Research Article

Modified Motor Vehicles Travel Speed Models on the Basis of Curb Parking Setting under Mixed Traffic Flow

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The ongoing controversy about in what condition should we set the curb parking has few definitive answers because comprehensive research in this area has been lacking. Our goal is to present a set of heuristic urban street speed functions under mixed traffic flow by taking into account impacts of curb parking. Two impacts have been defined to classify and quantify the phenomena of motor vehicles' speed dynamics in terms of curb parking. The first impact is called Space impact, which is caused by the curb parking types. The other one is the Time impact, which results from the driver maneuvering in or out of parking space. In this paper, based on the empirical data collected from six typical urban streets in Nanjing, China, two models have been proposed to describe these phenomena for one-way traffic and two-way traffic, respectively. An intensive experiment has been conducted in order to calibrate and validate these proposed models, by taking into account the complexity of the model parameters. We also provide guidelines in terms of how to cluster and calculate those models' parameters. Results from these models demonstrated promising performance of modeling motor vehicles' speed for mixed traffic flow under the influence of curb parking.

1. Introduction

Curb parking refers to using the road's spatial resource (i.e., hard shoulders or wide lane) as the parking carrier. It is an important part of the supplied pattern by the parking facilities. Obviously, it has advantages of being flexible, space-saving, and convenient contrast to the off-street parking. However, curb parking occupies road spaces, which directly influences the running characteristics of motor vehicles and bicycles. There have been a lot of controversy about in what condition should we use curb parking. However, research in this subject has been lacking, especially considering the bicycles and motor vehicles under mixed traffic flow.

Some downtowns simply provide curb parking wherever possible, while others prohibit it as being unsafe and a nuisance to moving traffic.

This paper intended to present a set of heuristic urban street speed functions under mixed traffic flow by taking into account integrative impacts of curb parking, including the different types of curb parking, the different compositions of the road traffic flow (bicycles and motor vehicles), and the different control modes of the road traffic (one-way and two-way traffic). By relying on these studies, we intend to forge a more in-depth analysis of curb parking.

Literature Review

Prevost developed a theoretic model for curb parking by dividing it into long-term (applying to the residential area) and short-term parking (applying to the commercial area). He adopted the stochastic gap theory and the queue theory to study the distribution of gaps between cars and the equilibrium queue distribution, and he also derived a formula of the capacity and occupancy [1].

Rawal and Rodgers studied the distribution model of gaps between curb parking cars in London which is modeled in intensive parking and optimal parking type and analyzed the distribution law of gaps between the parking cars [2].

The students of Tennessee University adopted lots of data which are used in the research of Safety Aspects of curb parking researched by Federal Highway Administration (FHWA) to analyze the influence of the safety to the parking cars, moving cars, pedestrian, and parking drivers from lots of factors in the different road grades, the different manage mode of parking, and the different setting mode (parallel and diagonal parking) and analyze their interactions [3].

Jilla studied the influence of the nonmotorized vehicle lane on the traffic flow in 1974. In his research, he concluded that when vehicles drive through the nonmotorized vehicle lane, their average speeds will decrease and their locations in the lane will shift away from the nonmotorized vehicle lane [4].

Bang et al. adopted a side friction method for investigating curb parking. In this research, the traffic flow of the nonmotorized vehicles and other factors such as pedestrian and bus station are considered as the side friction factors that reduce the speed of the vehicles. According to the experimental data, Bang et al. proposed an empirical formula to forecast these factors and developed a classifier standard for these side friction factors [5].

In China, curb parking under mixed traffic conditions has also received lots of attention. Zang and Yang proposed a mathematic model to model the side disturbance at the point of the drivers and the vehicular characteristics [6]. Guan et al. took the phenomenon of the nonmotorized vehicles disturbing the vehicles as an investigative object, analyzed the times that the time headway appears and the nonmotorized vehicles crosses in the open interzone, and then used the traffic flow theory and the traffic dynamics theory to get the mixed traffic model based on analyzing the basic road mixed traffic flow [7]. Long and Yan used the kinetic viscosity in the hydrodynamics theory and the Newtonian law of internal friction according to the stream characteristics to find the influencing model of the nonmotorized vehicles to the roadway [8].

The literature review suggests many different empirical methods and mathematic models for investigating the mixed traffic and the traffic impact of curb parking. However, some important aspects were not well considered in these existing studies, such as the traffic flow under different road sections and mixed traffic, the influencing process of the
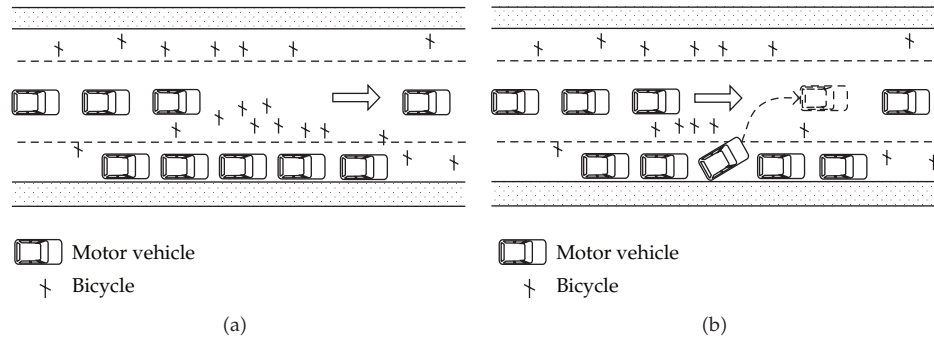
Figure 1: The friction and Time impact of the setting curb parking on the road.

nonmotorized vehicles to the traffic flow, and the coalescent to the parking. The exiting analytical methods and models are based on lots of oversimplified assumptions, which make it difficult to analyze the complicated impact of road traffic flow (especially mixed traffic flow).

The rest of this paper is organized as follows. Section 2 classifies the different impacts of setting curb parking. Section 3 gives the details of traffic data collection. Sections 4 and 5 put forward the basic speed model and the modified speed model about motor vehicles with the results of calibration and validation. Section 6 concludes this research.

2. Impacts of Setting Curb Parking

The main influences of setting curb parking on traffic flow can be concluded by the following aspects. One is the process that curbing parking would compel the running track of the nonmotorized vehicles (bicycle, etc.) to change their track or occupy the roadway, reducing the vehicle-speed to form mixed traffic state. In this paper, we named such process as Space impact. As shown in Figure 1(a), where the road section is mixed with motor vehicles and bicycles, such impact would decrease the speeds of motor vehicles. The other is that when the vehicles move out from curb parking areas, these vehicles obstruct the traffic flow. In particular, when the traffic volume is high, the vehicles in the nonmotorized vehicle lanes are likely to merge into traffic flow without enough accepted gap, which might cause serious traffic congestion or accidents. In this paper, we named such process as Time impact (see Figure 1(b)).

According to our observation, the different angles of setting curb parking (parking types) are the main causes of the Space impact. Meanwhile, the vehicle lay-off modes, which denote the modes that vehicles run into the berth and vehicles drive from the curb parking area to the main road, are the primary factors influencing the Time impact.

2.1. The Main Types of Curb Parking

The main types of curb parking can be divided into several major types: parallel, perpendicular, and angled parking (see Figures 2(a), 2(b), and 2(c)) [9]. Different parking types result in different spatial occupancy of road space. To be more specific, as China is a right-side driving country, drivers park their vehicles on the right side of the roadway. Here, we
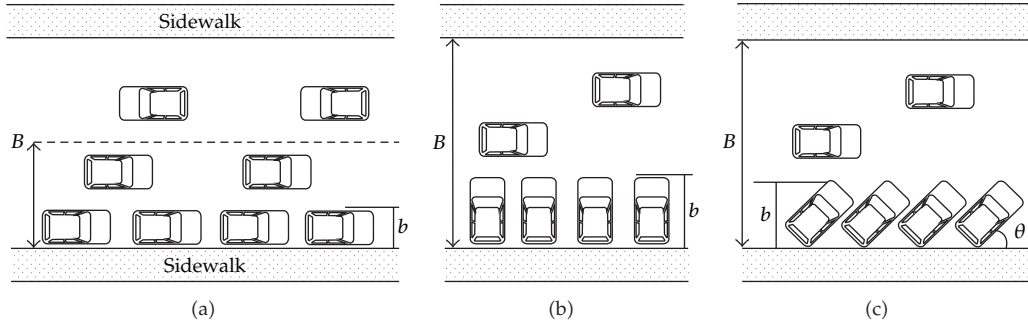
Figure 2: Different setting method of the curb parking.

Table 1: Main type of car parking spaces.

Type	Recommended Dimensions
parallel	6.0 m × 2.4 m (min 4.8 × 2.1 m) buffer strips between spaces, if possible
perpendicular	5.5 m × 2.4 m (min 4.8 × 2.28 m)
angled	Up to 5.5 m perpendicular depth × 2.4 m width

propose to use a ratio, space interruption rate, to quantify the degree of spatial occupancy in terms of parking types. The space interruption rate R_b is defined as the ratio of the width b, which is occupied by curb parking vehicles, to the whole road width B. However, R_b can be calculated by

$$R_b = \frac{b}{B} \times 100\%, \tag{2.1}$$

where b is the width of the roadway occupied by curb parking. B is the width of the roadway in one direction. B is one half of the entire roadway width for two-way roads as shown in Figure 2(a). It equals the entire roadway width for one-way roads as shown in Figures 2(b) and 2(c).

For the different parking types, b can be calculated by the following equation:

$$b = L_{\text{veh}} \cdot \sin \theta + W_{\text{veh}} \cdot \cos \theta, \tag{2.2}$$

where L_{veh} is the average length of the vehicle. W_{veh} is the average width of the vehicle. θ is the horizontal inclination from the parking vehicle to the road in Figure 2. Note that since the majority of vehicles driving on the roadway are of mid-sized length, so here, we use the average length of the vehicles to calculate b.

Table 1 lists the recommended dimensions about three main types of car parking spaces [10]. The length of berth ranges from 5.5 m to 6.0 m, while the width ranges from 2.1 m to 2.4 m.

2.2. The Vehicles' In-Out Mode

The driver maneuvering in or out of parking space, which is often called In-Out mode, can distinctly influence the mixed traffic flow. This paper uses the jam time to quantify such impact. The jam time for the whole roadway is the time from a vehicle starting and influencing the traffic flow to the vehicle completely drives into the roadway.

Because of the different jam time to the roadway between the vehicles moving in and out of the car parks, the calculation of the influence to the vehicle In-Out mode can adopt the total delay time (T) in the statistical time interval. In our study, vehicles' In-Out mode exerts the greatest influences in the weaving section, where vehicles interweave. Therefore, generally, we calculate T in the length of the weaving section. Let n_1 be the number of vehicles run into the berths in a given time interval, n_2 is the number of vehicles driving from curb parking area to main road. T can be calculated by the following equation:

$$T = n_1 \times t_1 + n_2 \times t_2, \tag{2.3}$$

where T is the total delay time in the statistical time interval (in hour). t_1 is the jam time that vehicles run into the berths from the adjacent roadway(s). t_2 is the jam time that vehicles back out of the berths and enter the adjacent roadway(s).

The total delay time (T) differs according to different statistical time intervals. Here, we can define the time influence rate R_T to measure the extent to which T exerts influences on the roadway. The time influence rate R_T is defined as the ratio of the total influence time T to the statistical time interval T_d (in hour). R_T can be calculated by the following equation:

$$R_T = \frac{T}{T_d} \times 100\%. \tag{2.4}$$

3. Data Collection

The following criteria are used to choose appropriate urban streets for data collection.

(1) In the case that vehicles might be interrupted by some kind of uncertain factors, like pedestrian cross-passage along the streets, this kind of street would not be selected.

(2) Since vehicles decelerate when they approach intersections and accelerate when they have the right to leave intersections, the speeds within the scope of intersections are heterogeneous. To filter out the influence of intersections, the mid block of streets is suitable to be selected. Therefore, in this paper, only street segments that are 80 m away from intersections are selected [11].

(3) The quality of pavement, horizontal, and vertical curves is also among the main factors influencing speed. To concentrate on curb parking, this paper choses the well pavement (without potholes, cracks, or other surface defects) and straight alignment [12].

According to the above principles, six typical streets with curb parking were selected to be test beds. The detailed features of these roads are listed in Table 2.

The layout of measurement equipments is shown in Figure 3. As mentioned above, the greatest influence to roadway from vehicle parking types occurred mainly in the weaving

Table 2: Detailed circumstance of the chosen streets in Nanjing city.

No.	The road name	Lane distribution	The width of the curb parking (m)	The width of the motor vehicle lane (m)	The width of the nonmotorized vehicle lane (m)	The width of the road (m)	The organizing modes of the road traffic
1	Chengxian Street	1 motor vehicle lanes + 2 nonmotorized vehicle lanes	1.5	4.0	1.5 × 2	7.0	One-way traffic
2	Tianjin Road	2 motor vehicle lanes + 2 nonmotorized vehicle lanes	2.5	4.0 × 2	2.0 × 2	12.0	Two-way traffic
3	Yunnan North Road	2 motor vehicle lanes + 2 nonmotorized vehicle lanes	2.0	4.5 × 2	2.0 × 2	13.0	Two-way traffic
4	Hubei Road	2 motor vehicle lanes + 2 nonmotorized vehicle lanes	2.2	5.5 × 2	2.65 × 2	16.3	Two-way traffic
5	Beiting Road	1 motor vehicle lanes + 2 nonmotorized vehicle lanes	1.5	3.0	1.5 × 2	6.0	One-way traffic
6	Xikang Road	2 motor vehicle lanes + 2 nonmotorized vehicle lanes	2.25	3.0 × 2	2.0 × 2	10.0	Two-way traffic

section where vehicles and bicycles interweave, and this study is focused on weaving sections. Moreover, although the deceleration and acceleration road sections are part of the effect of parking, they are excluded from our study for the same reason that the majority of vehicles interweave in the weaving section where the influences are the most significant.

As shown in Figure 3, cameras are set up at upstream (survey place 1) and downstream locations (survey place 2) of the segment of interest. These locations are usually more than 80 meters away from neighboring intersections, to reduce traffic impacts from neighboring intersections. These cameras automatically record all the vehicles passing by in the midblock area, for the parking strip in this area it is often uninterrupted. Also, for the accuracy and integrity of the data collected within this segment, we install two cameras to ensure that they could guarantee an integrated field of vision of the study segment. To match the same license numbers recorded at both locations, mean journey speeds can be easily derived from segment length divided by travel time, which is the time difference between two cameras. Moreover, from these recorded images, traffic data such as traffic volumes, traffic compositions, number of parking vehicles, stop modes of car park, the frequency of the vehicles running in or out of the roadway. Although the workload of indoor data processing is quite intensive, this method is still adopted due to its advantages in the following aspects: we can replay again and repeatedly use the record. This method avoids the abuse of the traditional method of vehicle registration mark and effectively ensures the dependability and precision of the data.
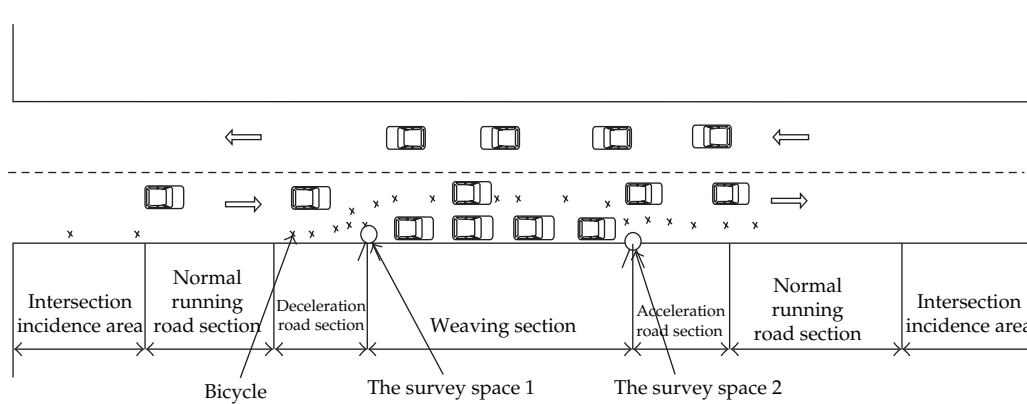
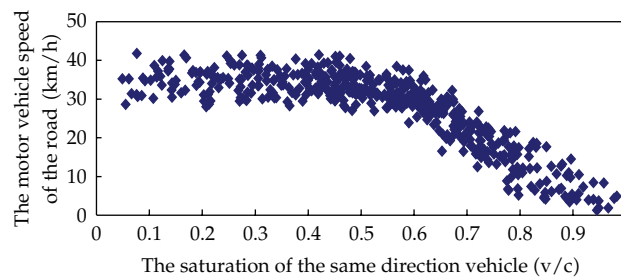**Figure 3:** The figure of the survey road and place.

Figure 4: Dispersed point figure of the empirical data obtained from the test bed based on curb parking set.

4. Speed Model for Streets with Curb Parking

4.1. Basic Speed Model

In this paper, we mainly use the degree of saturation (volume to capacity (v/c) ratio for the lane) to modify the motor vehicle travel speed models. The motor vehicles' speeds decrease with the increase of the degree of saturation when curb parking vehicles exist.

Figure 4 depicts the empirical data obtained from the test beds described above. From the results, it is obvious that when the value of v/c ratio is less than 0.3, the vehicles' speeds remain constant. While the value of v/c ratio changes within 0.3 to 0.8, the speeds decline significantly. When the value is higher than 0.8, the speed values are less than 5 km/h which is almost breakdown. This suits three academic characters of jam function which are described by Blunden (1971). (1) When the traffic volume is enough low, the travel time is close to the average free-flow travel time t_0. (2) When the traffic volume is much less than the road capacity, the volume changes slightly and leads to minor changes in travel time. (3) Under the condition of the "steady" system (the volume is approaching the road capacity), the curve comes into the gradual line of the saturated volume y-axis (the travel time increases rapidly).

Based on the above results, we try to set up vehicle travel time equation on the basis of curb park setting. By far the most widely used volume delay functions are the link travel time functions of the Bureau of Public Roads (BPRs) [13]. The simplicity of these BPR functions

is certainly one reason for their wide-spread use. Also, the original BPR functions modeled a steady degradation of speeds as the volume of traffic approaches capacity as follows:

$$t = t_f \cdot \left[1 + \alpha \left(\frac{q}{c}\right)^{\beta}\right], \tag{4.1}$$

where t is the link travel time (h), t_f is the link travel time at free-flow link speed (h), q is the traffic volume (veh/h). c is the road capacity (veh/h). α and β are BPR parameters.

Literature changes the forms of function (4.1) as follows [10]:

$$V(v_0, q_i, c_i) = \frac{v_0}{\Pi_i \left[1 + \alpha_i (q_i/c_i)^{\beta_i}\right]}, \tag{4.2}$$

where V denotes the actual running speed of the motor vehicles on the road (km/h). v_0 denotes free-flow speed (km/h). q denotes the traffic volume (veh/h). c denotes the road capacity (veh/h). α and β are parameters. Index i is used to represent a certain type of traffic, for instance, car, truck, or nonmotorized vehicle.

4.2. The Modified Space Impact Model of the Curb Parking

As described in Section 2, when R_b increases, the space interruption rate among the road vehicles increases and the speed of the traffic flow as well as the capacity decreases. Under the condition of different value of R_b, the degrees of saturation are grouped into 0.2~0.4, 0.4~0.6, and 0.6~0.8. Figure 5 shows that the relationship between the road traffic flow speed and the space influence rate R_b is liner monotonic.

Based on the above results, we can modify (4.2) and develop a new formulation as shown below:

$$V(v_0, R_b, q_i, c_i) = (1 - k_1 R_b) \times \frac{v_0}{\Pi_i \left[1 + \alpha_i (q_i/c_i)^{\beta_i}\right]}, \tag{4.3}$$

where k_1 is the parameter related to the slope based on the space influence rate, the rest of parameters are the same as in (4.1).

4.3. The Time Impact Modify Model of the Curb Parking

As described in Section 2, the Time impact is modeled mainly by the value of R_T. Under the condition of different R_T, the degrees of saturation are grouped into 0.2~0.4, 0.4~0.6, and 0.6~0.8. Figure 6 shows that the relationships between the road traffic flow speed and the time influence rate R_T is square monotonic.

Based on the above conclusions, we can modify (4.2) into the following equation:

$$V(v_0, R_b, R_T, q_i, c_i) = \left(1 - k_1 R_b - k_2 R_T^2\right) \times \frac{v_0}{\Pi_i \left[1 + \alpha_i (q_i/c_i)^{\beta_i}\right]}, \tag{4.4}$$
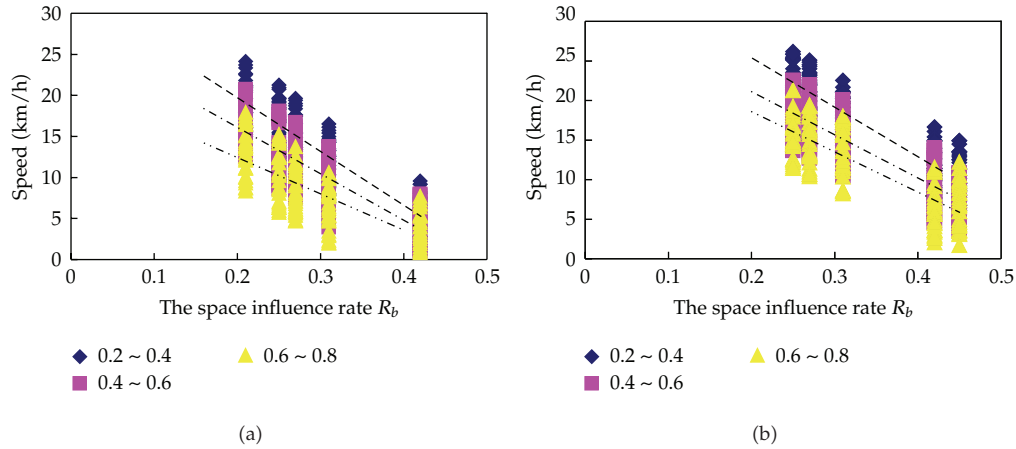
Figure 5: Relationship between one-way (a) and two-way (b) traffic flow speed and the value of space influence rate R_b under different saturation of the road traffic flow.
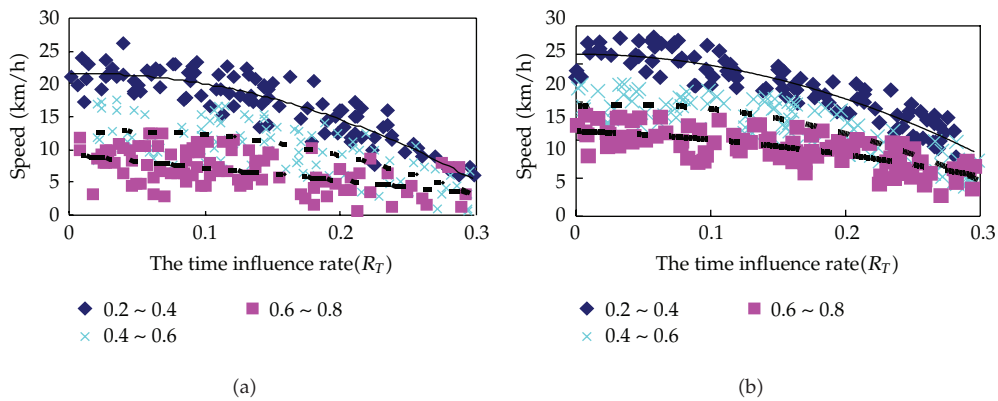

Figure 6: Relationship between one-way (a) and two-way (b) traffic flow speed and the time influence rate R_T under different saturation of the road traffic flow.

where k_2 is the parameter based on the time influence rate and other parameters are the same as (4.3).

5. Model Calibration and Validation

This paper adopts parameter clustering and phase method for model calibration and validation. By doing so, it can greatly decrease the required time for calibration and ensure the accuracy. The following are the calculation processes.

(1) The parameter clustering analysis: we classify the model parameters of (4.4) into two categories. k_1 and k_2 are determined by the degree of saturation and hence can be considered as the first group of indicators. α_i, β_i are the traffic flow parameters and can be considered as the second group of indicators.

(2) The parameter phase calibration: aiming at the above two groups of indicators, we fix the range of the degree of saturation (e.g., 0.2–0.4 and 0.4–0.6), R_T, and R_b and calibrate the value of k_1 and k_2, to get their initial values for iterative method of least squares. Meanwhile, under the same condition, we calibrate α_i, β_i to get its initial value for iterative method. Then, based on the field data and the initial values of k_1, k_2, α_i, and β_i, we calibrate the parameter (4.4).

In the following section, we will calibrate the parameters for (a) one-way and (b) two-way traffic flow speed model, respectively.

5.1. One-Way Traffic

Under the condition of one-way traffic, not only motor vehicles driving in the same direction but also the nonmotorized vehicles driving in opposite direction should be taken into account. However, (5.1) is used in this case:

$$V = \frac{(1 - k_1 R_b - k_2 R_T^2) \cdot v_0}{\left[1 + \alpha(q/c)^\beta\right] \cdot \left[1 + \alpha_b(q_b/c_b)^{\beta_b}\right] \cdot \left[1 + \alpha_b'(q_b'/c_b')^{\beta_b'}\right]}, \tag{5.1}$$

where q/c is the saturation of the same direction motor vehicles (q/c has the same meaning of v/c ration mentioned in Section 4.1), q_b/c_b is the saturation of the same direction nonmotorized vehicles, q_b'/c_b' is the saturation of the counter nonmotorized vehicles, α_b, β_b, α_b', β_b' are the corresponding parameters.

There are 8 parameters which need to be calibrated. If we use the method of least squares entirely, the alternate times will increase and it cannot get reasonable value if the initial value is unreasonable. Based on these consideration, firstly we fixed the value of R_b and R_T, get the value of α, β, α_b, β_b, α_b', and β_b' by the alternate method as the initial value, and get k_1, k_2 by alternate method in the same time, in the end it adopts the actual observational data to calibrate (5.2). With $k_1 = 2.143$, $k_2 = 6.524$, $\alpha = 6.879$, $\beta = 2.589$, $\alpha_b = 7.140$, $\beta_b = 3.298$, $\alpha_b' = 1.210$, $\beta_b' = 1.378$, we get the following equation:

$$V = \frac{(1 - 2.143 \times R_b - 6.524 \times R_T^2) \cdot v_0}{\left[1 + 6.879(q/c)^{2.589}\right] \cdot \left[1 + 7.140(q_b/c_b)^{3.298}\right] \cdot \left[1 + 1.210(q_b'/c_b')^{1.378}\right]}. \tag{5.2}$$

The coefficient of correlation $R = 0.759$ and the F statistic is 403.62, suggesting this model is statistically significant at the level of 0.05, as listed in Table 3.

5.2. The Two-Way Traffic

Under the condition of the two-way traffic, we must simultaneously consider the influence of the same direction vehicles and nonmotorized vehicles and the motor vehicles traffic in the opposite direction. So we develop the following model in (4.4) for the two-way traffic:

$$V = \frac{(1 - k_1 R_b - k_2 R_T^2) \cdot v_0}{\left[1 + \alpha(q/c)^\beta\right] \cdot \left[1 + \alpha_b(q_b/c_b)^{\beta_b}\right] \cdot \left[1 + \alpha'(q'/c')^{\beta'}\right]}, \tag{5.3}$$

Table 3: F test of the regression equation.

	The freedom	The square sum	The mean square	The F statistic value	$F_{0.05}$	F test
The regression analysis	3	1528.35	509.45			
				403.62	2.60	√
The residual error	323	536.63	1.66			

Table 4: F test of the regression equation.

	The freedom	The square sum	The mean square	The F statistic value	$F_{0.05}$	F test
The regression analysis	3	4221.31	1407.10			
				158.13	2.60	√
The residual error	634	1530.15	7.25			

where q'/c' is the saturation of the opposite motor vehicles. The other parameters are the same as those in (5.1).

Data collected in real world were used to calibrate (5.3). With $k_1 = 1.563$, $k_2 = 5.376$, $\alpha = 3.871$, $\beta = 1.542$, $\alpha_b = 4.362$, $\beta_b = 2.171$, $\alpha' = 0.703$, and $\beta' = 1.778$, we get the following equation:

$$V = \frac{\left(1 - 1.563 \times R_b - 5.376 \times R_T^2\right) \cdot v_0}{\left[1 + 3.871\left(q/c\right)^{1.542}\right] \cdot \left[1 + 4.362\left(q_b/c_b\right)^{2.171}\right] \cdot \left[1 + 0.703\left(q'/c'\right)^{1.778}\right]}. \tag{5.4}$$

The coefficient of correlation is 0.653 and the F statistic is 158.13, suggesting this model is statistically significant at the level of 0.05, as in Table 4.

Under the condition of two-way traffic, the road width is larger and the same direction vehicles can use the opposite lane, so the values of α, β, α_b, β_b, α'_b, and β'_b are smaller than the one-way traffic. When the saturation is larger than 0.6, compared to the one-way traffic, the motor vehicle speed of two-way traffic is relative slower.

5.3. Validation of the Proposed Model

The data collected from the Beiting Street (see Figure 7) were used to validate this proposed speed model. This is a one-way street with only one lane. For this street, only one lane of 3.0 m width is dedicated for motor vehicles and two 1.5 m wide lanes are for nonmotorized vehicles. The width for curb parking is 1.5 m. Other features are listed in Table 5.

Based on our analysis using field data collected from the Beiting street, the curb parking type and Time impact appear to have great influences on the speed. For the proposed model in (5.2), two more parameters R_b and R_T are added on the basis of (4.2). As shown in Figure 8, comparisons are made among the results from the models in (5.2) and (4.2) and the field data. To have a fair comparison of the modified model and the original model, the same parameters used in (4.2) are also used in (5.2).
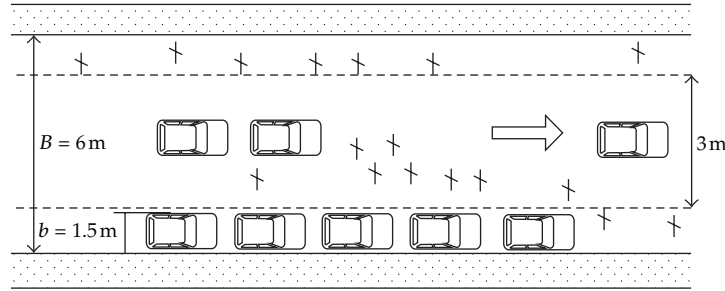
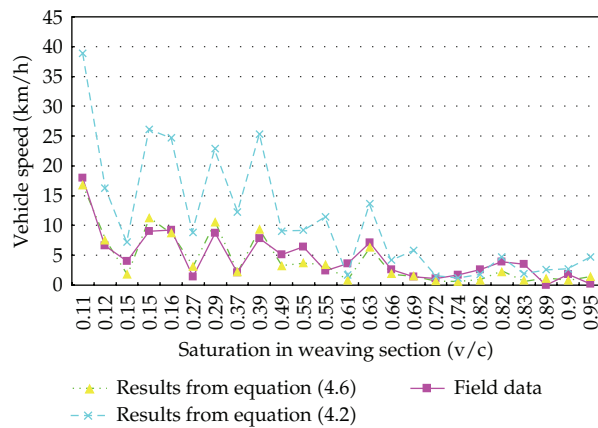**Figure 7:** Sketch map of Beiting Street.

Figure 8: Comparison among calibration results from (5.2), (4.2), and field data.

From the comparisons shown in Figure 8, we can find that the following hold.

(1) As the degree of saturation in the studied segment increases, the motor vehicles' speeds in the weaving section will fluctuate within a certain range, which is more or less related to the stochastic nature of vehicles' maneuvering in or out of parking space. However, the general tendencies of field data and calculation results from (4.2) and (5.2) are all the same, showing that the motor vehicles' speeds decrease with the increase of the degree of saturation when curb parking vehicles exist.

(2) When the saturation of the traffic flow is lower than 0.8, calculation results from (5.2) can preferably reflect the change of the vehicle speed. Meanwhile, the calculation results from (4.2) are much larger than the actual vehicle speed, probably because it does not take into account the impacts of the curb parking space and time influence.

(3) With the further increase of the degree of saturation, differences between the calculated results from (5.2) and the field data become larger, but they are still smaller than the corresponding differences between the calculated results from (4.2) and the field data. Moreover, considering that the average speed of all motor vehicles from (5.2) tends to zero, (5.2) can still reflect the tendency of actual speed.

Table 5: The relative observational data of the Beiting laneway.

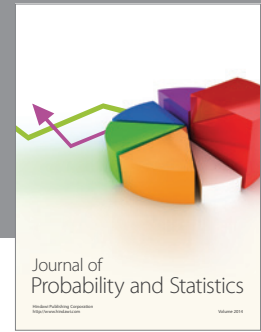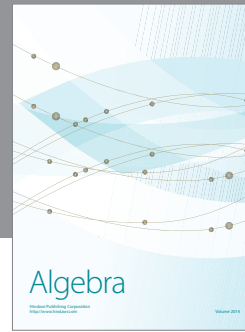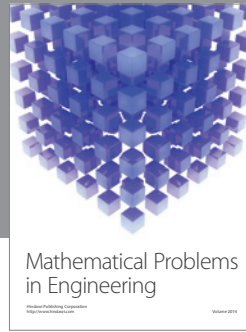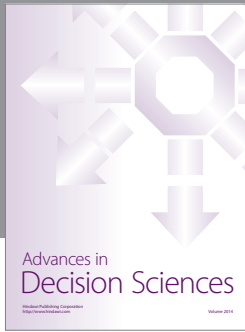| No.	Saturation of the motor vehicles	Saturation of the same direction nonmotorized vehicles	Saturation of the counter direction nonmotorized vehicles	The time influence rate R_T	The observation speed (veh/h)
symbol	q/c	q_b/c_b	q'_b/c'_b	R_T	V
1	0.11	0.29	0.19	0.07	18.03
2	0.12	0.53	0.59	0.01	6.63
3	0.15	0.88	0.23	0.18	3.99
4	0.15	0.22	0.7	0.07	9.05
5	0.16	0.46	0.3	0.13	9.24
6	0.27	0.6	0.86	0.13	1.44
7	0.29	0.48	0.09	0.02	8.77
8	0.37	0.38	0.91	0.21	2.1
9	0.39	0.11	0.3	0.12	7.81
10	0.49	0.49	0.59	0.13	5.17
11	0.55	0.31	0.81	0.1	6.38
12	0.55	0.48	0.14	0.16	2.46
13	0.61	0.84	0.88	0.04	3.58
14	0.63	0.04	0.26	0.01	7.11
15	0.66	0.51	0.86	0.03	2.66
16	0.69	0.44	0.61	0.18	1.4
17	0.72	0.94	0.29	0.03	1.09
18	0.74	0.97	0.38	0.02	1.67
19	0.82	0.66	0.79	0.09	2.63
20	0.82	0.48	0.33	0.02	3.96
21	0.83	0.66	0.75	0.06	3.51
22	0.89	0.59	0.46	0.05	0.05
23	0.9	0.54	0.53	0.16	1.83
24	0.95	0.16	0.52	0.16	0.25

6. Conclusion

In this paper, the influences to the traffic flow from the setting method of curb parking on the roadway are discussed and quantified analysis is made on the time and space influence rate. On the basis of the feasibility of the BPR jam function basic model, the vehicle speed-traffic flow model under the condition of the "Space" and "Time" impacts is established and the model parameters are calibrated by using simple method. For this specific case study, parameters of the one lane one-way and two-way traffic are calibrated using the proposed model, and a comparison is made between the calibration from our model and field data, the results show that our model is both simple and reliable.

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