
# Neutrosophic Environment for Traffic Control Management

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**Abstract**

Neutrosophic along with its environment development over the past decades. Neutrosophic environment is apply to various applications in logic,statstics,albebra, neural networks and several other fields. Neutrosophic sets has been presented to handle the indeterminacy in real-world decision-making problem. Real world problems have some kind of uncertainty in nature and one of the influential problem in environment. Neutrosophic environment results are apply to a new dimension in traffic control. Neutrosophic is the vital role on traffic flow control . It is deal with membership , non membership and also indeterminacy of the data as well. The advantage of the neutrosophic environment is to find the optimized result of the system choosing the best alternative.In this paper, traffic flow control is analyzed under neutrosophic environment using MATLAB.

**Keywords**: Traffic flow ,Neutrosophic environment, Neutrosophic network

## 1.Introduction

If the number of vehicles are increased and having lower phase of highways then there will be a traffic congestion problem. The general factors for traffic problems are density of the vehicles, human behavior, traffic light system and social behavior. The complex and changing traffic situations cannot be dealt by conventional traffic control methodologies or control systems. Analyzed the Parametric and nonparametric traffic volume forecasting[1]. Deals with Spectral and cross-spectral analysis of urban traffic flows [2]. To introduced the traffic forecast using simulations of large scale networks[3]. Analyzed the multivariate state space approach for urban traffic flow modeling and prediction[4].Introduced Interval neutrosophic Sets and Logic[5].Introduced A unifying field in logic. Neutrosophy: Neutrosophic probability, set, logic[6]. Analyzed A Bayesian Network Approach to Traffic Flow Forecasting[7]. Introduced a novel Fuzzy Neural Approach to Road Traffic Analysis and Prediction[8]. Introduced the Type-2 fuzzy logic approach for short term traffic forecasting[9]. Analyzed the Ensemble learning approach for freeway short-term traffic flow prediction[10]. Introduced the Fuzzy Neural Network model Applied in the Traffic Flow Prediction[11]. Introduced an Aggregation Approach to Short-Term Traffic Flow Prediction[12].Predicting traffic flow, speed, length of the queue and travel time are necessary for the transportation management applications

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[13]. Predicting and modeling traffic flow has drawn attention from literature as it is very important for formatting intelligent transportation system theoretically and practically. The area of transportation studies has attracted interest among the researchers [14]. Fuzzy logic is a powerful tool to used in unncertainties in measurements and information used to calculate the parameters; here the membership value for a particular traffic state is not a crisp value Any number of intersections and lanes can be handled using fuzzy and interval fuzzy logic in traffic control management. Generally there are two types of signal control available, namely, fixed time control (the traffic conditions are fixed) and adaptive time control (the traffic conditions may be refined over a period of time control [15-16]. Introduced an intelligent Traffic Light Control System for Isolated Intersection Using Fuzzy Logic[17]. The complex and changing traffic situations cannot be dealt by conventional traffic control methodologies or control systems

If the number of vehicles are increased and having lower phase of highways then there will be a traffic congestion problem. The general factors for traffic problems are density of the vehicles, human behavior, traffic light system and social behavior. The complex and changing traffic situations cannot be dealt by conventional traffic control methodologies or control systems.

As the flow of traffic varies from hour to hour in morning and evening. Especially during office timing the traffic flow will be high in general. The one of the advantage of fuzzy logic is, there is a possibility of computing with words [18].

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Neutrosophic logic was proposed by Smarandache can express determinate as well as indeterminate of the information by neutrosophic numbers. Solving traffic flow problem is a difficult one for certain parameters as the real-time situations are uncertain in nature and can be solved easily by considering neutrosophic logic [19]. Introduced a Traffic signal control using fuzzy logic[20]. Deal with Interval neutrosophic multiple attribute decision-making method with credibility information[21]. An Improved score function for ranking neutrosophic Sets and Its Application to decsion making process Fuzzy and neutrosophic logic are playing a vital role in dealing with uncertainties. Introduced the traffic control management in triangular interval type-2 fuzzy and interval neutrosophic environments [26-34]. Introducted the traffic control management using Gauss Jordan method under neutrosophic Environment[35].

## 2. Definition

Neutrosophic number

Neutrosophic linear equations and solving method for traffic flow control under neutrosophic number (z=a +bI) environment. A system consists of linear equations (LEs) can be solved . By finding an augmented matrix form the given system, one can find the inverse of the matrix and using MATLAB.

## 3. Applications

At Analyze of traffic flow

The roads are considering as Road1, Road2, Road3 and Road4. FIGURE 1 shows the traffic flow on the four roads. Here z is a neutrosophic variable, and $y_1$, $y_2$ and $y_3$ are the unknown variables. In this junctions falsity considered as zero. Where I is the indeterminacy of the traffic flow.

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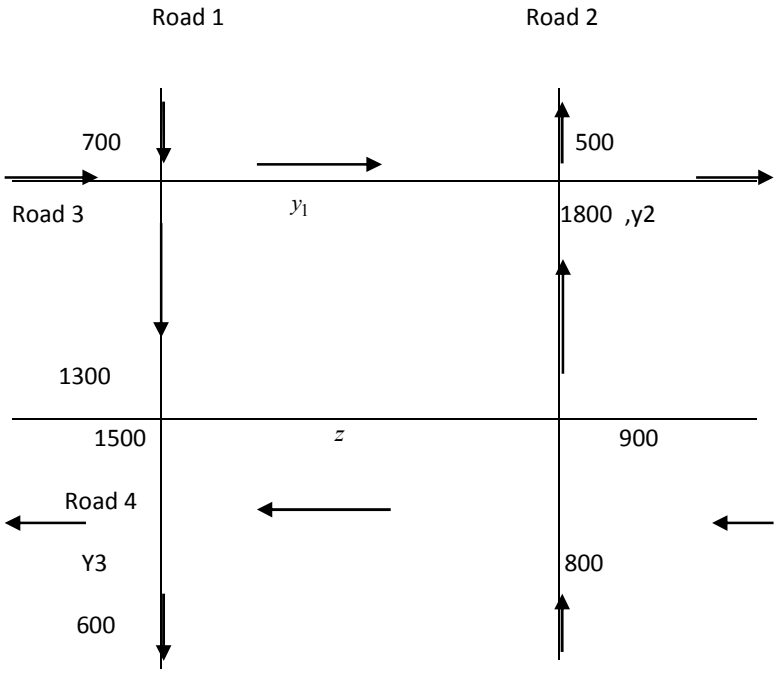


FIGURE 1. The traffic flows of four roads

The traffic in the junction as follows:

$$2000=y+z$$

$$2300=y1+y2$$

$$1700=y2+y3$$

$$2100=y3+z$$

Rewrite the equation as,

$$y1 = 2000-z$$

$$y1+y2 = 2300$$

$$y2+2y3 = 3800-z$$

Based on, z = 500+I, the system can also be described by the following three NLEs:

Then, the neutrosophic equations are:

$$y_1=1500\text{-}I$$

$$y1+y2 = 2300$$

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y2+2y3 = 3300-I

Thus, the neutrosophic matrices are:

$$A=\begin{bmatrix}1 & 0 & 0\\ 1 & 1 & 0\\ 0 & 1 & 2\end{bmatrix} \quad Y=\begin{bmatrix}y_1\\ y_2\\ y_3\end{bmatrix},$$

$$B=\begin{bmatrix}1500-I\\ 2300\\ 3300-I\end{bmatrix}$$

For the system consists of NLEs, apply the MATLAB software, shown in the following program and the solution of the system is :

For the system consists of NLEs, apply the MATLAB software, shown in the following program

```
clc

syms I;

a=[1 0 0;1 1 0;0 1 2]

b=[1500-I;2300;3300-I]

[v,j]=jordan(a)

j=inv (v)*a*v

y=a\b
```

Output of the program are as follows:

```
a=[1 0 0;1 1 0;0 1 2]

 b=[1500-I;2300;3300-I]

 [v,j]=jordan(a)

y=a\b
```

$$Y=\begin{bmatrix}1500-I\\ I+800\\ 1250-I\end{bmatrix}$$

The values of Y are NNs.

In some of the real-time situations, when I ∈[0, 100] is the possible range, the solution of the system is:

$$\begin{bmatrix}y_1\\ y_2\\ y_3\end{bmatrix}=\begin{bmatrix}[1400,1500]\\ [800,900]\\ [1150,1250]\end{bmatrix}$$

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Corresponding to the possible traffic flow z = [200,250]

Thus the ranges of the three traffic flows are

$$y_1 = [1400,1500]$$
$$y_2 = [800,900]$$
$$y_3 = [1150,1250]$$

In table 1 represent the various range of indeterminacy.

TABLE 1. Traffic flo ws according to various ranges of Indeterminacy

| $I$ | $z$ | $y_1$ | $y_2$ | $y_3$ |
|---|---|---|---|---|
| $I=0$ | 200 | 1500 | 800 | 1250 |
| $I \in [100,200]$ | $[300,400]$ | $[1300,1400]$ | $[900,1000]$ | $[1050,1150]$ |
| $I \in [200,300]$ | $[400,500]$ | $[1200,1300]$ | $[1000,1100]$ | $[950,1050]$ |
| $I \in [300,400]$ | $[500,600]$ | $[1100,1200]$ | $[1100,1200]$ | $[850,950]$ |
| $I \in [400,500]$ | $[600,700]$ | $[1000,1100]$ | $[1200,1300]$ | $[750,850]$ |

In table 2 shows that the advantages and disadvantage in fuzzy and Neutrosophic traffic control management.

Table :2 Comparison of Traffic Control Management using Crisp , Fuzzy and Neutrosophic

| Traffic Control Management | Advantages | Limitations |
|---|---|---|
| Crisp | • Traffic density for all fixed time period. | • It is not possible to act in varing traffic density.<br>• Not able to solve quickly in uncertainty behaviour |
| Fuzzy | • Traffic density in different time can be consider.<br>• Intelligent<br>• Act the best security | • Not able to use in stability.<br>• Not able to use flexibility.<br>• Not able to use in on line planning. |
| Neutrosophic | • Deals not only uncertainty but also indeterminacy due to unpredictable environmental disturbances | • Not able to calculate the error. |

## 4. CONCLUSION

Traffic control management is an essential task which insure the safty of the people . In this paper, fundamental concepts of traffic control have been reviewed. Triangular and Trapezoidal Fuzzy numbers are widely used in many of the real world problems as it deals with the problems which having less number of membership values with covering the linguistic parameters of the system effectively. Traffic flow management has been analyzed with respect to various

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ranges of indeterminacy under neutrosophic environment using MATLAB program Also compared the traffic control management for crisp sets,fuzzy and neutrosophic.

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**References**

[1] R. K. Oswald, B.L. Smith and B.M. Williams, "Parametric and nonparametric traffic volume forecasting," in Transportation Research Board Annual Meeting, (Washington, DC, 2000).
[2] Stathopoulos and M.G. Karlaftis "Spectral and cross-spectral analysis of urban traffic flows," in Intelligent Transportation Systems, (2001 IEEE Proceedings 2001), pp. 820 –825.
[3] R. Chrobok, J. Wahle and M. Schreckenberg, "Traffic forecast using simulations of large scale networks," in Intelligent Transportation Systems, IEEE Proceedings pp. 434 –439, 2001
[4] A. Stathopoulos and M. G. Karlaftis, A multivariate state space approach for urban traffic flow modeling and prediction. Transportation Research Part C: Emerging Technologies, 11(2), 121 – 135, 2003.
[5] H. Wang, F. Smarandache, Y. Q. Zhang, R. Sunderraman, Interval neutrosophic Sets and Logic: Theory and Applications in Computing (Hexis, Phoenix, 2005.
[6] F. Smarandache, A unifying field in logic. Neutrosophy: Neutrosophic probability, set, logic (American Research Press, Rehoboth, fourth edition, 2005
[7] Shiliang, Chnagshui and Guoqiang, A Bayesian Network Approach to Traffic Flow Forecasting. IEEE Transactions on Intelligent Transportation Systems 7(1), 2006.
[8] Chai, Michel, Bernard and Seng, POP-TRAFFIC: A Novel Fuzzy Neural Approach to Road Traffic Analysis and Prediction. IEEE Transactions on Intelligent Transportation systems 7(2), 2006.
[9] Li, Lin and Liu, Type-2 fuzzy logic approach for short term traffic forecasting. Intelligent Transportation System, 153(1), 2006.
[10] L. Chen and P. Chen, "Ensemble learning approach for freeway short-term traffic flow prediction," in IEEE 2007.
[11] Tong, Fan, Cui and Meng, "Fuzzy Neural Network model Applied in the Traffic Flow Prediction," in IEEE 2007.
[12] M. C. Tan, S. C. Wong, J. M. Xu, Z. R. Guan, and P. Zhang, An Aggregation Approach to Short-Term Traffic Flow Prediction. IEEE Transactions On Intelligent Transportation Systems 10(1) 60-69, 2009.
[13] W. Ge and Yan, "Research on Traffic Flow Fuzzy Time Series Forecasting Algorithm of Single Intersection," in Fourth International Conference on Innovative Computing, Information and Control, 2009.
[14] T. Zhang, L. Hu, Z. Liu, and Y. Zhang, "Nonparametric regression for the short-term traffic flow forecasting," in 2010 International Conference on Mechanic Automation and Control Engineering (MACE), pp. 2850 –2853, 2010.
[15] H. Wang, F. Smarandache, Y. Zhang and R. Sunderraman, Single Valued Neutrosophic Sets. Multispace and Multisrtucture 4, 410-413, 2010.
[16] M. A. Tahaa, L. Ibrahimb, Traffic Simulation System Based on Fuzzy Logic. Procedia Computer Science 12, 356 – 360, 2012.
[17] J. Alam, M. K. Pandey and H. Ahmed, "Intelligent Traffic Light Control System for Isolated Intersection Using Fuzzy Logic," Conference on Advances in Communication and Control Systems 2013 (CAC2S 2013), 209-215
[18] B. Sharma, Gupta, Fuzzy Logic model for the prediction of traffic volume in week days. International Journal of computer Applications 107(17), 2014.
[19] E. Pasetiyo, O. Wahyunggoro and S. Sulistyo, Design and Simulation of Adaptive Traffic Light Controller Using Fuzzy Logic Control Sugeno Method. International Journal of Scientific and Research Publications 5(4), 2015.
[20] S. Prontri, P. Wuttidittachotti and S. Thajchayapong, "Traffic signal control using fuzzy logic," in International conference on, Electrical Engineering/ Electronics, Computer, Telecommunications and Information Technology(ECTI-CON), 2015.
[21] J. Ye, Interval neutrosophic multiple attribute decision-making method with credibility information. International Journal of Fuzzy Systems 18(5), 914–923, 2016.

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[22] S. Broumi, T. Mohamed, A. Bakali and F. Smarandache, Single Valued Neutrosophic Graphs. Journal of New Theory 10, 86-101, 2016.
[23] Nancy, and G. Harish, An Improved score function for ranking neutrosophic Sets and Its Application to decsion making process. International Journal for Uncertainty Quantification 6 (5), 377–385, 2016.
[24] M. Alodat and I. Addullah, "Surveillance Rapid Detection of Signs of Traffic Services in Real Time," 4 th international conference on E-Commerce ICoEC, pp. 51-55,2017.
[25] S. Banerjee, S. Biswas and T. K. Roy, Intuitionistic Fuzzy Linear System, Advances in Fuzzy Mathematics. 12 (13), 475-487, 2017.
[26] J. Ye, Neutrosophic linear equations and application in traffic flow problems, Algorithms 10(4), 133, 2017.
[27] D. Nagarajan, M. Lathamaheswari, R. Sujatha and J. Kavikumar, Edge Detection on DIOM Image using Triangular Norms in Type-2 Fuzzy. International Journal of Advanced Computer Science and Applications 9(11), 462-475, 2018.
[28] M. Lathamaheswari, D. Nagarajan, A. Udayakumar and J. Kavikumar, Review on Type-2 Fuzzy in Biomedicine. Indian Journal of Public Health Research & Development 9(12), 322-326,2018. DOI Number: 10.5958/0976-5506.2018.01855.7.
[29] S. Broumi, A. Bakali, T. Mohamed, F. Samarandache, L. H. Son, P. K. K. Kumar, New matrix algorithm for minimum spanning tree with undirected interval valued Neutrosophic Graph. Neutrosophic Operational Research 2, 54-69, 2018.
[30] M. Lathamaheswari, D. Nagarajan, J. Kavikumar and C. Phang. A Review on Type-2 Fuzzy Controller on Control System. Journal of Advanced Research in Dynamical and Control Systems 10(11), 430-435, 2018.
[31] S. Broumi S, A. Bakali, M. Talea, F. Smarandache, V. Ulucay, M. Sahin, A. Dey, M. Dhar, R. P. Tan, A. Bahnasse and S. Pramanik, Neutrosophic Sets: On overview, Project: New Trends in Neutrosophic Theory and Applications 2, pp.403-434, 2018.
[32] D. Nagarajan, M. Lathamaheswari, R. Sujatha and J. Kavikumar, A Type- 2 Fuzzy in Image Extraction for DICOM Image. International Journal of Advanced Computer Science and Applications 9(12), 351-362, 2018.
[33] S. Broumi, K. Ullah, A. Bakali, M. Talea, P. K. Singh, T. Mahmood, F. Samarandache, A. Bahnasse, S. K. Patro and A. D. Oliveira, Novel System and Method for Telephone Network Planing based on Neutrosophic Graph. Global Journal of Computer Science and Technology: E Network, Web & Security 18(2), 1-11, 2018.
[34] D. Nagarajan, M. Lathamaheswari, S. Broumi and J. Kavikumar, A new perspective on traffic control management using triangular interval type-2 fuzzy sets and interval neutrosophic sets. Operations Research perspectives, Article in Press. https://doi.org/10.1016/j.orp.2019.100099
[35] D. Nagarajan, T. Tamizhi, M. Lathamaheswari, and J. Kavikumar" Traffic control management using Gauss Jordan method under neutrosophic Environment" AIP Conference Proceedings 2112, 020060 (2019); https://doi.org/10.1063/1.5112245

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