1 Constraints of Participant Behaviors

(1) The constraints for "park":
$c_1 : pos_p^{init} = pos_p^{dest}, pos_p^{init} \in ap$
(2) The constraints for "retrograde":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = -1$
(3) The constraints for "follow vehicle":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = 1$
$c_3 : road(pos_p^{init}, pos_p^{dest}) = 1$
$c_4 : lane(pos_p^{init}, pos_p^{dest}) = 1$
$c_5 : lane(pos_p^a, pos_o^a) = 1,\ pos_a \in ap \wedge a \in (e_{ga}, e_{la})$
$c_6 : lane(pos_p^m, pos_o^m) = 1, m \in (e_{ga}, e_{la})$
$c_7 : forward(pos_p^a, pos_o^a) = 1$
$c_8 : forward(pos_p^m, pos_o^m) = 1$
(4) The constraints for "follow lane":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = 1$
$c_3 : road(pos_p^{init}, pos_p^{dest}) = 1$
$c_4 : lane(pos_p^{init}, pos_p^{dest}) = 1$
$c_5 : car\_forward(p) = 0$
(5) The constraints for "cut in":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = 1$
$c_3 : road(pos_p^{init}, pos_p^{dest}) = 1$
$c_4 : lane(pos_p^{init}, pos_p^{dest}) = -1$
$c_5 : lane(pos_p^a, pos_o^a) = -1,\ pos_p^a \in ap \wedge a \in (e_{ga}, e_{la})$
$c_6 : lane(pos_p^m, pos_o^m) = 1,\ m \in (e_{ga}, e_{la})$
$c_7 : forward(pos_p^a, pos_o^a) = -1$
(6) The constraints for "change lane":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = 1$
$c_3 : road(pos_p^{init}, pos_p^{dest}) = 1$
$c_4 : lane(pos_p^{init}, pos_p^{dest}) = -1$
$c_5 : lane(pos_p^a, pos_o^a) = -1,\ pos_p^a \in ap \wedge a \in (e_{ga}, e_{la})$
$c_6 : lane(pos_p^m, pos_o^m) = 1,\ m \in (e_{ga}, e_{la})$
$c_7 : forward(pos_p^a, pos_o^a) = 1$
(7) The constraints for "vehicle cross":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = 1$
$c_3 : road(pos_p^{init}, pos_p^{dest}) = -1$
$c_4 : road\_parallel(road_p^{init}, road_p^{dest}) = 1$
(8) The constraints for "turn around":
$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$
$c_2 : forward(pos_p^{init}, pos_p^{dest}) = 1$
$c_3 : road(pos_p^{init}, pos_p^{dest}) = -1$

$c_4 : road\_parallel(road_p^{init}, road_p^{dest}) = -1$

(9) The constraints for "pedestrian walk":

$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$

$c_2 : road(pos_p^{init}, pos_p^{dest}) = 1$

$c_3 : spd_p \in [0, spd_{max}]$

(10) The constraints for "pedestrian cross":

$c_1 : pos_p^{init} \notin ap \wedge pos_p^{dest} \in ap$

$c_2 : road(pos_p^{init}, pos_p^{dest}) = -1$

$c_3 : spd_p \in [0, spd_{max}]$

Common constraints: Besides these constraints for each behavior, there are some common constraints for all behaviors (except "brake") to compute the intermediate waypoints.

$cc_1 : dist(pos_p^t, pos_p^{t+\Delta t}) = \frac{spd_p^t + spd_p^{t+\Delta t}}{2} \times \Delta t, spd_p^{t+\Delta t} \leq spd_p^t + ac_{max} \times \Delta t$

$cc_2 : \sum_{t=p^{init}}^{p^{dest}-\Delta t} dist(pos_p^t, pos_p^{t+\Delta t}) = dist(pos_p^{init}, pos_p^{dest})$

$cc_3 : e_{ga} < dest \leq e_{la}$