Neutrosophic Sets and Systems

Volume 50 Article 2

6-10-2022

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Neutrosophic Sets and Systems, Vol. 50, 2022
University of New Mexico

An Intelligent Traffic Control System Using Neutrosophic Sets, Rough sets, Graph Theory, Fuzzy sets and its Extended Approach: A Literature Review

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Abstract: Recently, the intelligent traffic control system and its uncertainty analysis are considered one of the hot spots for utilizing the available techniques. It became more essential when the automatic car, electric vehicle, and other smart cars have introduced the transportation. To control the traffic accident and smooth road services an intelligent traffic control system required. It will be also useful in decreasing the time, reaction time, and efficiency of traffic. However, the problem arises while characterization of true, false or uncertain regions of traffic flow and its future approximation. To deal with this issue some available mathematical technique for traffic flow using rough set, fuzzy rough set, and its extension with the neutrosophic set is discussed in this paper. Some of the papers related to graphical visualization of traffic flow is also discussed for further improvement. The rough set theory can be useful for dealing the uncertain, incomplete, and indeterminate data set. Hence, the hybridization of the neutrosophic set and rough can be considered one of the efficient tools for intelligent traffic control and its approximation via automatic red, green and yellow lights. This paper tried to provide an overview of each available technique to solve the traffic problem. It is hoped that the proposed study will be helpful for several researchers working on traffic flow, traffic accident diagnosis, and its hybridization as future research.

Keywords: Neutrosophic Set ; Rough set ; Fuzzy Set ; Graph theory ; Intelligent Transportation System ; Uncertainty; Urban traffic ; Traffic Flow

1. Introduction

Recently, the urban traffic control system and its analysis have attracted the attention of various researchers. The reason is many electric, automatic, and other smart vehicles are proposed for transportation services. To control the urban traffic beyond red, green, and yellow light signals many traffic management systems have been developed over time. One of the reasons is in the case of the human driver the traffic control is based on Human Turiyam cognition rather than red, green, or yellow light as discussed by Singh (2021). The problem arises when the automatic car needs to be aware of when to stop, when to start and when to slow as the car does not has awareness. It becomes more crucial in the case of large towns and cities. The computerized traffic signal controls, which are known as Urban Traffic Control (UTC), also have some limitations. Hence, the fuzzy set theory, Rough Set Theory, fuzzy-rough set theory, and neutrosophic set theory, and others can be used to synchronize traffic control in crowded metropolitan networks. The reason is these types of data may contain a heteroclinic pattern as discussed by Singh (2022). Hence maximizing vehicle throughput is no longer the only goal of traffic control. The balance demand and flow with extra consideration namely lane assignment, parking limits, turning bans, one-way street systems, and tidal flow schemes. They can be constructed to provide deliberate traffic constraints, such as by prioritizing buses over other vehicles or implementing queue management procedures and deliberate area entry control. These advancements provide traffic engineers and network controllers with the tools they need to implement a highly adaptive type of urban traffic management - one that responds to transportation policies and management priorities, as well as the public's and local politicians' acceptance of them (Wang 2013, Chen et 2014). It is one of the major issues as the public and local politicians acceptation and Turiyam cognition contains lots of uncertainty in the word. Computing with these types of words for precise management of traffic control is one of the major tasks for data science researchers.

The mathematical computation of uncertainty and its analysis is one of the crucial tasks for data science researchers. To achieve this goal, Prof. Zadeh proposed fuzzy set theory in 1965 as an expansion of the classical notion of a set (Zadeh, 1965) as an alternative of probability. With the proposed methodology, Zadeh established a mathematical framework that allows for decision-making based on fuzzy representations of some data. Uncertainty, subjectivity, imprecision, and ambiguity can be found in à wide range of traffic and transportation factors. As a result, mathematical approaches that can deal successfully with uncertainty, ambiguity, and subjectivity must be utilized in the mathematical modeling phase of traffic and transportation processes whose individual parameters are unclear, ambiguous, or subjectively evaluated. Fuzzy set theory is a useful mathematical tool for dealing with indeterminacy, subjectivity, and ambiguity. A fuzzy set is a collection of elements that fits the membership degree of a set. For example, suppose there are two fuzzy sets that represent two categories of people: old and young. As a result, the higher a person's age, the higher his or her membership degree among the elderly, and the lower his or her membership degree among the youth. Calculating the gradual indiscernibility connection in large datasets with many items is difficult in terms of memory and runtime. RST is a revolutionary mathematics technique for dealing with uncertain and inexact knowledge in a variety of real-world applications such as data mining, medicine, and information analysis. Rough set theory is used to analyses and handle data (Wang et al. 2009). Z. Pawlak, a Polish mathematician, initially presented it in 1982 to find the underlying laws of data. It's very useful for dealing with irregularities in information systems. In order to manage data with continuous qualities and find inconsistencies in the data, fuzzy rough set theory can be used with rough set theory. The fuzzy-rough set model has shown to be beneficial in a variety of applications because it is a potent tool for analyzing inconsistent and ambiguous data. RST is concerned with data that is inconsistent, such as two patients with the same symptoms but different diagnoses. Data is intended to be ambiguous in the rough set analysis. As a result, it's necessary to discretize a continuous numerical property. The fuzzy-rough set theory (FRST) is a continuous numerical attribute extension of the rough set theory. It can handle both numerical and discrete data and can address the same problems that a rough set can. The value of FRST can be observed in a variety of applications. The FRST is built on the foundations of two theories

: rough set theory and fuzzy set theory. The two important and mutually orthogonal aspects of faulty data and knowledge are addressed by fuzzy sets and rough sets. While the former allows things to belong to a collection or relation to a certain extent, the latter provides approximations of concepts in the face of incomplete data. The primary goal of fuzzy-rough sets is to define lower and higher approximations of the set when the universe of a fuzzy set turns rough due to equivalence or to transfer the equivalence relation to a similar fuzzy relation. Fuzzy approximations of a fuzzy set in a crisp approximation space are called rough fuzzy sets and fuzzy approximations of a crisp set in a fuzzy approximation space are called fuzzy rough sets (Shao 2015) and their applications (Weng et 2007 ; Chai 2015). The problem arises when data sets contain hesitant parts as an independent value. To represent this type of indeterminacy 3D-Neutrosophic set is introduced by the Smarandache (2010, 2021), with each dimension representing the statement's truth (T), indeterminacy (I), and falsity (F). These functions are unrelated, and the total of their parts does not equal one. It should add up to 3 in the meantime. To deal with ambiguity, many approaches have been devised. Starting with Fuzzy logic (Xiong et al. 2021), which depicts the concept of "partial truth" as the true value ranges between 0 and 1, depending on whether it is wholly false or completely true.

Meanwhile, the researchers proposed interval-valued sets to allow interval membership values within the same set because fuzzy logic had several downsides. An intuitionistic fuzzy set was then created as a generalization of traditional fuzzy sets. Each element has a degree of membership and even non-membership in an intuitionistic fuzzy set (Thakur, 2014). Meanwhile, it had flaws, prompting some scholars to suggest a neutrosophic set of rules. Information is often ambiguous and imprecise in the fields of safety, reliability, risk analysis, and management.

When some barriers against accidents fail to achieve their aim, the "severe occurrence" is frequently an extremely deadly event. They are invaluable resources for information on air transportation safety assurance systems. With such research at hand, it is possible to determine if current safety measures are adequate or whether they need to be improved. Estimation of safety barrier reliability must be carried out in order to evaluate this likelihood.

Unfortunately, most of the time there isn't enough evidence to make statistical inferences about the frequency of events in an accident scenario. Regrettably, finding that information is extremely improbable. The condition is caused by two factors. The first is that some of these events occur seldom, and in the past, events with minor implications were not routinely reported. The second aspect is the human factor, which includes difficult-to-quantify indicators like differing reaction probabilities and mistake activity probability. Uncertainty and subjective judgments are present in such metrics. Expert estimations are the only way to get such information. These estimates aren't exact enough to be used in probabilistic analysis. Information is frequently ambiguous and imprecise in the areas of safety, reliability, risk analysis, and management.

Recently, uncertainty and its characterization is considered one of the major issues. To deal with this issue neutrosophic set and its metric is used for the characterization of data beyond acceptation, rejection, and uncertain part, independently. A parallel rough set also gives away to characterize the uncertainty in positive, negative, and boundary regions. These two methods are applied in several areas for knowledge processing tasks.

In this paper, we tried to focus on dealing with the traffic flow and its approximation. The traffic flow is a complex, changeful, nonlinear, unstructured, space time-varying and random system. With the foundation operationating of the intelligent traffic system, it is imperative to search for a traffic state estimation model, which is suitable for mixed-traffic in China. On the basis of analysis of the multidimensional state characteristics of mixed traffic, using the rough set theory, the four-dimensional state estimation model is founded. By data discretization and attribute reduction, the two-dimensional decision table is gained, and the rules of multidimensional state estimation in urban traffic systems are presented. A case is given and it indicates that this method can eliminate the redundancy information of the system effectively and improve the precision of rule mining. Rough set theory (RST) is a new mathematical tool to deal with vagueness and uncertainty. The main objective of using RST is to combine approximation of concepts from the collected data. This set can easily integrate community opinion and experience without having a precise mathematical model and hence, it is pertinent for applications in traffic prediction and control. Uncertainty in the rough set approach is expressed by a bounded region of a set, not by partial membership like in fuzzy set theory and it is defined by means of topological operations, interior and closure called approximations.

Other parts of the paper are organized as follows: Section 2 provides some literature on road traffic control using a Neutrosophic set and its hybrid method. Section 3 discussed the method for Rough set for traffic control. Whereas Section 4 provides some recent methods for utilization of different graphs for traffic control. Section 5 provides methods for a fuzzy set for traffic control followed by conclusions, acknowledgments, and references

2. Road traffic control management based on neutrosophic approaches:

This section contains some of the available methods using Neutrosophic set for Road Traffic control.

Table 1 summarizes some of the neutrosophic techniques dealing the road traffic control.

Table 1: The neutrosophic approaches for dealing with the Traffic flow

Reference	year	Techniques used	Solve problem
[1]	2017	neutrosophic linear equations	Traffic flow
[2]	2018	Neutrosophic C-means	Road safety
[3]	2019	Type 2 fuzzy and interval neutrosophic	operational laws, and aggregation. operators have been proposed under triangular interval type-2 fuzzy and interval neutrosophic environments. The validity of the proposed concepts has been verified using a numerical example.
[8]	2019	Gauss Jordon	Traffic control in a neutrosophic environment
[9]	2019	Dombi interval neutrosophic	Traffic control in Dombi interval
[4]	2019	Jordan method	Traffic control in a neutrosophic environment
[6]	2019	Neutrosophic set	transport sustainability assessment
[11]	2020	Single valued neutrosophic sets	Emergency Transportation Problem

[17]	2020	Interval-valued neutrosophic soft set	Control traffic signals
[19]	2019	on neutrosophic Markov chain	Crowed management
[5]	2019	Neutrosophic Cognitive maps	Crowded junction in Chennai
[10]	2020	Developed Plithogenic fuzzy hypersoft set based TOPSIS under neutrosophic environment	Developed Plithogenic fuzzy hypersoft set based TOPSIS under a neutrosophic environment to solve a parking problem and validated the findings by taking two different sets of choices compared with fuzzy TOPSIS
[14]	2020	neutrosophic exponentially weighted moving average	Monitoring the road traffic crashes
[13]	2021	Type-2 neutrosophic sets based CRITIC and MABAC	Public transportation pricing system selection
[12]	2021	Fuzzy FUCOM and neutrosophic fuzzy MARCOS	Assessment of alternative fuel vehicles for sustainable road transportation
[15]	2021	Neutrosophic statistical approach	Reducing and identifying the reasons for road accidents and road injuries
[16]	2021	AHP, MABAC, and PROMETHEE II with single-valued neutrosophic sets	Risk Management in Autonomous Vehicles
[18]	2021	multi-valued neutrosophic MULTIMOORA method	Traffic flow and its application in a multi-valued way
[19]	2021	Neutrosophic exponentially weighted Moving Average Statistics	Monitoring road accidents and road injuries
[20]	2022	Neutrosophic weighted Sensors Data Fusion	Occupancy detection system

Prof. Abdel-Basset et al. (2021) propose an opinion that autonomous vehicles play a key part in an intelligent transportation system, however, there are a number of dangers associated with these vehicles. As a result, a new hybrid model for identifying these risks is introduced. Uncertainty and hazy data are present in this procedure. To deal with the uncertainty, the neutrosophic hypothesis is employed. True, indeterminacy and false are the three membership functions provided by the neutrosophic theory (T, I, F). The notion of Multi-Criteria Decision Making (MCDM) is employed with the neutrosophic theory in this research since autonomous cars have various and conflicting criteria. The Analytic Hierarchy Process determines the weights of criteria in the first stage (AHP). Second, methodologies such as Multi-Attributive Border Approximation Area Comparison (MABAC) and Preference Ranking Organization Method for Enrichment Evaluations II are used to rate the risks of autonomous vehicles (PROMETHEE II). Ten different options were used in the case study. To demonstrate the robustness of the proposed model, a sensitivity analysis and a comparative study with a fuzzy environment are presented.

Bendadi (2018) proposed two clustering techniques for road traffic control. The first is Credal C-Means clustering (CCM), and the other is Neutrosophic C-Means clustering (NCM) (NCM). When it comes to overlapping items, both proposed methods have a similar tendency to form a new cluster that decides the imprecision object. Both techniques have different interpretations of the indeterminacy cluster. The number of meta-clusters formed by the CCM algorithm are proportional to the number of singleton clusters, whereas, with the NCM technique, all indeterminate objects are represented by a single indeterminacy cluster.

The application of CCM and NCM approaches to real-world data in the field of road safety, as represented by trajectories gathered in a bend, provides four clusters that represent the behavior of four different types of drivers based on their Turiyam consciousness (Singh 2021):

- The first cluster depicts the family of the slowest safe driving trajectories.
- The second cluster consists of the family of fast trajectories with safe driving.
- The third cluster is the family of sport driving's slowest trajectories.
- The fourth cluster is the family of sport driving's fastest trajectories.

Pamucar et al. (2021) suggested a hybrid model for evaluating alternative fuel cars for sustainable road transportation in the United States that included fuzzy FUCOM and neutrosophic fuzzy MARCOS. For public transportation pricing system selection, Simic et al. (2021) extended the CRITIC and MABAC techniques to type-2 neutrosophic sets.

Rayees et al. (2020) propose four possible categories of Plithogenic hypersoft sets in this study, based on the number of characteristics chosen for the application, the type of alternatives, or the degree of attribute value appurtenance. The fuzzy and neutrosophic scenarios that potentially have neutrosophic applications in symmetry are covered by these four PHSS classes. Then, as an extension of the methodology for order preference by the resemblance to an ideal solution, they introduced a novel multi-criteria decision making (MCDM) method, which is based on PHSS (TOPSIS). A number of real-world MCDM situations are compounded by uncertainty, which necessitates subdividing each selection criteria or attributes into attribute values and evaluating all alternatives independently against each attribute value. The suggested PHSS-based TOPSIS can be utilized to solve real MCDM problems that are precisely characterized by the PHSS concept, in which each attribute value has a neutrosophic degree of appurtenance matching to each alternative under examination, in light of some supplied criteria. In a real-world application, the suggested PHSS-based TOPSIS solves a parking place selection problem in a fuzzy neutrosophic environment, and it is validated by comparing it to fuzzy TOPSIS.

Aslam (2020) developed a control chart for neutrosophic exponentially weighted moving average (NEWMA) employing recurrent sampling under neutrosophic statistics. The author used a NEWMA chart to track traffic collisions on the highway (RTC). According to a simulated analysis and a real-world example, the suggested NEWMA chart outperforms existing control charts for monitoring the RTC. According to the comparative analysis, It is indicated that the proposed NEWMA chart may be successfully used to control RTC. In this way, it built a new S2 N NEWMA control chart for road accident monitoring employing a repeating sample strategy in another study by the same author. The new chart will help notice shifts in accidents and injuries more quickly than existing charts.

Lin et al. (2020) developed a novel emergency transport model that simulates emergency transport from the logistics center to each disaster location as well as between disaster sites. In ambiguous and uncertain contexts, the single-valued neutrosophic set (SVNS) idea was used to convert the emergency transshipment problem into a multi-attribute decision-making problem. To rank and optimise alternate transportation routes, the proposed method was used to an emergency operation scenario.

Enalkachew Teshome Ayele et al. (2020) in developing countries, For controlling traffic flow at traffic intersections, a fixed time traffic signal control method is used. if there are high traffic conditions at the junction because it is unable to identify the level of traffic at the junction and enable vehicles waiting to cross the junction. To address these challenges, operators must formulate their judgment and design an automatic decision-making system to take their place. To make use of fuzziness in traffic flow and find efficient and effective timings for optimal phase changes, the operator's decision process could be examined using the method of interval-valued neutrosophic soft set theory. The proposed interval valued neutrosophic soft sets (IVNSS) traffic control system can improve traffic congestion management. It analyses variable phases and time lengths for the green light time duration depending on the present traffic density at the intersection instead of a constant time duration

Wang et al. (2020) proposed a travel time prediction model based on exclusive disjunctive soft set theory is developed to address the prediction problem of expressway trip time. The key impact factors are retrieved using the soft set parameter reduction theory, and the mapping relationship between the influence factors and the travel time is generated using the exclusive disjunctive soft set decision system. The soft set theory is used to create the journey time model, and the travel time is estimated using the mapping relationship. The experimental results reveal that, when compared to the BPR function model, the trip time model based on exclusive disjunctive soft set theory reduces prediction error and improves performance significantly.

Xiao et al. (2021) proposed a method based on prospect theory, this method improves the multi-valued neutrosophic MULTIMOORA method. The proposed method is used to choose a subway building scheme that is appropriate. Sujatha et al (2019) demonstrated how to use Fuzzy Cognitive Map and Induced Fuzzy Cognitive Map to assess the traffic flow pattern at a busy crossroads in Chennai, India's largest city. Nagarajan et al(2020) developed a decision-making mechanism based on a neutrosophic Markov chain to anticipate the traffic volume.

Fayed et al. (2022) proposed a comprehensive occupancy detection system based on a new fusion technique for fusing heterogeneous sensor data that greatly enhances occupancy detection efficiency. The proposed algorithm can be used in a traffic control system for roads. This study motivated to use its graphical visualization for precise analysis of Traffic Road management. In the next section, some of the available methods related to the traffic control system using graph theory is discussed.

If the Markov Chain (MC) has 'n ' states, The position of the state vector is tracked using the state vector (Fort and colleagues, 2008). Olaleye and colleagues (2009) For the dynamics of the system, the Markov technique was applied to automobile traffic. Ning (2013) investigated traffic flow disruption along a highway length. The traffic bottleneck caused by big trucks was discussed by Rui et al.(2017). Syed Imran Hussain Shah et al (2020) conducted a case study on modern urban transportation sustainability assessment. Uncertain or insufficient data must be dealt with when dealing with traffic flow issues. Partially indeterminacy and/or partial determinacy are common in real-time decision-making challenges. Due to a lack of knowledge or other factors, this is the case. Although fuzzy sets, as proposed by Zadeh (1965), may handle uncertain information and have been widely employed (Koukol et al. (2015). fuzzy numbers cannot represent data with both determinate and indeterminate information. For addressing unclear information, biassed possibilities can often be utilised instead of biassed probabilities to define MC in a neutrosophic environment (Smarandache, 2013). Markov chains are commonly used in vehicle control systems, traffic regulation, currency exchange rates, and queuing systems. Indeterminacy is distinguished from randomness by the fact that the objects in the space are both true and untrue at the same time.

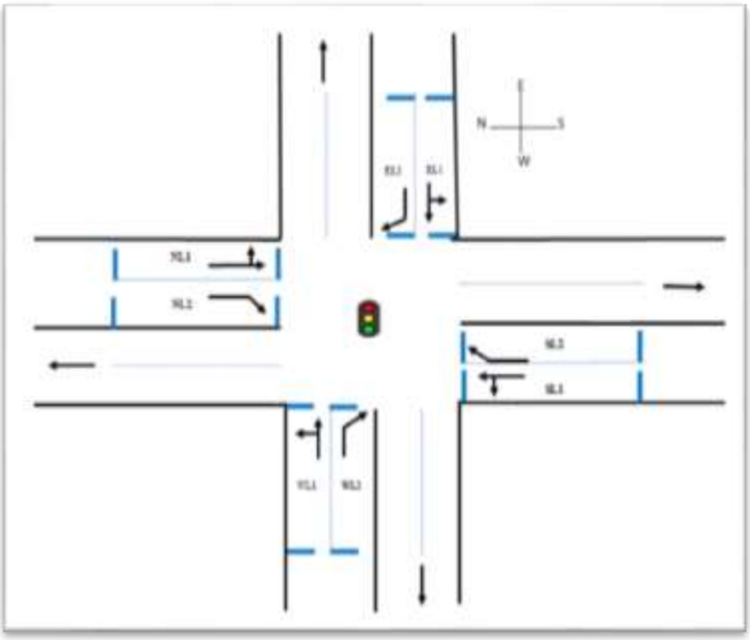

Figure 1 : The understanding of Traffic flow using time based and directions

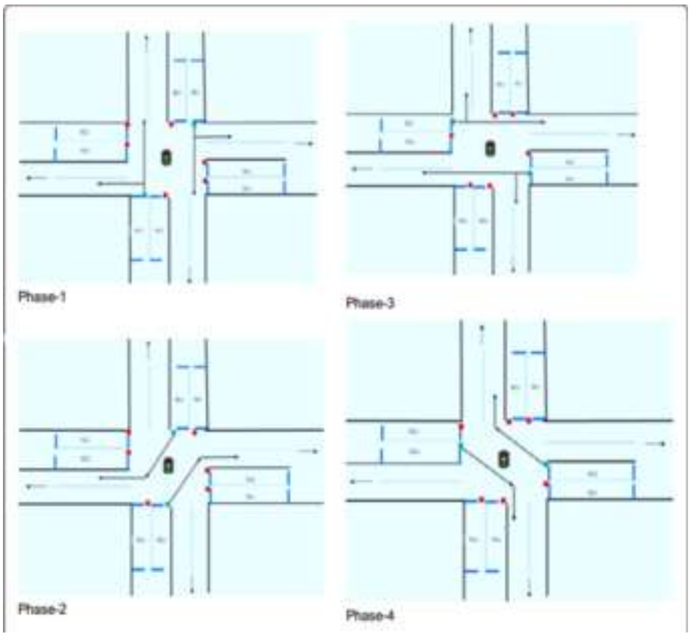

Figure 2: The phases of light and its connection with traffic flow

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3. Road Traffic Control Management Based on Rough Set based Approaches

This section provides some prominent methods for dealing the traffic control using the rough set as shown in Table 2. Table 3 providese some methods for dealing the traffic control using fuzzy rough sets whereas Table 4 contains hybrid methods for rough sets. In addition, this section clearly demonstrates the function of rough set approaches in traffic control management from many angles.

Table 2: Some available methods for dealing the Traffic flow using a Rough set

Author	Year	Country	Techniques used	Solved Problem
[55]	2005	Singapore	Rough set and neural network	Highway traffic flow prediction
[56]	2007	China	Rough set approach	Accident chains exploration
[57]	2007	china	Rough set approach	Determine the most important inducement of black-spot and repair its effect to reduce traffic accident frequency.
[58]	2007	China	Rough set approximation	Multidimensional state estimation rules in the urban traffic system
[59]	2008	China	Rough set	To Identify Causal Factors of Accident Severity
[60]	2009	China	Rough set	Prediction Model of Traffic Flow
[61]	2009	China	Rough set	Analyze the cause of road black-spots
[62]	2009	China	Rough set	Traffic accident diagnosis, Traffic Accident Discrimination
[63]	2009	China	Random Forest Rough Set Theory	To identify the factors Significantly Influencing single Vehicle crash
[64]	2009	Australia	Data Mining	Assess Crash Risk on Curves
[65]	2010	China	rough sets and association rules data mining	Traffic rule and its flow
[66]	2010	China	rough set and neural network	Traffic flow forecasting
[67]	2010	China	Back	Forecasting the railway passenger traffic demand.

			propagation neural network with a rough set	
[68]	2010	China	Rough Set with Support Vector Machine	Travel Time Prediction on Urban Networks
[69]	2010	China	Rough set	Road Traffic Accidents Causes Analysis Based on Data Mining.
[70]	2010	China	Rough set	Accident cause analysis

Table 3 : Some available methods for dealing with the Traffic flow using the Fuzzy Rough set

Author	Year	Country	Techniques used	Solved Problem
[71]	2011	China	Rough Set and RBF Neural Network	Traffic Safety Evaluation of Expressway
[72]	2011	India	Tabu Search and rough set	Optimizing parking space
[73]	2011	China	Neural Networks Algorithm and Rough Set Theory	A Traffic Accident Predictive Model
[74]	2012	China	Rough sets	Analyzing traffic accidents
[75]	2012	India	Rough set	Traffic Discretization
[76]	2012	Poland	Reducts Set	Traffic intensity prediction, for junctions of the network graph's arches description
[77]	2013	China	Evidence theory combined with the fuzzy rough set.	Traffic flow
[78]	2013	China	Rough sets+fuzzy set	Trafic prediction
[79]	2013	China	Rough sets+fuzzy set	A Knowledge-Based Fast Recognition Method of Urban Traffic Flow States

[80]	2013	China	Evidence Theory Combining with Fuzzy Rough Sets	Urban Traffic Flow.
[81]	2013	India	Rough set and its extension	Short term traffic prediction
[82]	2014	China	Rough set and granulation	Traffic congestion
[83]	2014	China	Rough sets	Study on Traffic Control of Single Intersection
[84]	2014	Australia	Rough set	Assessing Road-Curve Crash Severity
[85]	2015	China	rough sets+ fuzzy sets	Emergency plan matching highway traffic
[86]	2015	Italy	Dominance-Based Rough Set Approach	Setting Speed Limits for Vehicles in Speed Controlled Zones

Table 4: Recent methods for dealing the Traffic flow using Rough set and it's Hybrid

Author	Year	Country	Techniques used	Solved Problem
[87]	2015	China	Degrees of Attribute Importance of Rough Set	Selecting scientific and reasonable indexes for the prediction model of road traffic accident morphologies
[88]	2015	China	fuzzy rough set	Predicting Urban Traffic Congestion
[89]	2015	China	Rough set tree	Accident morphology diagnoses
[90]	2015	Thailand	Rough set	highway traffic data
[91]	2016	Turkey	Rough set	Accident factor analysis
[92]	2016	China	Rough set decision tree	Accident morphology analysis
[93]	2016	China	grey relational analysis+rough set	To judge the traffic congestion state
[94]	2017	China	fuzzy rough set theory+SVM classifier	Predict city traffic flow breakdown
[95]	2017	Iran	rough sets	Solving Road Pavement Management Problems

[96]	2018	China	Rough set	Data-driven car-following model
[97]	2018	India	Rough sets	Predict the causes of traffic accidents
[98]	2018	Egypt	Rough set	Intelligent Traffic System
[99]	2018	China	Rough Sets (RS) and Bayesian Networks (BN)	Predict accident type.
[100]	2019	India	Combination of Support Vector Machine and Rough Set,	Traffic Flow Prediction using
[101]	2019	China	Rough set	Traffic Network Modeling and Extended Max-Pressure Traffic Control Strategy
[102]	2019	China	Rough sets based on classification	A classification and recognition model for the severity of road traffic accidents.
[103]	2019	Poland	rough sets	Reduce congestion in the city by predicting the intensity of the traffic
[104]	2020	China	fuzzy neural network and rough set theory	Data imputation for traffic flow
[105]	2020	India	Neuro-Fuzzy	Traffic flow
[106]	2020	Egypt	Rough interval	Transportation problem
[107]	2020	Thailand	Rough Set and Decision Tree Classification algorithm	Predict the accident damage magnitude
[108]	2021	China	Rough set	Analyzing Road Users' Precrash Behaviors and Implications for Road Safet

Table 3 shows the hybridization of a rough set with other set theories for handling traffic flow. Motivated by Table 4 Prof. Ang, K. K. (2005) proposes a new rough set–based pseudo-outer-product RSPOP) the algorithm that combines the RSPOP technique with the sound concept of knowledge reduction from rough set theory. The suggested algorithm not only accomplishes feature selection by reducing characteristics but also extends the reduction to rules that are devoid of redundant attributes.

Wong and Chung (2008) used a comparison of methodology approaches to identify causal factors of accident severity. Accident data were first analyzed with a rough set of theories to determine whether they included complete information about the circumstances of their occurrence according to an accident database. Derived circumstances were then compared. For those remaining accidents without sufficient information, logistic regression models were employed to investigate possible associations. Adopting the 2005 Taiwan single auto vehicle accident data set, the results indicated that accident fatality resulted from a combination of unfavorable factors, rather than from a single factor. Moreover, accidents related to rules with high or low support showed distinct features. Li, (2011) developed an enhanced rough set theory algorithm to investigate the cause of roadblock spots in order to confirm the most relevant inducements in road traffic accidents. Pang et al. (2010), proposed traffic flow forecasting based on a rough set and neural network. The forecasting data provided by the neural network-forecasting model is adjusted by rough set theory to improve the traffic flow forecasting accuracy in the proposed traffic flow-forecasting theme. The simulation results suggest that using the proposed traffic flow technique can greatly enhance forecasting accuracy.

Deng (2010) proposed a hybrid intelligent forecasting model combining back propagation neural networks with a rough set to forecast railway passenger traffic demand with pre-treated forecasting data. The experiment used data from China's railway passenger traffic from 1991 to 2008 as learning and testing samples, and the efficiency of this method was established in comparison to the linear recursive method. Chen et al. (2010) put forward a new prediction model that combined a rough set with a support vector machine. The concept of Rough set is used to pre-process the traffic data that is noisy, missing, and inconsistent then deduce some rules for framing the support vector machine (SVM) model. When comparing the committee model to the single SVM predictions utilizing real traffic data collected in Chengdu, the authors concluded that the integration of the two models leads to predicting travel time effectively

Banerjee & Al-Qaheri (2011) developed a revolutionary software interface to guide and help drivers in making better parking spot decisions and dealing with unpredictable traffic situations on the road. The interface is based on an intelligent hybrid strategy for parking space optimization that combines a Tabu metaphor with a rough set. The interface might be tested as an off-line decision support system before being integrated into an online traffic network, with instruction delivered via mobile phone-based voice instructions (Fan, 2013), both traffic prediction and control have been done using a rough set theory. In general, the transport system is a non-linear, time-varying, and delaying large-scale system, whereas the traffic system is a complex, time-varying, high ambiguous, and non-linear large system with human assistance and hence faces the greatest challenge to the transportation system. The fundamental principle of predicting traffic flow is predicting the number of vehicles at the k+1th moment in accordance with the previous moments. Once this prediction is done, then the controller starts controlling accordingly and it can be observed that the prediction of short-term traffic flow is very important in real-time intelligent traffic control.

The objective of signal control is to minimize the average delay time or a number of stops for vehicles passing through the junction. In a cycle, various traffic flows will take the right of passing in an intersection called phase. There are four phases in a normal four-direction intersection. In China, the right turning movement has a special passing rule. Therefore, the four phases movements namely straight going in south-north left turning in south-north, straight-going in east-west, and left-turning in east-west. Cars can pass through only two directions in one phase at the same time. According to the given cycle, the rate of green light is independently adjusted to track the immediate traffic flow. In this work, there are three control variables namely signal period (T), the rate of green light (ƛ), and phase difference tp. When the flow of vehicles is infrequent, the signal period may be short but not smaller than 30 seconds. In such a manner, this can prevent the green light time of assured direction smaller than 15 seconds, and vehicles do not have sufficient time through the direction, which affects the safety of traffic. When the flow of vehicles is heavy, the signal period should belong, but cannot exceed 200 seconds. Else ways, the red light time of a certain phase is too long and the drivers cannot suffer from behaviorism. Here, it has been dealt with a multiphase fuzzy control algorithm where the vehicle queues have been characterized by the number of vehicles between two detectors. The distance of detectors is normally from 80 to 100 meters and lies in front of the stopping line in the intersection. In each phase, the basic green light time is 10 seconds and the time of directing is 15 seconds.

By considering the number of vehicles in the controlled phase future in 10 seconds and the vehicle queues in other red phases, the system provides the delaying time and makes the rough set rule judgment. The range of delaying time is 4 to 26 seconds. Using simulation to the general control method and the rough set predicting control algorithm, the delaying time of green light in four phases and eight periods. If the greatest green light time of directing is 70 seconds then turning left and right is 40 seconds. In each period, the loss of green light time is 15 seconds. The signal period and green light time of all the phases can be adjusted accordingly in addition to the variation of traffic flows and mitigates traffic difficulty and the waste of green light resources.

Predicting the short-term traffic flow is expedient using a rough set. The average time delay may be minimized using a rough set than with fixed timing in signal control of the unusual intersection. Here, six state variables have been taken into account for the signal control in a single intersection at the same time and it is found that the present system is highly reliable, compatible, and surpasses the traditional time control during great traffic change. Minal and Bajaj (2013) uses some data mining tools were used to develop a prediction system. The approach helped to advance rough set theory, evolutionary algorithms, and wavelet neural networks. There were three stages to the modeling process: discretion, attribute reduction, and training. To begin, the upgraded genetic algorithm was applied to discrete-continuous qualities with the fewest broken points to keep the discernable ability of the judicial system.

Decretive data was then reduced using rough set theory in order to improve prediction speed and simplify network construction. Finally, nonlinear wavelet neural networks were used to process the reduced data. Through comparative testing, improved precision and speed were gained using the data mining approach, which provided a novel concept for short-term traffic flow prediction.

A paper by Chen et al. (2014) proposed a generalized model based on granular computing to recognize and analyze the traffic congestion of urban road networks. Cheng, (2014) the authors described the experience and principle of traffic control as knowledge. The complete state of the intersection is determined by the classified arrival car number. In the space of intersection state, the knowledge face to the controlling of isolated intersection is applied. After that, a traffic signal control model based on a rough set was created. In Rakotonirainy et al. (2014) the authors utilized Text mining methods such as rough set theory and the Ward clustering algorithm to improve knowledge related to risk and contributing factors to road-curve crash severity. In this study, the authors proved that the proposed techniques could be applied within other safety domains and may reveal heretofore unrealized contributors to incidents and accidents. Shao(2015) the authors applied the concept of the soft fuzzy rough set theory to predict urban traffic congestion. For this purpose, they present a practical example predicting urban traffic congestion based on the soft fuzzy rough set. In Gang (2015) proposed a traffic accident morphology diagnostic model based on a rough set decision tree. The advantage of this model it can be used by road traffic managers to identify the potential accident morphology realized the prediction for potential traffic accidents and formulated targeted accident solutions. Zhang (2016) the authors analyzed urban road traffic information using grey relational clustering and combined the results with rough set theory to establish a decision table system. To evaluate the degree of urban traffic congestion (jam), the authors used three properties of traffic flows (traffic flow velocity, traffic flow density, and traffic volume). They judged which road was allowed smooth traffic flows, which was suffering from a light traffic jam, which was suffered from a traffic jam, and which was suffered from a heavy traffic jam state. Finally, the authors found their method can be more conducive to dynamic traffic warnings. Yang(2017) introduced the fuzzy rough set theory to solve the task of attribute reduction, and then utilized an SVM classifier to forecast city traffic flow breakdown. Particularly, in this paper three definitions to describe city traffic flow more accurately are given that is, 1) Pre-breakdown flow rate, 2) Rate, density, and speed of the traffic flow breakdown, and 3) Duration of the traffic flow breakdown. In another study, Nithya et al. (2018)

described the Rough set approaches for detecting and analyzing the causes of an accident. In this work, they conclude that Driver Fault is the major cause of traffic accidents.

Xiong et al. (2018) applied the rough set-based Bayesian networks as a complementary tool for roadway traffic accident analysis based on Naturalistic driving data (NDD). The proposed framework was demonstrated using the the100-car naturalistic driving data from Virginia Tech Transportation Institute to predict accident type. The authors employed Rough Set Theory to reconstruct and simplify the components that influence the severity of a traffic collision in this research.

The importance of qualities in people, cars, roads, environments, and accidents was calculated using rough set theory. Marek and Anna (2019) utilized using rough set theory, data mining of traffic vehicles and decision rules for the number of traffic vehicles that have been constructed at specific locations around the city (RST). As part of the Green and Sustainable Freight Transport Systems (GRASS) in Cities project, RST was used to extract knowledge from empirical data collected during a study of traffic intensity in favored areas in Szczecin.

In this paper, vehicle traffic volume was investigated using RST with 120 objects, 16 well-defined rules, 9 useful advantageous vague rules, three condition characteristics (vehicle type, experiment location, and vehicle speed), and one decision attribute (number of vehicles). And it was discovered that 65 percent of the examined examples admit to generating specific rules, according to the estimated signal of the quality of approximation of the condition attributes. Furthermore, because RST's knowledge extraction ratio is 4.8, the average of five objects has been characterized by one helpful rule and the connotation of conditional attribution has been checked. Zaher et al. (2020) presented a new rough interval max algebra approach (RIMAA) for solving the traffic problem with rough interval data. It motivated to deal with traffic flow using interval-valued rough set and its hybridization. In the next section, some of the available approaches are interval-set, vague set, and another set.

4. Road Traffic Control Management based on graph approaches:

In this section, some graph theory-based approaches for resolving road transport networks or studying traffic flow across road networks are provided in Table 5 under classical, fuzzy, intuitionistic fuzzy, and neutrosophic environments. One of the reasons for this is that, as illustrated in Figure 3, traffic flow can be represented by the vertex and edges of any defined graph.

Table 5. Summary of the available multi-criteria decision-making (graphs) approaches for the traffic management system.

Reference	Year	Techniques used	Solve problem
[39]	2012	m-polar fuzzy graph	Traffic-accidental zones in a road network.
[23]	2013	Fuzzy graph	Minimize the waiting time of the vehicle using vertex coloring function
[24]	2013	Fuzzy graph	Classify the accidental zone of a traffic flows.
[25]	2014	Interval-valued fuzzy planar graphs	Minimize the crossing between roads
[28]	2018	Neutrosophic bipolar planar graph	To monitor traffic
[29]	2019	product bipolar fuzzy graphs	PBFPG of a road network
[31]	2019	Hesitancy fuzzy magic labeling	Smooth the network traffic and contribute the uniformity of the traffic distribution using fuzzy magic labeling graphs
[32]	2020	Fuzzy graphs+ MatLab program	Using a MATLAB program based on fuzzy graph-FCN-FIS, minimize traffic light cycle time at crossings.
[34]	2020	cubic graphs	Get the least time to reach the destination
[35]	2020	Multigraph with Picture Fuzzy Information	Minimize the crossing between roads
[36]	2020	Fuzzy graph Structures	Detection of the road crimes
[37]	2020	Intuitionistic fuzzy soft digraph	Road Safety Measures
[38]	2020	Edge coloring of fuzzy graphs	Determined the present condition of the traffic in the traffic light system using color density with a percentage

[40]	2021	Cyclic connectivity index of fuzzy incidence graphs	Minimize road accidents
[41]	2021	fuzzy graph	Reduce the traffic congestion in accidental prone zone
[42]	2021	Application of genus graphs under picture fuzzy environment	To control traffic jam on road network
[43]	2021	Fuzzy incidence coloring techniques	Reduce the frequency of accidents and vehicle waiting times in traffic flow scenarios,

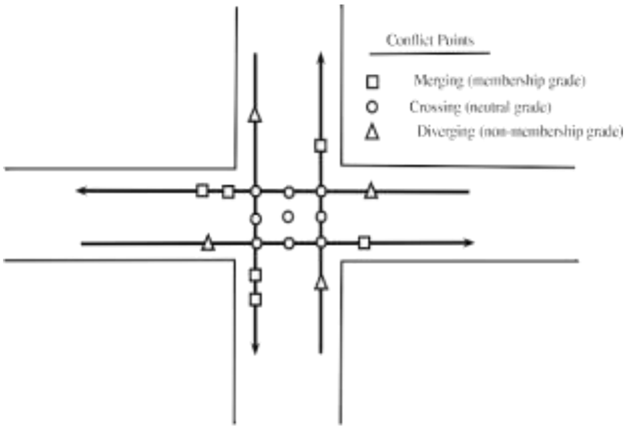

Figure 3. The graphical visualization of Traffic can be possible using vertex and edges [116]

Akram et al. (2012) described how to discover traffic-accidental zones in a road network using various sorts of m-polar fuzzy edges. Dey and Pal (2013) traffic congestion has become a major issue in cities as the number of vehicles on the road grows rapidly. The goal of the traffic light setting problem is to figure out how to set the traffic lights such that the total time vehicles spend on the road is as short as possible. To depict the traffic network in this paper, we employ a fuzzy graph model. The traffic light problem is solved using the vertex coloring function (crisp mode) of a fuzzy graph. Cut of graph G=(V, E), the cuts of fuzzy graph G, is the basis for the function. Using this method, the traffic light issue is investigated. The authors solved the problem discussed in Dey and Pal (2013) by utilizing a fuzzy network to encode the vertex membership value for traffic signal length based on vehicle number. In this scenario, because the route had the most vehicles, the time spent waiting was the longest. When a track has a large number of vehicles, it must be protected in order to avoid accidents, in which all of the vehicles on the track must wait. Moreover, there is a maximum amount of time to wait.

Pramanik et al.(2014) developed a model for designing the road map as an interval valued fuzzy planar graph with membership values of vertices and edges taken as an interval number, and then estimated the degree of planarity of interval valued fuzzy graphs to minimize road crossings (IVF graph). The measurement of congestions in the paper was done as an interval valued fuzzy (IVF) number.

Akram (2018) developed a traffic-monitoring road network model using the concept of bipolar neutrosophic planar graph. The notion of bipolar neutrosophic planar graphs was utilized to build road networks. The proposed method can be used to calculate and track the annual proportion of accidents. By monitoring and implementing extra security steps, the total number of accidents can also be minimized.

Sumera et al. (2019) explained the notion of planarity product bipolar fuzzy graphs was used to solve the problem of crossing roads in a road network modelled by product bipolar fuzzy graphs. In the paper of Fathalian et al. (2019) the authors demonstrate whether any simple graph is hesitancy fuzzy magic labeling in this work by studying the concept of hesitancy fuzzy magic labelling of a graph. We show that any finite path graph, cyclic graph, star graph, and any complete graph derived from these, as well as any connected graph, have hesitancy fuzzy magic labelling. Finally, we discuss various plumbing and traffic flow applications for hesitancy fuzzy magic labelling graphs.

Rosyida et al. (2020) propose a phase scheduling that considers traffic intensities using fuzzy graph and fuzzy chromatic number (FCN) of the fuzzy graph. In this paper, two algorithms are constructed. The first is an algorithm to model a traffic light system on an intersection using fuzzy graph and determine phase scheduling using FCN of the fuzzy graph. The second is an algorithm to determine duration of green lights of the phases in the first algorithm using Mamdani-FIS. In addition they created Matlab codes of the above two algorithms.

The authors evaluated the algorithms through case studies on two intersections with 4 approaches in Semarang City, Indonesia, namely "Kaligarang" intersection and “Lamper Gadjah” intersection. The results show that the combination of FCN of fuzzy graph and the Mamdani-FIS gives some options of phase scheduling with different cycle times. In addition, the approach with high traffic volume gets a longer green time. The phase scheduling proposed in this research increases performances of intersections under study in that the cycle times of the proposed scheduling are shorter than that of the existing systems. It means that it is superior in reducing the average time a driver spends his/her time on the intersection.

Muhiuddin (2020) applied the notion of cubic graphs in traffic flows to arrive at the shortest time possible. They used fuzzy variables and interval-valued fuzzy variables to represent two primary parameters in their study: traffic volume and distance between two intersections. Each intersection is represented by a single vertex, and each highway between two intersections is represented by a graph edge. The authors of Koam (2020) adapted the concept of fuzzy network structures to decision-making in the detection of marine and road crimes, and provided an algorithm to solve these two problems. The authors investigated whether road connecting any two cities is the most important for a certain crime, using the notion of fuzzy graph structure. Singh (2021) tried to provide the threshold for which cubic graph can be approximated for given traffic and its density. It can be used to control the traffic speed based on human turiyam cognition (Singh 2021) rather than red, green or yellow light. It is totally based on human Turiyam cognition that red light need to stop, green light need to go and yellow light means slow. It will be helpful in finding heterocolinic pattern on the traffic in case of Neutrotraffic (Singh 2022).

Sarala and Tharani (2020) tried to minimize the human loss during accidents and reduced the waiting time of vehicles in lane at traffic flow from existing traffic system, Yamuna et al.(2021) proposed a new methodology based on Fuzzy incidence coloring numbers to identify a solution to traffic flow problem. The real-time traffic flow problem was modeled by fuzzy graph including eight vertices. Nazeer et al. (2021) provided real-life applications of cyclic connectivity index of fuzzy incidence graphs in a highway system of different cities to minimize road accidents. In the planning of road maps the crossing between congested (strong) road and non-congested (weak) road may be accepted with certain amount of protection as this crossing is low risky as comparison to the crossing between two congested (strong) roads.

Das et al. (2021) considered the rate of congestion as picture fuzzy set (PFS) and modeled up the design of road map as PFPG. They defined a very important notion of PFG theory called degree of planarity. The concept of degree of planarity (DP) determine the nature of planarity (NP) of a PFPG .If the DP of a PFG is (1, 1, 1), then there is no crossing between two edges on DP. The congestions of roads is a fuzzy quantity as rate of congestions depends on decision makers attitude, practices, behavior, etc. The measurement of congestions as a point is not easy for decision maker.

Mahapatra et al. (2020) discussed the degree of capacity of vehicles of a city is defined in terms of its positive membership and negative membership. Positive membership degree can be depicted as how much capacity, vehicles of a city posses and negative membership can be depicted as how much capacity is lost by the vehicles of a city. The membership values of edges of this graph show the capacity of vehicles on the road joining any two cities. The positive and negative membership degree of edges can be interpreted as the percentage of increasing and decreasing capacity of vehicles on the road between any two cities

The authors claimed that the concept of Fuzzy incidence coloring might be applied to other modes of transportation, such as air, rail, and marine, to reduce human loss. It can be observed that the positive, negative and uncertain regions of traffic flow can be approximated via rough neutrosophic theory and its graph visualization, which will be the future scope of the paper.

5. Traffic management systems based on other novel fuzzy sets approaches

This section will discuss a few applications of fuzzy set extensions on road traffic networks, such as intuitionistic fuzzy sets, interval-valued intuitionistic fuzzy sets, vague sets, and hesitant fuzzy sets. Table 6 contains some of the methods for resolving problems involving road traffic networks.

Table 6: Some new methodology to solve Traffic technique using an extension of Fuzzy set

Reference	year	Techniques used	Solve problem
[44]	2008	Vague set	Route Choice Approach to Transit Travel
[45]	2010	Vague set theory	road safety evaluation
[33]	2014	Linguistic variable in interval type-2 fuzzy entropy weight	Ranking of causes lead to road accidents
[47]	2017	The hesitant distance set on hesitant fuzzy sets	urban road traffic state identification
[48]	2017	Dual hesitant fuzzy rough pattern recognition approach	Urban traffic modes recognition
[46]	2018	Interval-valued intuitionistic fuzzy sets	Prediction of traffic emission
[50]	2018	Entropy Analysis on Intuitionistic Fuzzy Sets And Interval-Valued Intuitionistic Fuzzy Sets	Mode assessment of open communities on surrounding traffic
[51]	2019	Double hierarchy hesitant fuzzy linguistic -ORESTE method	Assessment of traffic congestion
[53]	2020	Euclidean distance intuitionistic fuzzy value with TOPSIS ranking method	Measuring drivers incapability
[54]	2020	Interval-valued intuitionistic fuzzy environment	Public bus route selection
[50]	2021	IVIF-VIKOR method	To assess urban road traffic safety.
[116]	2021	Complex Spherical Set	CSF information could be used to monitor the day and night traffic clashes on four-way road junctions.
[52]	2021	IF-MABAC	Evaluating the intelligent transportation system

[49]	2021	Interval-valued spherical fuzzy analytic hierarchy process method	Evaluate public transportation development

Here's a quick rundown of some of the possible findings: Tan (2008) connected the vague rough set for road section traffic state identification utilizing ambiguous sets was presented to identify the traffic condition of road sections and give decision support for traffic management. They have set up a decision matrix for traffic conditions. The steps for determining the traffic state of a road stretch were supplied by the authors. They presented a vague set and group decision-making-based method for acquiring knowledge about regional road network traffic situations followed by Wei and MA(2020).

The traffic state identification methods could meet the current demand for real-time traffic control and guidance, while the traffic state knowledge acquisition methods might give a mechanism for analyzing the time-space traffic flow evolution pattern of road networks. The hazy aggregation value, the weighted sums, and the scoring value are discovered and used to determine the substantially worst traffic status link called the regional road network's bottleneck link.

Fangwei et al. (2017) proposed a fuzzy traffic state identification method in which the three attributes f 1 (saturation degrees of the traffic flow), f 2 (vehicle queue length), and f 3 (average delay time of vehicles) are described by the Hesitant Fuzzy Sets concept for the four congestion levels E 1 (unobstructed traffic), E 2 (slight congestion traffic), E 3 (congestion traffic), and E_4 (extreme congestion traffic).A another author from China, Tian et al.(2018) offered a novel multiple attribute decision makings strategy for handling the problem of mode assessment of open communities on surrounding traffic in an intuitionistic fuzzy environment under an intuitionistic fuzzy environment. Taking into account road capacity, safety, and other factors. Also, The Chinese authors looked at four aspects of mode assessment of open communities which is based on human Turiyam as discussed by Singh (2021). These attributes are denoted as F = { f_1,f_2, f_3, f_4},where f_1 represents the average delay time at the community; f_2 represents the-safety-level of the community(number of vehicles collisions at the community intersection); f_3 represents the average speed of vehicles;, and df_4 represents the average driving path length of vehicles. Wang (2019) developed the DHHFL-ORESTE method (double hierarchy hesitant fuzzy linguistic ORESTE method) to evaluate traffic congestion and identify the most congested city in new first-tier cities in the article. Akram et al. (2021) created a new concept known as a complicated spherical fuzzy set in their research (CFS). The CSF data can be used to track traffic congestion on four-way intersections during the day and at night. Merging, diverging, and crossing are three common forms of traffic collisions to expect. Figure 2 depicts a clear picture of the clashing spots on a four-way intersection, which include six merging clashes, nine crossing clashes, and four diverging clashes.

The day and night check on traffic collisions may be done with complete information about prospective collisions, which can be demonstrated using CFS data by Akram et al. (2021). The daytime merging, crossing, and diverging clashes are represented by the amplitude term of membership, neutral, and non-membership grades, respectively, whereas the nighttime merging, crossing, and diverging clashes are represented by the phase term of membership, neutral, and non-membership grades, respectively and can be assigned 0.1, 0.7, and 0.3 as the membership, neutral and non-membership respectively, for a stray four-way junction with one merging, five crossing, and two diverging collisions during the day. If there are 12 traffic disputes during the night, three for merging, four for crossing, and five for diverging, the membership, neutral, and non-membership grades might be assigned phase terms of 0.2, 1.2, and 1.4, respectively. These data may be used to create a CSFN that describes information regarding traffic jams at a four-way intersection. Furthermore, the CSF data allows for the investigation of traffic collisions at all types of road crossings, as well as the characterization of traffic flow over a certain time period.

If they utilize a spherical fuzzy set here, it will only gather data during daytime traffic jams because it can't store two-dimensional data. The use of a complex Pythagorean fuzzy set, on the other hand, epitomizes two-dimensional information and only comprises data for merging and diverging traffic confrontations. It does not, however, constitute a crossing clash at any time of day or night. These facts raise CSFS requirements within the existing model by improving the information on day and night traffic collisions, as well as merging, crossing, and diverging collisions.

Yanping (2021) proposes a unique intuitive distance-based IF-MABAC approach to evaluate the performance of financial management, based on the standard multi-attribute border approximation area comparison (MABAC) method and intuitionistic fuzzy sets (IFSs). First, a literature review is carried out on the subject. In addition, certain key IFS theories are briefly discussed. Furthermore, because subjective randomness is common while calculating criteria weights, the maximizing deviation approach is used to determine objectively the weights of criteria. After that, the traditional MABAC approach is extended to the IFSs using innovative distance measurements between intuitionistic fuzzy numbers (IFNs). As a result, all businesses may be ranked, and the one with the best environmental practices and awareness can be found.

Duleba et al. (2021) presented Interval-valued Spherical Fuzzy Analytic Hierarchy Process as a methodological approach presented with the goal of handling both types of problems at the same time, taking into account hesitant scoring and synthesizing different stakeholder group opinions through a mathematical procedure. The additional extensions with a more flexible characterization of membership function are preferable to interval-valued spherical fuzzy sets. Decision makers' judgments regarding the membership functions of a fuzzy set are incorporated into the model using interval-valued spherical fuzzy sets instead of a single point. Also, solved public transportation problems using an interval-valued spherical fuzzy AHP approach. Due to the inclusion of three traditionally antagonistic stakeholder groups, public transportation development is an appropriate case study to explain the new model and analyze the outcomes. This motivated me to utilize neutrosophic set for dealing the Road traffic. In the next section, some of the available methods for road control using a neutrosophic set is discussed.

6. Conclusions

This paper provide a survey on available mathematical model for traffic flow using neutrosophic set, rough set, fuzzy set, and its extensions in Table 1 to 4 and Table 5. The graph based traffic flow methods also discussed in Table 5. It can be observed that neutrosophic rough set the hybrid set structures where computational techniques based on just one of these structures will not always produce the best results. The hybrid of two or more methods can frequently produce better results, which can be considered as one of the efficient method for measuring uncertainty in traffic flow as positive, negative and uncertain region to control the accidents.

In near future the author will focus on neutrosophic rough set based traffic flow and its graphical visualization. As can be seen, even with certain norms and laws in place, passengers and drivers disregard the traffic system, resulting in a variety of large and little incidents, how do we govern, manage, and maintain road discipline? Is the car-sharing system a viable option for eco-friendly and urban mobility?

Acknowledgements : Author thanks anonymous reviewers for their valuable suggestions and comments.

Funding : There is no funding for this paper.

Conflict of Interest : The authors declares that there is no conflict of interest for this paper.

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Received: Feb 1, 2022. Accepted: Jun 5, 2022