spectra. The theory of neutrosophy make the concept intelligible, were the incidence of the application of a law, an idea, an axiom, a conceptual construction on an unclear,

DOI: 10.4018/978-1-5225-9380-5.ch021

imprecise, indeterminate phenomenon. Also the Neutrosophic set theory is applied in various fields such as topology, operations research, control theory, mechanics and in many more real life time problems. Neutrosophic theory is made more convenient by the introduction of Single Valued Neutrosophic Set, neutrosophic cubic sets, bipolar neutrosophic sets and so on. The Single Valued Neutrosophic sets are introduced to make the Neutrosophic theory more convenient to apply in real time physical and engineering problems. Neutrosophic cubic sets are very good tool by which are can manage vague data in a very effective way as compared to cubic sets and other models of fuzzy sets. Bipolar fuzzy sets are an extension of fuzzy sets whose membership degree range is [-1,1]. It is noted that positive information represents what is granted to be possible, while negative information represents what is considered to be impossible. In many domains, it is very convenient to deal with bipolar information.

On other hand graph is a convenient and attractive way of representing information in which the objects are represented by vertices and their relations by edges. When there is an uncertainty in describing an element or in its interconnections, fuzzy graph model and its extensions were designed. But Fuzzy graph theories and their extensions fail if the relation between the nodes in the problem is indeterminate. To overcome this neutrosophic graphs were developed. Many researchers applied the neutrosophic cubic sets to graph theory to make it more applicable and represent a problem physically in the form of matrices, diagrams etc., which is very easy to understand and deal with.

In this article, we propose the concept of neutrosophic cubic graph in bipolar setting and elucidate its various characterizations. We apply this defined model to real time problem. We also test its applicability based on present time and future prediction which is the key advantage of this model.

BACKGROUND

L. Zadeh (1965) introduced the concept of fuzzy sets by defining the degree of membership to deal with the data with uncertainties. To cope with the lack of non-membership degree K. T. Atanossov (1986) proposed the notion of intuitionistic fuzzy sets by associating the degree of non-membership in the concept of fuzzy set as an individual element. In addition to this Gau W. L and Buehrer D. J (1993) introduced vague sets. F. Smarandache (1999) introduced neutrosophic logic to handle and understand the indefinite information in a more effective way. F. Smaradache (2006) introduced neutrosophic sets as a generalization intuitionistic Fuzzy sets. Every element of a neutrosophic element has three grades of membership defined within the real non-standard interval]–0, 1+[. H. Wang and F. Smarandache (2010) defined single valued neutrosophic set which is a subclass of neutrosophic sets with three membership functions that are independent and their value defined in [0,1].

Fuzzy graph theory was designed by A. Rosenfeld (1975) and has been extended by many researchers. As a result, fuzzy hyper graphs by Mordeson, J.N. and Nair P. S(2001), intuitionistic fuzzy graph (2006) by M. G. Karunmbigai and Parvathi Rangasamy, strong intuitionistic fuzzy graph (2012) by M. Akram and Davvaz. M, interval- valued Fuzzy Planar Graphs by T. Pramanik Et. Al. are developed. S. Samanta and M. Pal studied Fuzzy Tolerence Graphs (2011), Fuzzy planar Graphs (2015) etc. Smarandache (2015) developed four kinds of neutrosophic graphs, two of them based on literal indeterminacy (I), named as I-edge neutrosophic graph and I-vertex neutrosophic graph. Many researchers studied deeply about these concepts, hence has gained more popularity due to its applications in many real world problems. Other two are based on (t,i,f) components namely the (t,i,f) – Edge neutrosophic graph and the (t,i,f)- vertex neutrosophic graph. Later on, third neutrosophic graph model was introduced by Broumi Et. al (2016)

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