The categories of NPC vehicles' motions contain: drive forward, change to the left, change to the right, cross, turn left, turn right, stop/park. W_0 represents the initial waypoint and W_f represents the ending waypoint of the NPC vehicle or pedestrian. *POS* is the position and *DIR* is the direction. The starting position and destination of ego vehicle are marked as S and D respectively. i is the ID of the lane of ego vehicle's starting position. L_i represents the lane with ID i, LD_i represents the direction of L_i, and $DR(W_0, W_f)$ represents the direction from the initial waypoint to the ending waypoint. LE_i represents the length of L_i, LT_S represents the lane distance of position S.

Table 1: The modeling for "drive forward"

POS	Trajectory rules
far left	$W_0, W_f \in L_m, L_m \in A(S, lv), sin(LD_i, LD_m) = 1, LT_{w_0} < LT_{w_f} < LE_m$
far right	$W_0, W_f \in L_m, L_m \in A(S, rv), sin(LD_i, LD_m) = -1, LT_{w_0} < LT_{w_f} < LE_m$
other side	$W_0, W_f \in L_m, L_m \in A(S, o), cos(LD_i, LD_m) = 1, LT_{w_0} < LT_{w_f} < LE_m$
front	$W_0, W_f \in L_i, LT_S < LT_{W_0} < LT_{W_f}$
left front	$W_0, W_f \in L_m, L_m \in A(S, lf), LD_i = LD_m, LT_{w_0} < LT_{w_f} < LE_m$
right front	$W_0, W_f \in L_m, L_m \in A(S, rf), LD_i = LD_m, LT_{w_0} < LT_{w_f} < LE_m$

Table 2: The modeling for "change to the left"

POS	Trajectory rules
far left	$W_0 \in L_m, W_f \in L_n, L_m, L_n \in A(S, lv), m \neq n, LT_{W_0} < LT_{W_f}$ $sin(LD_i, LD_m) = sin(LD_i, LD_n) = 1, sin(LD_i, DR(W_0, W_f)) > 0$
far right	$W_0 \in L_m, W_f \in L_n, L_m, L_n \in A(S, rv), m \neq n, LT_{W_0} < LT_{W_f}$ $sin(LD_i, LD_m) = sin(LD_i, LD_n) = 1, sin(LD_i, DR(W_0, W_f)) > 0$
other side	$W_0 \in L_m, W_f \in L_n, L_m, L_n \in A(S, o), m \neq n, LT_{W_0} < LT_{W_f}$ $sin(LD_i, LD_m) = sin(LD_i, LD_n) = 1, sin(LD_i, DR(W_0, W_f)) > 0$
front	$W_0 \in L_i, W_f \in L_n, L_n \in A(S, f), m \neq i$ $LT_{W_0} < LT_{W_f}, sin(LD_i, DR(W_0, W_f)) > 0$
left front	$W_0 \in L_i, W_f \in L_n, L_n \in A(S, lf), m \neq i$ $LT_{W_0} < LT_{W_f}, sin(LD_i, DR(W_0, W_f)) > 0$
right front	$W_0 \in L_i, W_f \in L_n, L_n \in A(S, rf), m \neq i$ $LT_{W_0} < LT_{W_f}, sin(LD_i, DR(W_0, W_f)) > 0$

Table 3: The modeling for "change to the right"

POS	Trajectory rules
far left	$W_0 \in L_m, W_f \in L_n, L_m, L_n \in A(S, lv), m \neq n, LT_{W_0} < LT_{W_f}$ $sin(LD_i, LD_m) = sin(LD_i, LD_n) = 1, sin(LD_i, DR(W_0, W_f)) < 0$
far right	$W_0 \in L_m, W_f \in L_n, L_m, L_n \in A(S, rv), m \neq n, LT_{W_0} < LT_{W_f}$ $sin(LD_i, LD_m) = sin(LD_i, LD_n) = 1, sin(LD_i, DR(W_0, W_f)) < 0$
other side	$W_0 \in L_m, W_f \in L_n, L_m, L_n \in A(S, o), m \neq n, LT_{W_0} < LT_{W_f}$ $sin(LD_i, LD_m) = sin(LD_i, LD_n) = 1, sin(LD_i, DR(W_0, W_f)) < 0$
front	$W_0 \in L_i, W_f \in L_n, L_n \in A(S, f), m \neq i$ $LT_{W_0} < LT_{W_f}, sin(LD_i, DR(W_0, W_f)) < 0$
left front	$W_0 \in L_i, W_f \in L_n, L_n \in A(S, lf), m \neq i$ $LT_{W_0} < LT_{W_f}, sin(LD_i, DR(W_0, W_f)) < 0$
right front	$W_0 \in L_i, W_f \in L_n, L_n \in A(S, rf), m \neq i$ $LT_{W_0} < LT_{W_f}, sin(LD_i, DR(W_0, W_f)) < 0$

The categories of pedestrians' motions contain: walk/run along, walk/run across, wait/stand/look. A[e] represents the edge lane of A.

Table 4: The modeling for "cross"

POS	Trajectory rules
far left	$W_0 \in L_m, L_m \in A(S, lv), sin(LD_i, LD_m) = -1$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = -1$
far right	$W_0 \in L_m, L_m \in A(S, rv), sin(LD_i, LD_m) = 1$ $W_f \in L_n, L_n \in A(S, lv), sin(LD_i, LD_n) = 1$
opposite side	$W_0 \in L_m, L_m \in A(S, o), cos(LD_i, LD_m) = -1$ $W_f \in L_n, L_n \in A(S, lf), cos(LD_i, LD_n) = -1$
front	$W_0 \in L_i, LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, o), sin(LD_i, LD_n) = 0$
left front	$W_0 \in L_m, L_m \in A(S, lf), LD_m = LD_i, LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = 0$
right front	$W_0 \in L_m, L_m \in A(S, rf), LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = 0$

Table 5: The modeling for "turn left"

POS	DIR	Trajectory rules
far left	left	$W_0 \in L_m, L_m \in A(S, lv), sin(LD_i, LD_m) = 1$ $W_f \in L_n, L_n \in A(S, o), LD_n = LD_i$
far right	left	$W_0 \in L_m, L_m \in A(S, rv), sin(LD_i, LD_m) = -1$ $W_f \in L_n, L_n \in A(S, lf), cos(LD_i, LD_n) = -1$
other side	left	$W_0 \in L_m, L_m \in A(S, o), cos(LD_i, LD_m) = -1$ $W_f \in L_n, L_n \in A(S, lv), sin(LD_i, LD_n) = -1$
front	left	$W_0 \in L_i, LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, lv), sin(LD_i, LD_n) = -1$
left front	left	$W_0 \in L_m, L_m \in A(S, lf), LD_m = LD_i, LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, lv), sin(LD_i, LD_n) = -1$
right front	left	$W_0 \in L_m, L_m \in A(S, rf), LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, lv), sin(LD_i, LD_n) = -1$

Table 6: The modeling for "turn right"

POS	DIR	Trajectory rules
far left	right	$W_0 \in L_m, L_m \in A(S, lv), sin(LD_i, LD_m) = 1$ $W_f \in L_n, L_n \in A(S, lf), cos(LD_i, LD_n) = -1$
far right	right	$W_0 \in L_m, L_m \in A(S, rv), sin(LD_i, LD_m) = -1$ $W_f \in L_n, L_n \in A(S, o), LD_n = LD_i$
other side	right	$W_0 \in L_m, L_m \in A(S, o), cos(LD_i, LD_m) = -1$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = 1$
front	right	$W_0 \in L_i, LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = 1$
left front	right	$W_0 \in L_m, L_m \in A(S, lf), LD_m = LD_i, LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = 1$
right front	right	$W_0 \in L_m, L_m \in A(S, rf), LT_{W_0} > LT_S$ $W_f \in L_n, L_n \in A(S, rv), sin(LD_i, LD_n) = 1$

Table 7: The modeling for "stop/park"

POS	Trajectory rules
far left	$W_0 \in L_m, L_m \in A(S, lv), sin(LD_i, LD_m) = -1$ $W_f = W_0, 0 \leq LE_m - LT_{W_0} \leq 10$
far right	$W_0 \in L_m, L_m \in A(S, lv), sin(LD_i, LD_m) = 1$ $W_f = W_0, 0 \leq LE_m - LT_{W_0} \leq 10$
other side	$W_0 \in L_m, L_m \in A(S, o), cos(LD_i, LD_m) = -1$ $W_f = W_0, 0 \leq LE_m - LT_{W_0} \leq 10$
front	$W_0 \in L_m, L_m \in A(S, f), cos(LD_i, LD_m) = 1$ $W_f = W_0, 0 \leq LE_m - LT_{W_0} \leq 10$
left front	$W_0 \in L_m, L_m \in A(S, lf), cos(LD_i, LD_m) = 1$ $W_f = W_0, 0 \leq LE_m - LT_{W_0} \leq 10$
right front	$W_0 \in L_m, L_m \in A(S, rf), cos(LD_i, LD_m) = 1$ $W_f = W_0, 0 \leq LE_m - LT_{W_0} \leq 10$

Table 8: The modeling for "walk/run along"

POS	Trajectory rules
far left	$W_0 \in L_m, L_m \in A(S, lv)[e], sin(L_m, L_n) = -1, cos(L_n, L_i) = -1$ $W_f \in L_n, L_n \in L_m \cup A(S, o)[e]$
far right	$W_0 \in L_m, L_m \in A(S, rv)[e], cos(L_m, L_n) = 0$ $W_f \in L_n, L_n \in L_m \cup A(S, o)[e] \cup A(S, rf)[e]$
other side	$W_0 \in L_m, L_m \in A(S, o)[e], sin(L_n, L_m) = 1 \cup 0$ $W_f \in L_n, L_n \in A(S, rv)[e] \cup L_m$
left front	$W_0 \in L_m, L_m \in A(S, lf)[e], W_f \in L_n, L_n \in A(S, lf)[e]$ $LT_{W_f} > LT_{W_0} > LT_S$
right front	$W_0 \in L_m, L_m \in A(S, rf)[e], W_f \in L_n, L_n \in A(S, rf)[e]$ $LT_{W_f} > LT_{W_0} > LT_S$

Table 9: The modeling for "walk/run across"

POS	DIR	Trajectory rules
far left	right	$W_0 \in L_m, L_m \in A(S, lv)[e], W_f \in L_n, L_n \in A(S, rv)[e]$ $cos(L_m, L_n) = 1, LT_{W_f} - LT_{W_0} < LE_m/2$
	other side	$W_0 \in L_m, L_m \in A(S, lv)[e], W_f \in L_n, L_n \in A(S, lv)[e]$ $cos(L_m, L_n) = -1, LT_{W_f} + LT_{W_0} = LE_m$
far right	left	$W_0 \in L_m, L_m \in A(S, rv)[e], W_f \in L_n, L_n \in A(S, lv)[e]$ $cos(L_m, L_n) = 1, LT_{W_f} - LT_{W_0} < LE_m/2$
	other side	$W_0 \in L_m, L_m \in A(S, rv)[e], W_f \in L_n, L_n \in A(S, rv)[e]$ $cos(L_m, L_n) = -1, LT_{W_f} + LT_{W_0} = LE_m$
other side		$W_0 \in L_m, L_m \in A(S, o)[e], W_f \in L_n, cos(L_m, L_n) = 1$ $L_n \in A(S, lf) \cup A(S, rf)[e], LT_{W_f} - LT_{W_0} < LE_m/2$
left front		$W_0 \in L_m, L_m \in A(S, lf)[e], W_f \in L_n, L_n \in A(S, rf)[e]$ $LT_{W_f} > LT_S, LT_{W_f} + LT_{W_0} = LE_m$
right front		$W_0 \in L_m, L_m \in A(S, rf)[e], W_f \in L_n, L_n \in A(S, lf)[e]$ $LT_{W_0} > LT_S, LT_{W_f} + LT_{W_0} = LE_m$

Table 10: The modeling for "wait/look/stand"

POS	Trajectory rules
far left	$W_0 \in L_m, L_m \in A(S, lv)[e], sin(L_m, L_i) = -1 \Rightarrow LT_{W_0} < 10$ $L\_n = L\_m, sin(L\_m, L\_i) = 1 \backslash Rightarrow LE\_m - LT\_\{W\_0\} < 10\$$
far right	$W_0 \in L_m, L_m \in A(S, rv)[e], sin(L_m, L_i) = 1 \Rightarrow LT_{W_0} < 10$ $L\_n = L\_m, sin(L\_m, L\_i) = -1 \backslash Rightarrow LE\_m - LT\_\{W\_0\} < 10\$$
other side	$W_0 \in L_m, L_m \in A(S, o)[e], cos(L_m, L_i) = 1, LT_{W_0} < 10, L_n = L_m$
left front	$W_0 \in L_m, L_m \in A(S, lf)[e], cos(L_m, L_i) = -1, LT_{W_0} < 10, L_n = L_m$
right front	$W_0 \in L_m, L_m \in A(S, lf)[e], cos(L_m, L_i) = 1, LE_i - LT_{W_0} < 10, L_n = L_m$