Homework/Project 7: Decision Making and Collision Avoidance

Due Date and Place: Please check the syllabus and Carmen for submission deadline (online submission in Carmen)

Philosophy: Learning by doing, also called experiential learning, is a proven and effective method of teaching. It is expected that students taking the course will understand implementation of decision making in the form of Finite State Machines (FSM) and collision avoidance. They will be manipulating the given Simulink models and using state flow charts for designing and testing an Automatic Emergency Braking System (AEBS).

Related Unit: Units 7 & 9

Homework/Project Aims: The aims are to apply the methods learned in Units 7 & 9 on Decision Making and Collision Avoidance, to construct a finite state machine using a stateflow chart and a simulation study on implementation of a simple Automatic Emergency Brake System. Model data to be used is provided.

Project Background: You will be using your Simulink model which identifies obstacles and implement the Stateflow chart that implements an emergency braking system. You can later change the decision making to include smooth velocity transitions during state changes and add additional meta states for more robust state transition diagrams.

Format: Prepare your report using powerpoint. You should have a cover page and a final page. Please use the provided template. Convert your powerpoint report to pdf before submitting online. Cut and paste any Simulink diagrams and Matlab script into your report. Submit the pdf version of your report in Carmen.

Software: Matlab and Simulink will be used in this homework assignment.

Homework/Project Statement:

Consider the given Simulink Automatic Emergency Braking model of a mid-sized passenger vehicle. The following files/data are provided for the simulation:

- AEB_decision.slx – Includes the model with a lead car and obstacle present, along with decision making for Automatic Emergency braking.
- All vehicle parameters have been provided within the Simulink model in parameter assignments. Please contact your TA for any clarification of parameter/values you may need.

Decision Making in Automatic Emergency Braking:

Consider the model given above which has a simple upper level model of the ego vehicle (host vehicle) with a longitudinal velocity controller (PID). The host vehicle starts from zero position and zero velocity. The controller tracks the set_point velocity (ego_velocity_set_point). There is a lead car block which starts 300 m ahead of the host vehicle with an initial velocity of 5 m/s. A sine wave acceleration input is given for the lead vehicle. A simple detection methodology is used, which takes the relative distance between the ego vehicle and the closest vehicle/obstacle within

190 m range (sensor range). There is also a static obstacle that is introduced after a particular time to simulate emergency condition.

- Complete the state-flow chart in the Simulink model for the decision making. The logic is given in the flowchart below. All the variables, including input and output have already been created in the Stateflow chart.
- Plot the variables in the Chart Out scope & Ego Scope in the model and provide your comments.

Note: You don't have to change any other input parameters for the simulations (initial position & velocity or the PID gains etc.)