Hindawi
Mobile Information Systems
Volume 2022, Article ID 6161154, 12 pages
https://doi.org/10.1155/2022/6161154

*Research Article*

# Coordinated Control of New Energy Environment and Mixed Vehicle Flow Speed Based on Sensor Network

**Huili Dou**,[1] **Yaming Wang**,[2] **Jian Zhou**,[2] **and Yuanyuan Liu**[1]

[1]*Institute of Rail Transit, Zhejiang Institute of Communications, Hangzhou, Zhejiang 310012, China*
[2]*Jiaxing Jiatong Expressway Management Co., Ltd., Jiaxing, Zhejiang 314001, China*

Correspondence should be addressed to Huili Dou; wanggh@zjic.com

Received 9 February 2022; Revised 3 March 2022; Accepted 10 March 2022; Published 24 March 2022

Academic Editor: Muhammad Babar



At present, China has accelerated the process of urban development that has led to a significant increase in the number of urban cars. The construction of basic transportation facilities has been unable to meet people's basic needs, and serious vehicle congestion has occurred on urban roads and expressways. Moreover, with the rapid increase of vehicles and the rapid development of industry, the harmful gases emitted pose a direct threat to the ecological environment. There is a dire need to vigorously promote the development of new energy vehicles based on this environment. All together, the miniaturization of sensor network, low power consumption, and low investment cost have become the preferred equipment for intelligent collection of traffic data. This article utilizes the sensor networks to study the speed coordination control of hybrid vehicle flow. It deploys the sensor nodes in roadside parking positions and driving sections of expressway. It also collects and fuses the data passing through sensor network nodes. Various algorithms in hybrid vehicle flow rate algorithm based on sensor networks are combined with the established speed flow relationship model of mixed vehicle flow. The actual highway road traffic situation is analyzed that can be used as an important basis to realize the coordinated control of mixed vehicle flow speed. The research shows that the average speed of expressway calculated based on quadratic parabola model is 83.72 km/h that has a deviation of 0.6% compared with the actual situation.

## 1. Introduction

An important parameter of traffic flow characteristics is the speed of mixed traffic flow. The use of this parameter can accurately analyze the service capacity and capacity of expressway. It is also an important reference for traffic management departments to make decisions. Nowadays, the problem of environmental pollution is becoming more and more serious. A large number of pollutants are produced after the combustion of traditional coal, oil, and other energy sources, resulting in a serious threat to the ecological environment. More and more countries begin to promote new energy including wind energy and hydropower and use wind power to form a new energy environment. A major feature of China's expressways is mixed traffic, and large, medium, and small types of vehicles account for a large proportion, while the dynamic performance of different vehicles varies greatly, resulting in the slow speed of mixed traffic flow on derivative highways. Simultaneously, the application of sensor networks in the field of transportation in China is not mature enough and lacks advanced traffic detection technology.

Subsequently, it is resulting in the inability to accurately predict the speed of mixed traffic flow that is causing traffic congestion and even serious traffic accidents. This paper identifies the significance of sensor networks in China's transportation field by describing its components and characteristics. It also introduces several hybrid vehicle flow rate algorithms based on sensor network including hybrid road traffic flow detection algorithm, hybrid traffic vehicle detection algorithm, hybrid vehicle length, and traffic flow algorithm. It also includes the hybrid vehicle speed detection algorithm that establishes the speed flow relationship model of hybrid vehicle flow. It further investigates the characteristics of expressway hybrid traffic flow through simulation experiments combining quadratic polynomial

parabola model and green Hiltz model regression fitting. The regression coefficients of large and medium-sized hybrid vehicles with different slopes are obtained, so as to realize the coordinated control of mixed vehicle flow speed. The research results obtained in this paper are conducive to solve the problem of highway traffic congestion and have certain practical application value.

This article arranges multiple sensor networks on the highway and collects the data of mixed traffic flow speed along with slope and different types of vehicles on the highway using the new energy environment. This article utilizes the coordinated control of new energy environment and mixed traffic flow speed based on sensor network suing the collected data. The innovations of this paper in studying the coordinated control of sensor network new energy environment and mixed vehicle flow speed: (1) in the new energy environment, the sensor network is used to collect the traffic data on the expressway. This data collection method is more accurate; higher accuracy and strong reference of the results are compared with the past. (2) When studying the speed coordination control of mixed vehicle flow, green Hiltz model and quadratic polynomial parabola model are selected for analysis. The mixed vehicle coordination control is realized according to the data on the model, which is an important basis for traffic managers to make decisions.

## 2. Related Work

Western developed countries began to study the operation speed and cost model of mixed vehicle flow in the 1960s. In the 1970s, France, the United States, Brazil, and other countries jointly formed a scientific research team and invested a lot of money in research. Finally, they obtained the operation cost model of different vehicle types under free traffic environment, namely, HDM-III model [1]. The most basic part of the model is to study the problem of vehicle mixed speed and select several different road sections for experiments. The changes of vehicle running speed on 162 different straight-line sections are collected. The results showed that the mixed speed of vehicles in straight-line sections was related to section length, front and rear curve radius, profile elements, cross-section elements, visual distance, and terrain. A vehicle running speed prediction model with geometric linear characteristics of roads was constructed using these properties [2]. Albert and other people deeply explored various design speed curves and the transition speed changes of adjacent sections, comprehensively investigated the behavior of drivers before and after the curve, and constructed the geometric characteristics and element straight-line curve speed prediction model [3]. The results showed that the speed of the straight-line section in front of the curve decreased by 67%, and the speed of the straight-line section behind the curve increased by 72%. In addition, the average acceleration was $0.448\,\mathrm{m/s^2}$. The average deceleration is $0.732\,\mathrm{m/s^2}$. China mainly studies the speed of mixed traffic flow from the perspective of traffic safety and vehicle driving speed. At present, the scale of road construction in China is expanding day by day. Scholars focus on various factors affecting the speed of mixed traffic flow. Zhong et al. collected and processed the driver's driving state data on the curved slope section of expressway in mountainous areas in China [4]. It established a processing model based on the driver's data. It also analyzed the speed law of minibus in the curved slope section of expressway and constructed the free flow running speed model of minibus on the curved slope according to the different connection modes before and after the curve of expressway. Yan et al. have measured and analyzed the mixed speed of vehicles in straight-line Liudan and curve sections of the expressway through field measurement [5]. The observed data is only the free flow state, and the relationship model between curve radius and running speed can be obtained, which can directly reflect the traffic characteristics of the expressway. Man et al. used SPSS statistical software to study the relationship between the moving speed of expressway and the average running speed of free flow in China and built a statistical model to obtain the numerical relationship between them [6, 7]. Feng et al. actually measured the free flow operation speed data of various slopes on the expressway, studied the operation law of small vehicles on the longitudinal slope, so as to construct the functional relationship between the operation speed, power mass ratio, slope, and slope length of mixed vehicle flow, and obtained the relationship model between slope and power mass ratio based on the statistical results of observed data.

## 3. Concept and Composition of Sensor Network

This article identifies the implication of sensor networks in transportation field of China by describing its concepts, components, and characteristics.

*3.1. Sensor Network Concept.* The concept of sensor network is that a group of sensors form a wireless or wired network based on ad hoc mode, collect, perceive, and process the network coverage of the object information in the geographical area according to the cooperation mode, and send the perceived object data to the observer. Figure 1 shows the architecture of sensor network [8, 9].

The components of sensor networks include observers, sensor nodes, and sensing objects, and each part communicates with each other in a wireless way according to the architecture of the sensor network. The main function of the sensor network is to cooperate with each other to collect, perceive, publish, and process information. Some or all nodes in the sensor network can move, and the corresponding wireless sensor network topology changes dynamically after moving nodes. The energy of the sensor is provided by the power supply, and the sensing part can sense and obtain the external information, and use the converter to convert the external information into a digital signal. The responsibility of embedded processor is to coordinate the work on different nodes to make them operate normally, for instance, taking certain measures to process and store the data of sensing components to control the working mode of power supply. The function of the memory is to save the network parameters and data in the sensor network. The

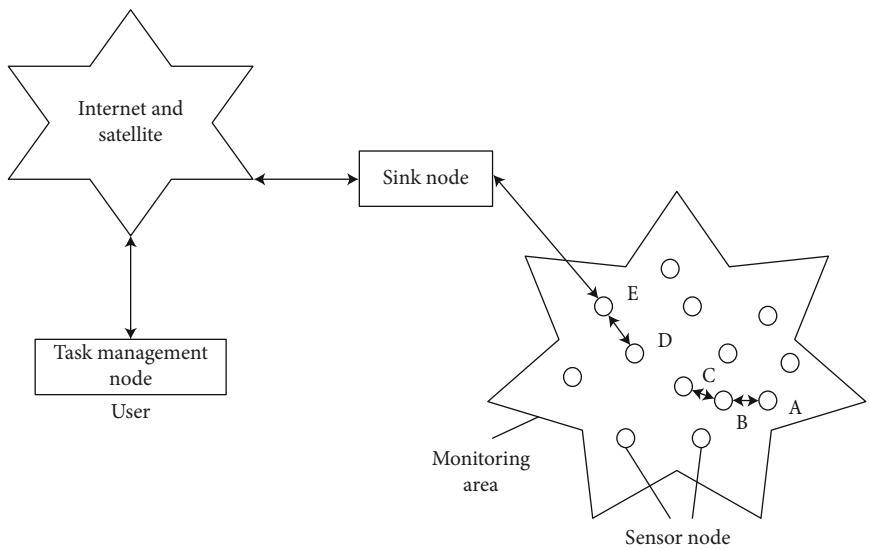


Figure 1: Sensor network architecture.

communication part is used to exchange data between other sensor nodes and observers. Software is an important part of the operation of sensor nodes. The common software includes embedded database system and embedded operating system [10].

*3.2. Sensor Network Composition.* Sensor networks contain multiple sensor nodes, which install sensors intensively in the environment that needs to be monitored. One of the characteristics of sensor networks is application-oriented and has a very complex network architecture. Different applications make up different nodes of sensor networks. Some systems with complex functions include actuators, positioning systems, and power regeneration devices. Figure 2 shows the composition of sensor network nodes.

*3.3. Characteristics of Sensor Networks.* Sensor networks not only have the characteristics of ad hoc network self-organization and mobility but also show many significant characteristics. The details are described as follows:

(1) The installation density and quantity of sensors are large. Sensor network nodes have the characteristics of miniaturization, and the communication interval of each node is limited. Typically, the sensor nodes are in sleep state that can save a lot of electric energy. Therefore, the way of installing multiple sensor nodes can be adopted to ensure high network quality. The density and number of nodes of sensor networks are many orders of magnitude higher compared with ad hoc networks

(2) The failure rate of sensor network nodes is low. Sensor networks generally operate in a severe environment; hence, the nodes in the network are affected by various unpredictable factors resulting in failure. However, sensor nodes have not been replenished for a long time and are quickly consumed, resulting in the difficulty of the normal operation of the sensor node. Therefore, sensor networks have strong fault tolerance and low failure rate, so as to ensure the normal operation of the network

(3) The network topology changes rapidly. Each node can switch back and forth between sleep mode and working mode starting from the sensor characteristics. It will also be affected by many factors. The network quality will be improved rapidly after adding new sensor nodes or in case of failure, the topology of wireless sensor networks has changed greatly based on this characteristic [11].

(4) Expand around data. People only focus on the observation index of a certain area of the wireless sensor, and do not pay attention to the detailed observation data on the node. In the past, the network transmission needs to connect the physical address and data of the data source. Around the data as the core, the wireless sensor network must be separated from the traditional network addressing process and quickly organize the node information in the organization; after fusion, the valuable data is extracted and sent to the user

## 4. Four Speed Algorithm of Mixed Traffic Flow Based on Sensor Network

The sensor network is utilized for mixed traffic flow. The Four Speed algorithm of mixed traffic flow is proposed. The major algorithms include road mixed vehicle flow detection algorithm, hybrid vehicle detection algorithm, hybrid vehicle length and traffic flow algorithm, and hybrid speed detection algorithm.

*4.1. Road Mixed Vehicle Flow Detection Algorithm.* Multiple magneto-resistive sensors are deployed on the driving road. The sensor node can accurately monitor the change degree of magnetic field intensity after the vehicle drives from the

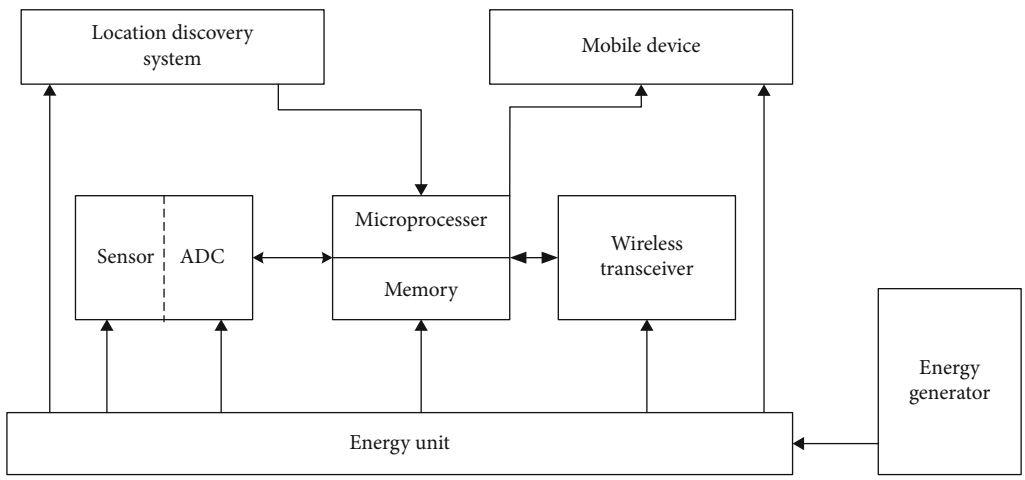


Figure 2: Sensor network node structure.

sensing area. The dynamic data of hybrid vehicles can be obtained after processing the magnetic field signal. Here, the magnetic field signal is divided into three types including

(1) The earth's magnetic field $G_S(k)$ represents the background magnetic field signal without vehicle driving, and the magnetic field signal is always constant

(2) Interference magnetic field, i.e., interference signal $N_s(k)$, hybrid vehicles interfere with each other on adjacent lanes

(3) $V_s(k)$ vehicle signal to be detected, which disturbs the background magnetic field signal when the vehicle passes by. The $M_S(k)$ signal collected by the magneto-resistive sensor at time $k$ is formed by superimposing $N_s(k)$ interference signal, $G_S(k)$ earth magnetic field, and $V_s(k)$ vehicle signal to be detected, which is expressed by the following:

$$M_s(k) = G_s(k) + N_s(k) + V_s(k). \tag{1}$$

From the above formula, the algorithm needs to extract the disturbed magnetic field signal $V_s(k)$ on the vehicle, and the vehicle speed data and quantity information can be obtained after signal processing. Figure 3 shows the signal processing process of vehicle dynamic detection:

*4.2. Hybrid Vehicle Detection Algorithm.* Set the threshold and baseline in advance and open the sensor network node. At this time, the system maintains the initialization state, calculates the signals collected by the sensor for many times, and takes the mean value as the initial baseline. The baseline will be updated according to the demand during the use of this algorithm that is represented by the following

$$Bs_i(k) = \begin{cases} Bs_i(k-1) \times (1-\partial_i) + A_i(k) \times (\partial_i) & \text{No car,} \\ Bs_i(k-1) & \text{Have a car,} \end{cases} \quad \text{for} \quad i \in [x, y, z], \tag{2}$$

where $\partial$ represents the weighting coefficient, $Bs_i(k)$ represents the baseline, and $A_i(k)$ represents the filtered magnetic signal.

The value of $\partial$ is set to 0.08 in the proposed model. The higher the weight, the faster the corresponding weight changes, and vice versa. When there are no vehicles in the area, the baseline will automatically turn on the adaptive update function. After the filtering module processes the magnetic field detection signal, it can obtain the smooth signal. It can obtain three differences. If the difference between three axes or two axes is higher than the threshold after subtracting the baseline value and the filtered magnetic field signal, the system will automatically judge the vehicle signal. Figure 4 shows the flow of hybrid vehicle detection algorithm. The maximum interference value is selected as the threshold according to the interference test results.

*4.3. Hybrid Vehicle Length and Traffic Flow Algorithm.* The daily average flow (ADG), monthly average flow (MADT), and annual average flow (AADT) shall be statistically calculated when calculating the traffic flow of hybrid vehicles. The average flow can be obtained by dividing the total number of vehicles passing this month by the number of days in this month in MADT computation as per statistics [12]. The sensor node needs to be deployed and installed in the middle of the road. The statistical calculation of the number of vehicles passing through the sensor node is expressed by the following Equation (3), and the daily

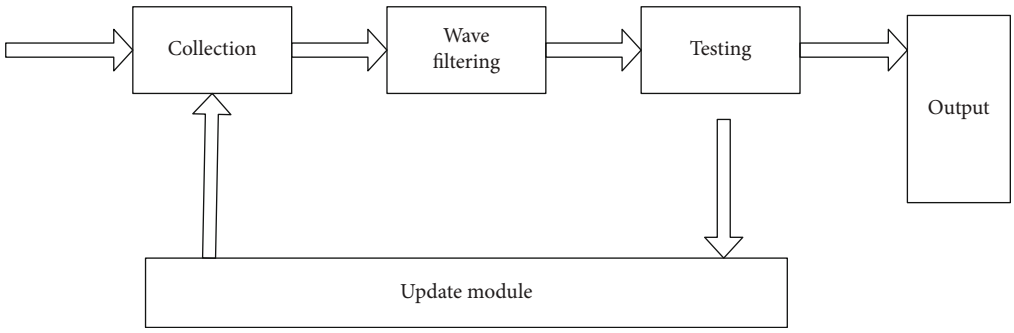


Figure 3: Hybrid vehicle detection structure.

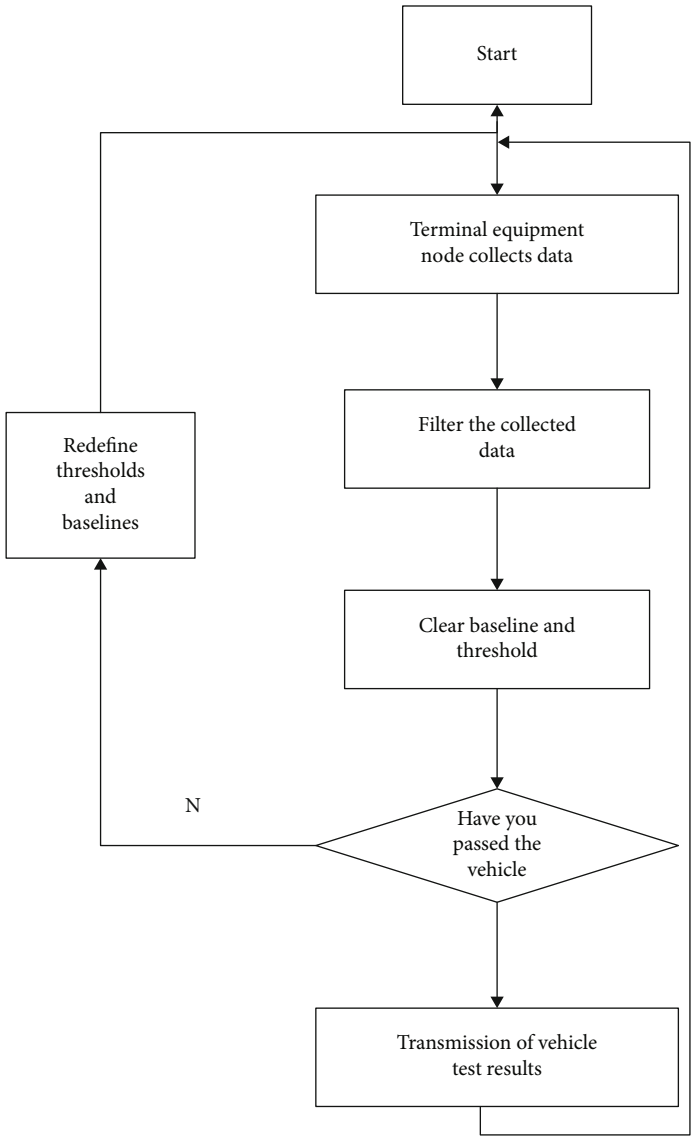


Figure 4: Flow chart of hybrid vehicle detection algorithm.

average traffic flow can be obtained by accumulating the daily data. However, the actual road traffic is more complex that should be analyzed in combination with road characteristics such as road surface friction resistance, road width, longitudinal slope, vehicle characteristics, sight distance, weather, and construction conditions. When studying the speed-coordinated control of mixed traffic flow, this paper selects the plain area with good climate, small

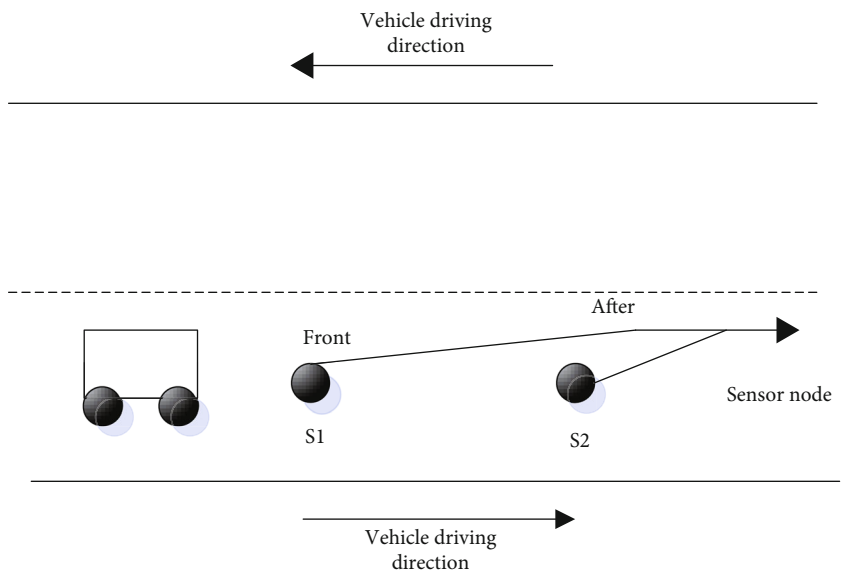


Figure 5: Location of vehicle hybrid speed sensor.

slope, saturated speed less than 35 km/h, and free speed less than 80 km/h.

$$V_{\mathrm{MADT}} = \frac{\sum_{i=1}^{N} V_{\mathrm{dayTraffic}}(i)}{N_{\mathrm{Month}}}. \tag{3}$$

Here, the formula for calculating the flow capacity of mixed vehicles at mixed speed on the lane is given, which is used to calculate the flow capacity of mixed vehicles on a road at any time [13]. In the calculation, the static vehicle saturation capacity of the pavement shall be analyzed first that can be obtained by multiplying the pavement length road and the number of lanes axle. The average mixed speed can be obtained by summing speed and dividing it by the number of lanes assuming that speed is the inflow speed of mixed vehicles. Mixed traffic capacity is the difference between the static pavement capacity and the outflow mixed flow rate and inflow mixed flow rate. In this paper, 50 m is set as a road section, and two speed detection points are set every 5 m at the entrance and exit of 50 m. The traffic mixed speed flow capacity is calculated by

$$V_{\mathrm{TrafficFlow}} = \frac{N_{\mathrm{axle}} \times L_{\mathrm{road}}}{\sum_{i=1}^{N_{\mathrm{inTraffic}}} V_{\mathrm{inSpeed}}(i)/N_{\mathrm{inTraffic}} - \sum_{i=1}^{N_{\mathrm{outTraffic}}} V_{\mathrm{outSpeed}}(i)/N_{\mathrm{outTraffic}}}. \tag{4}$$

*4.4. Hybrid Speed Detection Algorithm.* The two sensors are deployed in the middle of the carriageway that is shown in Figure 5. The distance between the two nodes is known, and it is assumed that the distance is 5 m. The set node distance should be appropriate when detecting the mixed speed. The vehicle will overtake and turn within this distance if the distance is too long. It will be resulting in the inaccurate detection of the mixed speed. When the vehicle is driving from the road, the magnetic field signal of the vehicle is detected by two sensors, and the magnetic field signal has similar waveform. Since the node distance is known, the popular driving speed of the vehicle hybrid can be obtained only by estimating the interval time of the node perceived magnetic field signal.

The magneto-resistive sensor installed on the road senses the magnetic field signal of the passing vehicle and the similarity of the magnetic field intensity signal output between the two sensor nodes [14]. Therefore, the mixed vehicle speed of this section can be calculated by the following formula:

$$v_1 = \frac{\Delta L}{t_1}, \tag{5}$$

$$v_2 = \frac{\Delta L}{t_2}, \tag{6}$$

$$\bar{v} = \frac{v_1 + v_2}{2}. \tag{7}$$

The above formula $v_1$ is to obtain the speed of vehicle mixed traffic flow according to the timing of the vehicle in the sensor sensing area; $v_1$ is timed according to the departure time of the vehicle from the sensor sensing area to obtain the mixed vehicle flow speed; $\bar{v}$ is the average of the speed of the mixed traffic flow of the two vehicles. $\Delta L$ is the time difference between the vehicle entering and leaving the sensing area; $t_1$ is the time difference when the vehicle enters from the sensing area; $t_2$ is the time difference when the vehicle leaves the sensing area. There are individual differences in the application of sensors, and there are large differences in detection sensitivity and range, which makes the waveforms of the same vehicle passing through $S_1$ and $S_2$ nodes different.

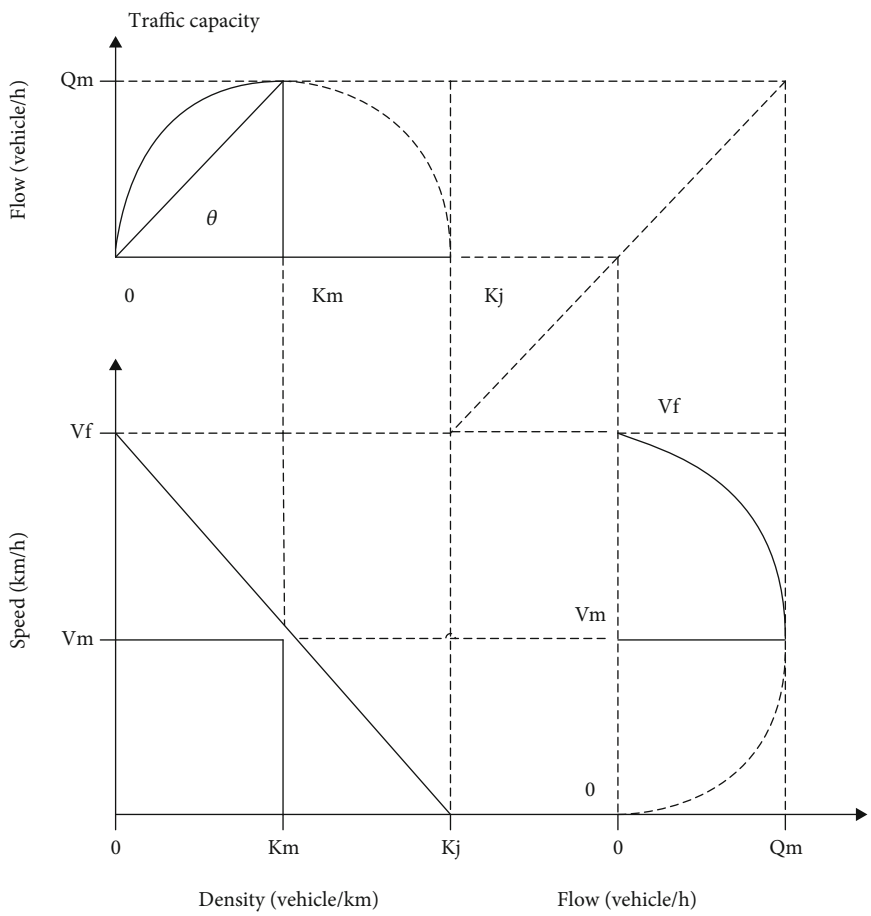


Figure 6: Relationship curve between parameters.

## 5. Speed-Coordinated Control of Mixed Traffic Flow Based on Traffic Simulation

The traffic simulation is carried in integrated with the speed-coordinated control of mixed traffic flow.

*5.1. Speed Flow Relationship Model of Mixed Vehicle Flow.* The basic parameters of mixed traffic flow include mixed speed, traffic flow, and density. The characteristics of expressway mixed traffic flow can be obtained by analyzing the relationship between the mixed speed, traffic flow, and density. The mixed vehicle flow represents the road system load, the mixed vehicle speed represents the road system service level, and the density represents the popular driving freedom of mixed vehicles in the traffic flow. Figure 6 shows the relationship among speed, vehicle type, and flow of mixed vehicle flow.

The following is the relationship (Equation (8)) between the three parameters of mixed traffic flow:

$$Q = VK, \tag{8}$$

where $V$ represents the average vehicle speed, km/h; $Q$ is the average flow (veh/h); and $K$ is the average density (veh/km).

One of the key models in the hybrid AC communication model is the relationship model between mixing speed and flow [15]. Based on the relationship between the three parameters of hybrid AC communication, the hybrid speed density relationship model and hybrid flow density model can be obtained through derivation. At present, the most widely used model is the green Hiltz model. The mixed speed flow model can be obtained based on the green Hiltz mixed speed density linear model. The following is the calculation formula:

$$Q = K_j\left(V - \frac{V^2}{u_f}\right), \tag{9}$$

where $V$ represents the average vehicle speed (km/h), $Q$ is the average flow, (veh/h), $K$ represents blocking density (veh/km), and $U_f$ is the free flow velocity (km/h).

The relationship between mixing speed and flow is a parabola represented in Figure 7. Select the highest flow point as the horizontal line. The noncongested area is above the horizontal line and the congested area is below it. Before the mixing flow rate increases to the maximum, the mixing speed is accelerated, and the flow rate continues to decrease. After it is higher than the maximum flow rate, the mixing speed and flow rate decrease together.

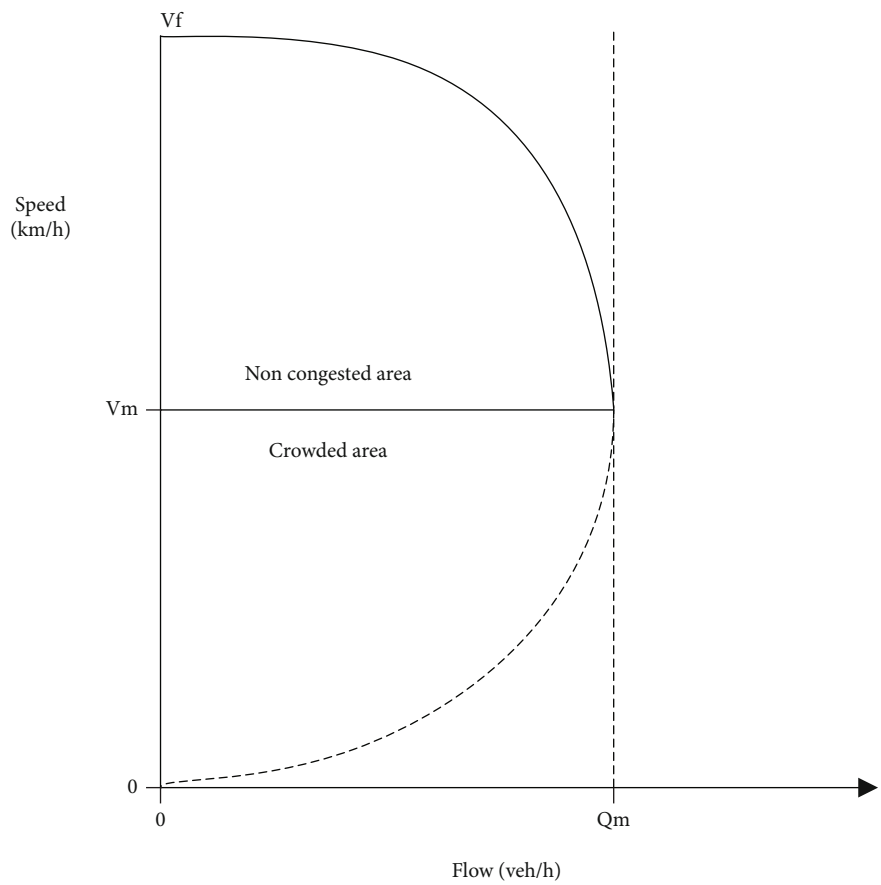


Figure 7: Greenhill mixed velocity flow parabola model.

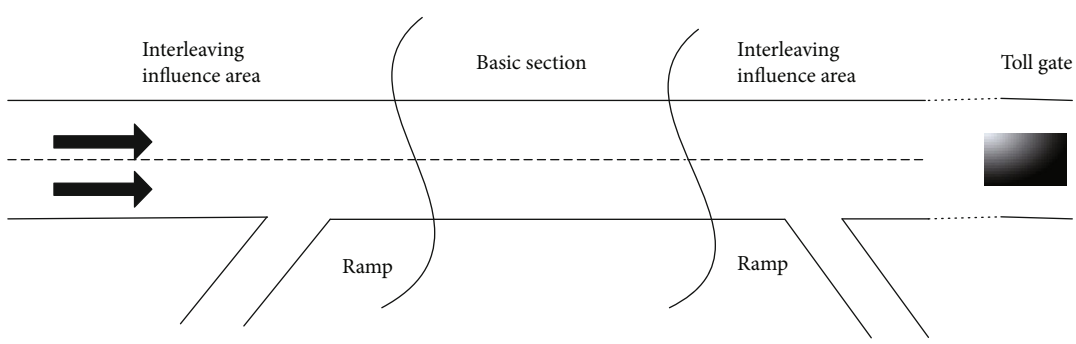


Figure 8: Composition and structure of expressway.

*5.2. Simulation Experiment.* The expressway is reasonably divided into four parts based on the characteristics of expressway mixed traffic flow that are ramp, basic section, toll station, and weaving area. It is depicted in Figure 8. The basic section of expressway is the section of expressway that is not disturbed by the shunting operation of mixed vehicles, ramp confluence, and interleaving operation.

The expressway is a closed section and is an interchange, which will not be affected by pedestrians, opposite vehicles, and nonmotor vehicles. Therefore, this paper focuses on the road conditions and traffic conditions of the basic section of the expressway and tests the CORSIM model through calibration [16]. The following is the simulation topology model designed in the proposed model. The one-way lane of the straight section of the expressway is selected for research, and the expressway is divided into three sections that are the front transition end, the research target section, and the rear transition section, with a length of 1500 m, so as to reduce the interference between the arrival model and the departure model [17]. Figure 9 shows the simulation structure model of basic road section.

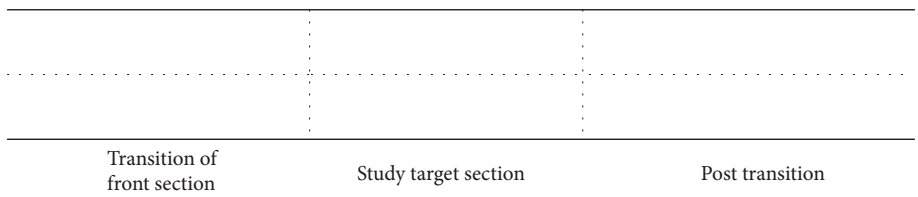


Figure 9: Simulation structure model of basic road section.

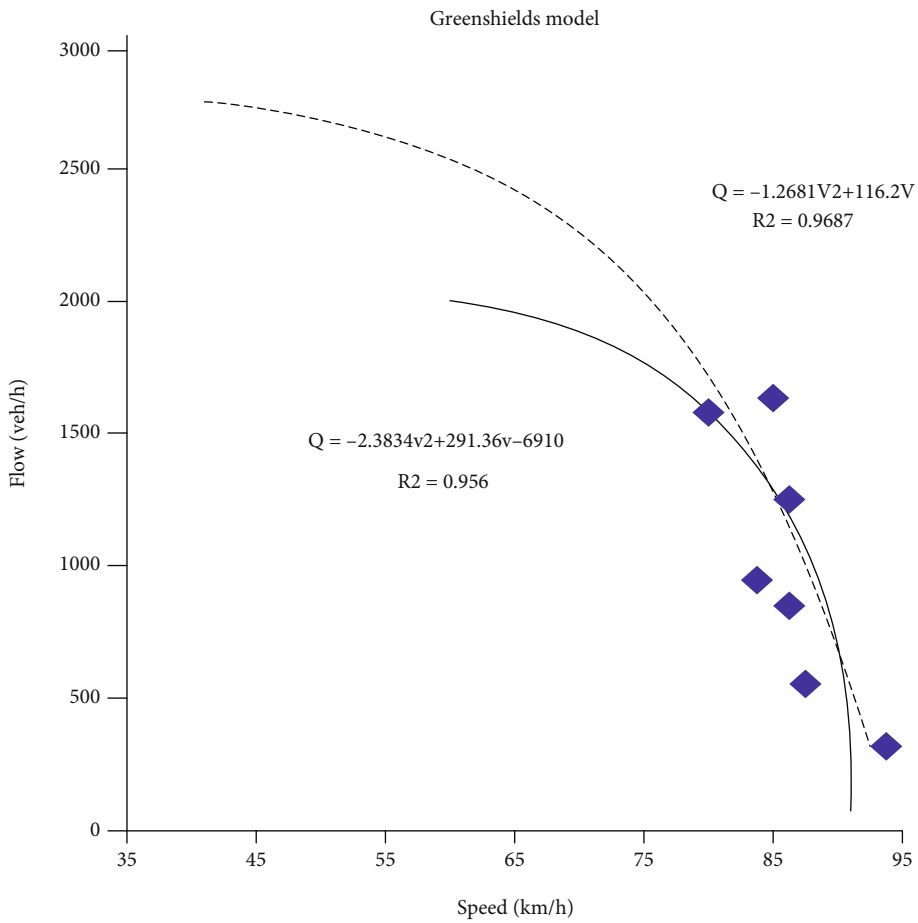


Figure 10: Mixed velocity flow model of large- and medium-sized vehicles.

*5.3. Vehicle Mixed Speed Flow Model Based on Simulation.* The following is a quadratic polynomial parabolic vehicle mixed speed flow model [18].

$$Q = aV^2 + bV + c, \tag{10}$$

where $V$ represents the average mixed speed in the section (km/h), $Q$ is the average flow, (veh/h), and $B$ represents a constant term.

Figure 10 describes the mixed velocity flow model of large- and medium-sized vehicles when the proportion of 5% slope is less than 2%.

The comparison of vehicle mixed flow velocity flow curve when the proportion of large- and medium-sized vehicles is 5% and the slope is equal to 3% is depicted in Figure 11.

The above are two different cases. The quadratic polynomial parabola model and green Hiltz model are used for regression fitting [19]. After collection, Figures 10 and 11 are obtained. The figure shows that the slopes of the two models are different, and the obtained correlation coefficients are higher than 0.95. Green Hiltz model calculates that the maximum vehicle mixed traffic flow under the two slopes is 2600 veh/h and 2352 veh/h, respectively, compared with the actual situation; it is quite different. The quadratic polynomial parabola model used in this paper does not include the correlation, and the maximum traffic flow obtained is highly similar to that in the figure, which can reflect the actual traffic situation.

According to the simulation results, for the mixed traffic flow formed by various large- and medium-sized vehicles, the best way to fit the mixed speed flow model under

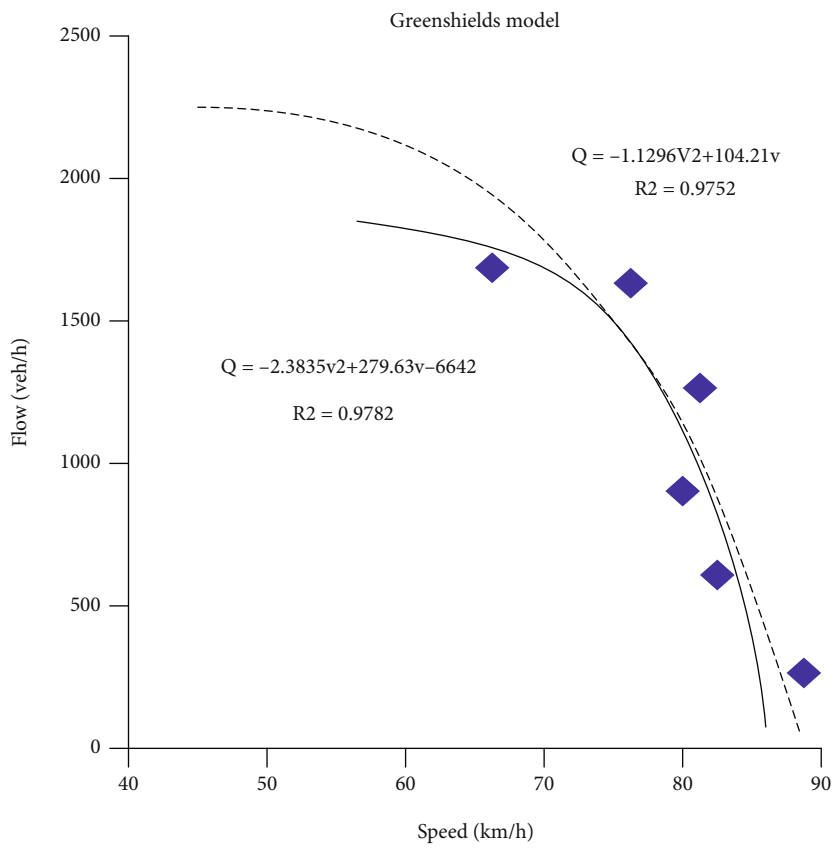


Figure 11: Comparison of vehicle mixed flow velocity flow curve.

Table 1: Regression coefficients of mixing speed flow.

| Proportion of large- and medium-sized vehicles $P$ (%) | Slope $i$ (%) | Model coefficient a | Model coefficient b | Model coefficient c | Correlation coefficient $R^2$ |
|---|---|---|---|---|---|
| 5 | <3 | -2.3902 | 292.07 | -6910 | 0.955 |
| | 3 | -2.2791 | 279.12 | -6637 | 0.973 |
| | 4 | -2.0375 | 246.29 | -5678 | 0.982 |
| | 5 | -1.6713 | 193.01 | -3842 | 0.988 |
| | 6 | -1.2417 | 147.18 | -2331 | 0.985 |
| 10 | <3 | -2.6693 | 331.96 | -8396 | 0.954 |
| | 3 | -1.9601 | 233.07 | -5075 | 0.988 |
| | 4 | -1.7128 | 199.01 | -4093 | 0.985 |
| | 5 | -1.0837 | 111.95 | -1275 | 0.976 |
| | 6 | -1.0635 | 109.15 | -1194 | 0.996 |
| 15 | <3 | -2.9156 | 370.26 | -9851 | 0.952 |
| | 3 | -2.4902 | 309.12 | -7842 | 0.983 |
| | 4 | -1.6267 | 189.05 | -3765 | 0.972 |
| | 5 | -1.2209 | 129.16 | -1803 | 0.998 |
| | 6 | -0.9632 | 95.46 | -858.26 | 0.998 |

different slopes is quadratic polynomial parabola, and the specific regression coefficients are listed in Table 1. Table 1 describes the regression coefficients of mixing speed flow under different large- and medium-sized hybrid vehicles and slopes.

This paper selects any high-speed section to observe in a certain period of time, arranges the vehicle data of high-speed section, and sets the slope as 0.3%. The proportion of large- and medium-sized vehicles is 44%, the statistical vehicle mixing flow is 245 veh/h, and the measured

average vehicle mixing speed is 85.01 km/h. The average speed calculated by interpolation method is 83.72 km/h based on the quadratic parabola model, and the deviation is 0.6% that indicates that the model has ideal simulation effect under this working condition.

The mixed vehicle flow speed decreases after increasing the traffic mixed vehicle flow. The mixed vehicle flow speed and flow decrease together when the mixed vehicle flow is at the highest value [20]. However, if the proportion and slope of large- and medium-sized vehicles are different, the decline mechanism of mixed vehicle flow speed also changes. When the gentle slope is less than 3%, the factor leading to the decline of mixed traffic flow speed is the increase of traffic flow and the increase of mixed traffic flow density. If the steep slope is more than 3%, the density and flow of mixed traffic flow will increase, and the corresponding speed of mixed traffic flow will also be affected. Combined with the quadratic polynomial parabolic vehicle mixed speed flow model, this paper installs sensor networks on the road to accurately calculate the mixed vehicle flow speed and achieve the purpose of coordinated control of the mixed vehicle flow speed. The research results show that the proportion of large- and medium-sized vehicles, slope, and other factors directly affect the mixed vehicle flow speed and flow. The speed of mixed traffic flow shall be coordinated and controlled according to the actual slope and vehicle proportion.

## 6. Conclusions

At present, the world is facing severe environmental pollution problems, and reducing pollutant emission has become the primary problem. Transportation needs to focus on research in the field of transportation and adopt new energy channels and traditional fossil fuels to reduce pollutant emission as a field with large pollutant emission. This paper briefly introduces the background of the research on the coordinated control of new energy environment and mixed vehicle flow speed based on sensor network. It describes the current research status at home and abroad, explains in detail the concept, components, and characteristics of sensor network. In addition, it also performs calculations using the mixed vehicle flow speed algorithm of sensor network and substitutes the data into the mixed vehicle flow speed flow relationship model for simulation experiment. The experimental results show that the proportion of large- and medium-sized vehicles, slope, and other factors directly affect the speed and flow of mixed traffic flow. Therefore, the speed of mixed traffic flow should be coordinated and controlled in combination with the proportion and slope of different vehicle types on the actual road.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

We declare that there is no conflict of interest for publication of this paper.

## References

[1] J. Hernandez-Sanchez, S. Moretti, R. Noriega-Papaqui, and A. Rosado, "Update of the 2HDM-III with a four-zero texture in the Yukawa matrices and phenomenology of the charged Higgs Boson," pp. 1–29, 2012, http://arxiv.org/abs/1302.0083.

[2] A. M. P. Zuriaga, A. G. García, F. J. C. Torregrosa, and P. D'Attoma, "Modeling operating speed and deceleration on two-lane rural roads with global positioning system data," *Transportation Research Record*, vol. 217, no. 1, pp. 11–20, 2018.

[3] Z. Guo, H. Wan, Y. Zhao, H. Wang, and Z. Li, "Driving simulation study on speed-change lanes of the multi-lane freeway interchange," *Procedia-Social and Behavioral Sciences*, vol. 96, pp. 60–69, 2013.

[4] X. M. Zhong, J. Rong, and X. M. Liu, "Research on speed prediction models for passenger cars on combined sharp horizontal and vital curves of expressways," *Journal of Highway And Trabsoirtation Resarch And Development*, vol. 21, no. 12, pp. 84–88, 2004.

[5] Y. Yan, H. Z. Yuan, and X. P. Jian, "Model of relation of expressway alignment 3D space comprehensive indexes with driving speed," *Journal of Highway and Transportation Research and Development*, vol. 28, no. 10, 2011.

[6] X. D. Man and B. Fan, "Study on the influence of rainfall on running speed of mountain expressway," *Highways & Automotive Applications*, vol. 5, 2020.

[7] M. J. Feng, T. Wang, X. S. Wang, and Y. Deng, "Safety evaluation of combined horizontal and vertical alignments on mountainous freeways," *Journal of Beijing University of Technology*, vol. 44, no. 6, pp. 919–925, 2018.

[8] V. Kumar, N. Jayapandian, and P. Balasubramanie, "Improving routing data security in wireless sensor network using clustering range indicators essentials in SMDSRNGs method," *Wireless Personal Communications*, vol. 4, 2021.

[9] D. Vujošević, I. Kovačević, M. Suknović, and N. Lalić, "A comparison of the usability of performing ad hoc querying on dimensionally modeled data versus operationally modeled data," *Decision Support Systems*, vol. 54, no. 1, pp. 185–197, 2012.

[10] Y. B. Liu, "Research on energy management model based on solar sensor network," *Computer Applications and Software*, vol. 30, no. 3, 2013.

[11] A. F. Alexander-Bloch, P. E. Vértes, R. Stidd et al., "The anatomical distance of functional connections predicts brain network topology in health and schizophrenia," *Cerebral Cortex*, vol. 23, no. 1, pp. 127–138, 2013.

[12] Y. C. Tang, "Vehicle tracking and counting based on vehicle recognition," *Information and Computers*, vol. 13, 2016.

[13] B. Credidio, M. Pugini, S. Malerz et al., "Quantitative electronic structure and work-function changes of liquid water induced by solute," *Physical Chemistry Chemical Physics*, vol. 24, pp. 1310–1325, 2022.

[14] B. Khondaker and L. Kattan, "Variable speed limit: a microscopic analysis in a connected vehicle environment," *Transportation Research Part C: Emerging Technologies*, vol. 58, pp. 146–159, 2015.

[15] J. L. Zocoler, L. A. Oliveira, and F. B. Hernandez, "Model for determining flow diameter and economic velocity in water elevating systems," *Mathematical Problems in Engineering*, vol. 2006, Article ID 17263, 62 pages, 2006.

[16] A. Paz, V. Molano, and C. Gaviria, "Calibration of CORSIM models considering all model parameters simultaneously," *2012 15th International IEEE Conference on Intelligent Transportation Systems*, vol. 18, pp. 1417–1422, 2012.

[17] Q. Q. Wei and G. L. Luo, "Model and simulation of enterprise value co-creation architecture based on hypernetwork," *Computer Applications and Software*, vol. 30, no. 3, 2013.

[18] G. Sil, S. Nama, A. Maji, and A. K. Maurya, "Modeling 85th percentile speed using spatially evaluated free-flow vehicles for consistency-based geometric design," *Journal of Transportation Engineering*, vol. 146, no. 2, 2020.

[19] R. Dupre, V. Argyriou, and D. Greenhill, "Prediction of physics simulation using dimensionality reduction and regression," *Journal of Graphics Tools*, vol. 17, no. 3, pp. 99–110, 2013.

[20] B. W. Li, Z. A. Lu, S. Y. Tang, T. An, and L. Zhao, "Research on lane division scheme of mixed traffic freeway based on binary interpolation," *Journal of Wuhan University of Technology*, vol. 42, no. 4, 2018.