Flatness-Based Control: Kinematic Car

Tutorial 1: simulating the car

D. Kastelan
d.kastelan@lsr.uni-saarland.de
Chair of Systems Theory and Control Engineering
Saarland University

Overview

The goal of these tutorials is to implement a few flatness-based controllers for a model of the kinematic car in simulation (cf. lecture notes §1.2–1.3, eq. (1.4)). The car should track a trajectory that realizes setpoint changes in the car's position and orientation. The building blocks needed for implementation are sketched in Figure 1.

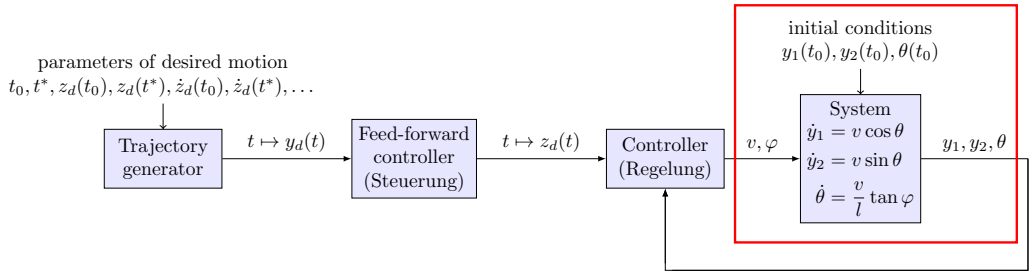

Figure 1: Sketch of flatness-based control in block diagram form for kinematic car model. The system variables are collected in $z = (y_1, y_2, \theta, v, \varphi)$. The focus of Tutorial 1 is contained in the red box.

Tasks

1. Implement the function `carref` to provide your car with a reference input (v, φ).
2. Implement the kinematic car system equations in function `carODE` and call the ODE Solver to return the system variables with a sampling rate of `dt=1/20` seconds.
3. Plot system variables as a function of time (don't forget your axis labels and units!)
4. Animate the car motion using the provided function `KinematicCarAnimate`.
5. Interpret your results. Is the motion as you expect?