Estimation for control – Practical Assignment 3
Nonlinear model, state-feedback control, observer design

Logistics

- This practical assignment should be carried out by a group of maximum two students.
- The assignment solution consists of Matlab code and Simulink model. This code will be checked and run by the teacher during the lab class, and your attendance to the lab will only be registered if you have a working, original solution. Validated attendances for all the labs are necessary for eligibility to the exam. Moreover, at most two labs can be recovered at the end of the semester, which means accumulating three or more missing labs at any point during the semester automatically leads to final ineligibility.
- Discussing ideas among students is encouraged; however, directly sharing and borrowing pieces of code is forbidden, and any violation of this rule will lead to disqualification of the solution.

Prerequisite:

- A nonlinear model, with state vector $x = [x_1,\ x_2, ...x_n]^T$, and input vector $u = [u_1,\ u_2, ...u_m]^T$ where $n \geq 3$, is the number of state variables, $m \geq 1$, is the number of inputs, and the dynamic equation has the form:
$$\dot{x} = f(x, u).$$
- A linear model in classical state space form, linearized around an equilibrium point
- A state feedback control law, which brings to system to 0 from a non-zero initial condition
- An observer, designed for the linear model, implemented in Simulink

Assignment description

In this assignment you need to extend the previously obtained results for the nonlinear system. Both control and observer was computed for the linear case and it is working properly, but your system is nonlinear and we want to see if it is still working when the nonlinear model is considered.

Requirements:

- Add the control law to your nonlinear model, and simulate it with close-to-zero initial conditions. What do you expect? Is it working properly?
- Add the observer to your nonlinear model. Give a different initial condition for the observer, and simulate it. Is it working as it was expected? Is the error converging to 0?
- Compare the results obtained with the linear model. Is it the same? What is the difference?
- Do the simulation again with far-from-zero initial conditions. Is it working the same way as previously?