Control and Perception in
Networked and Autonomous Vehicles
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Informatik 11
Embedded Software

RWTH AACHEN UNIVERSITY

Lab 5: Centralized Platoon Control 2

Exercise 1. (*Centralized platoon control*)
Your goal in this exercise is to realize a platoon using centralized model predictive control (CMPC). Use the folder `TEAMREPO/+cmpc` for this exercise.

a) Control vehicles to drive in a platoon using CMPC. Assume that vehicles in the platoon are ordered descending by their ID, i.e., the vehicle with the highest ID is in the front. Maintain a constant reference distance d_{ref} between the center of gravitys of consecutive vehicles of

$$d_{\text{ref}} = 0.5\,\text{m}. \tag{1}$$

Apply the following constraints on the input and output:

$$
\begin{aligned}
d_{\text{min}} = 0.3\,\text{m} \qquad v_{\text{min}} &= 0\,\text{m/s} \qquad a_{\text{min}} = -1\,\text{m/s}^2 \\
v_{\text{max}} &= 1.5\,\text{m/s} \qquad a_{\text{max}} = 0.5\,\text{m/s}^2
\end{aligned} \tag{2}
$$

b) Evaluate the CMPC developed in a) using the following scenario:
Vehicles with IDs 1, 2, 3, 5 and 7 form a platoon. Vehicle 7 is the leading vehicle, while the others follow in descending order. The vehicles' poses at $t = 0$ are given by the poses in which the vehicles are when they are newly simulated. Use the reference distance and the constraints you previously implemented. The platoon should follow the speed profile given by

$$
v_{\text{ref}} = \begin{cases}
0.5\,\text{m/s}, & 0\,\text{s} \leq t < 15\,\text{s} \\
1.4\,\text{m/s}, & 15\,\text{s} \leq t < 25\,\text{s} \\
0.8\,\text{m/s}, & 25\,\text{s} \leq t < 35\,\text{s} \\
0.0\,\text{m/s}, & 35\,\text{s} \leq t.
\end{cases} \tag{3}
$$

Stop the experiment at $t = 40\,\text{s}$. Examine the controller's performance with plots of the inter-vehicle distances, the velocities and accelerations. Generate relevant plots after an experiment with `plot_platooning`.

Checkpoint 1

Get a tutor to check your work. You should be able to

- control a platoon using CMPC

- present the plots from `plot_platooning`