Vehicle Model Exercise

Vehicle Dynamics, Planning and Control of Robotic Cars

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Assignment

In this exercise, you are going to apply the theory about the double track model. You are supposed to attach the solution of the following homework in the final report that you are going to deliver a few days before the oral exam.

Exercises

Exercise 1 - Vehicle model implementation

You are provided with a MATLAB & SIMULINK simulation environment, with a partially implemented double track (7 DoF) vehicle model.
The `Vehicle Model` block in SIMULINK has some missing parts that you have to write (calculation of the axle forces and derivatives of the main states of the model). Use the slides of the course to complete the model.
Once your SIMULINK model is fully written, launch the following script:
`mainVehicleModel_2Track.m`
This script enables you to load the vehicle parameters, define the initial conditions for the model states and the simulation timing. It also implements a basic post - processing to display the simulation results.
To assess the behavior of the vehicle model, simulate the following maneuvers:

1. initial conditions: $u_0 = 30$ km/h
   simulation timing: $T_s = 0.001$ s, $T_f = 20$ s
   requested pedal: req_pedal = 1
   requested steering wheel angle: req_steer = 0 deg.

2. initial conditions: $u_0 = 100$ km/h
   simulation timing: $T_s = 0.001$ s, $T_f = 1.5$ s
   requested pedal: req_pedal = -1
   requested steering wheel angle: req_steer = 0 deg.

3. initial conditions: $u_0 = 50$ km/h
   simulation timing: $T_s = 0.001$ s, $T_f = 20$ s
   requested pedal: req_pedal = 0.5
   requested steering wheel angle: req_steer = 20 deg.

For each maneuver, plot and comment the main results that you obtain, particularly focusing on tire forces and moments ($\{F_x, F_y, F_z, M_z\}$) and tire slips ($\{\kappa, \alpha\}$).