Robotics, Lab assignment 2

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Due on: 12-1-2025, 23:59:59

Introduction

The objective of the lab is to show how a functionality nowadays present is modern cars can be approached using the kinematics, dynamics, and control concepts studied in the theory classes.

Consider a car moving (i.e., being driven by a human) in a highway, where each lane is duly delimited by white lines. Ideally, the car must stay in the middle of a lane, except when overtaking other cars/obstacles. For the purpose of this lab assume that no other cars or obstacles are present in the highway.

The goal of a LTA system is to re-orient the car to stay in the lane in case the driver lets it cross any of the white/yellow lines bounding the lane. Whenever the system senses that the car is about to cross the bounding lines it forces the steering wheel to keep the car inside the lane. There is an extensive online documentation on LTA systems developed by several manufacturers, youtube videos, etc.

In this lab a LTA is to be simulated, using the ideas discussed in the theory classes.

Either Matlab or Python can be used to solve the computational tasks.

Tasks

Task 1 – Develop a joystick like function, i.e., using 2 keys in the computer keyboard (or a gaming pad) to steer right/left a simulated car. There are multiple Python libraries available online that can be used.

Task 2 – Develop a model for the car using the principles discussed in the theory classes. A kinematic model is enough for the purpose of the lab, though obtaining a realistic behaviour requires, in general, a dynamics model.

Task 3 – Show that, with the joystick-controlled steering, a simulated car can indeed stay within the lines of a road lane, i.e., develop a simulation environment with a road lane and show that just by using the joystick you can keep the car within the lane limits.

Task 4 – Using the simulation environment developed in task 3, plot the detection of the lane's left and right white lines as a function of time.

Task 5 – Develop a controller for LTA that can be integrated in the architecture developed in task 3. Carefully, explain how the LTA developed works. Use whatever tools/methods are available to show the LTA effectiveness

Task 6 – Using mathematical arguments demonstrate the effectiveness of the proposed LTA.

Task 7 – Show that the LTA system works, i.e., show, through simulation experimentation, that it can correct for small steering errors made by a human using the joystick.

Deliverables

- Report detailing the techniques used and results obtained. The role of each author must be explicitly stated in the report.

- All the software produced, including comprehensible instructions to allow anyone to install and run it.