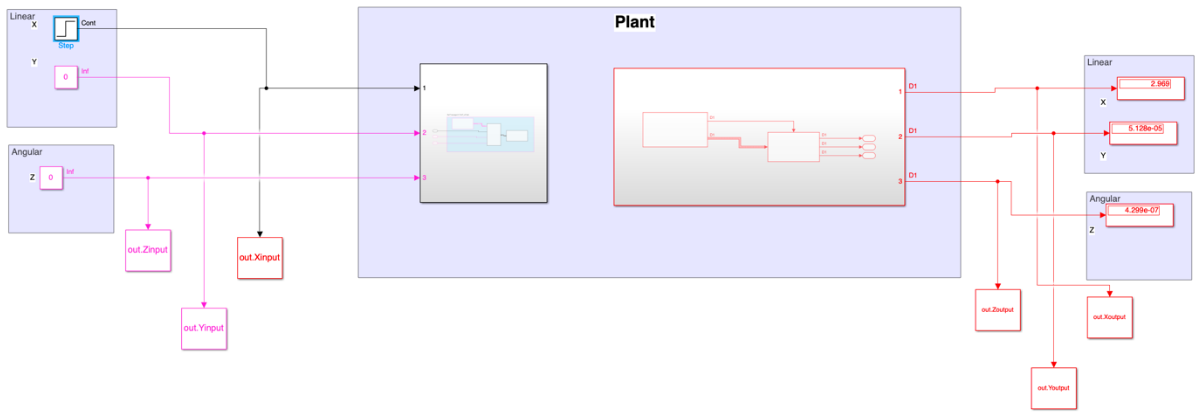
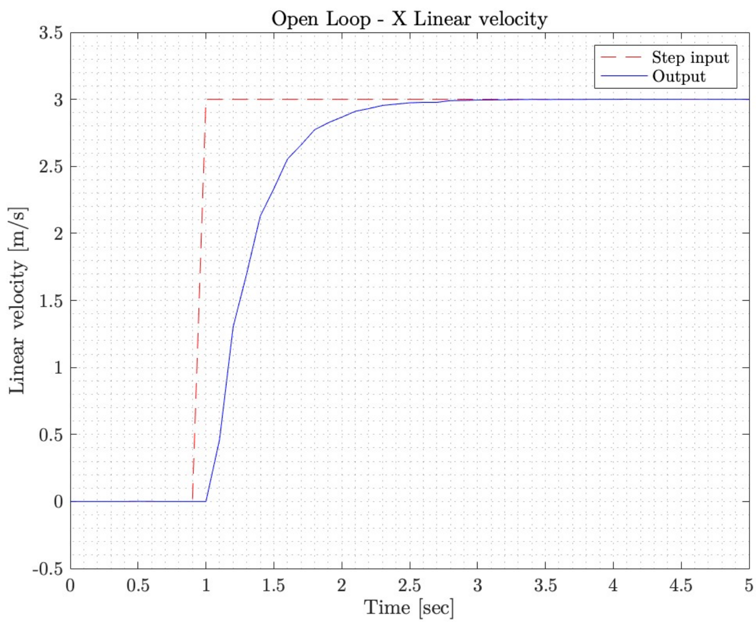
Lab Report

08.06.2023

Open loop - Velocity command input

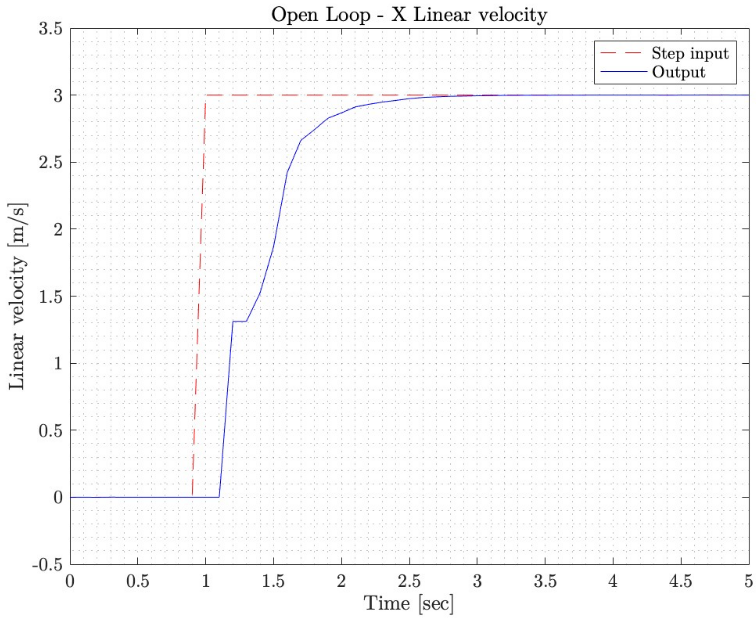


This is an open loop Block diagram for velocity command.
Below the results for step input with amplitude of 1 $\left[\frac{m}{s}\right]$. For each simulation, I got mor or less the same results. However, the responses weren't always smooth.

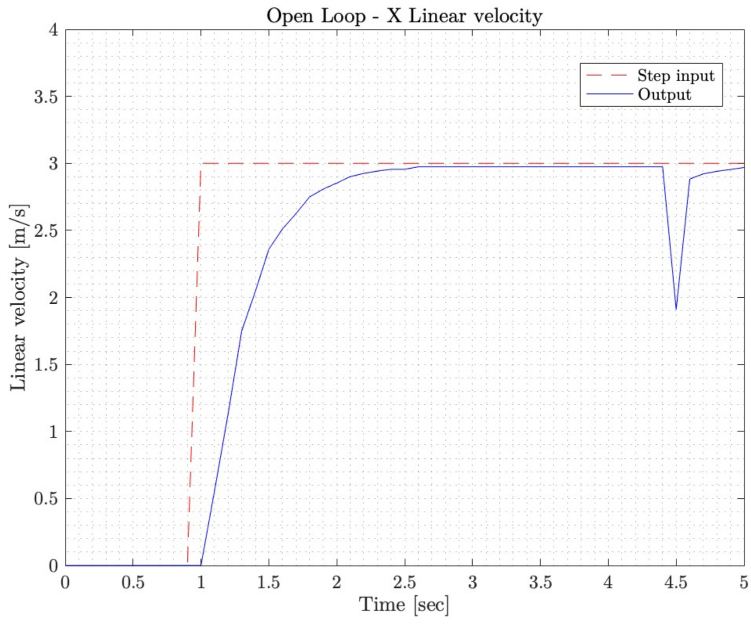


Simulation #1

This is the smoothest response that I got.
From what I remember from Dynamical systems and Control theory courses, we can **retrieve the transfer function** of the plant from the response and compare it with the real plant. As we can see this is a first order transfer function.



Simulation #2



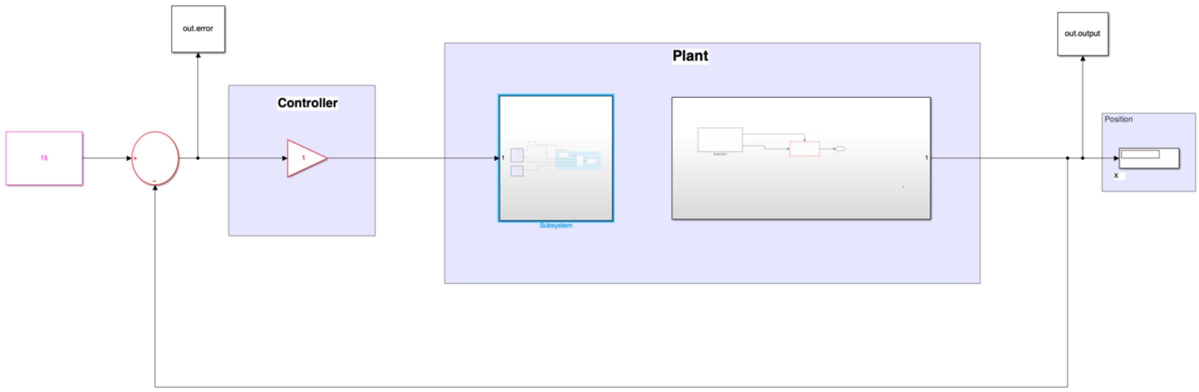
Simulation #3

As you can see from those two simulations, the response is the same (still need to calculate important **parameters** such as: rise time, settling time, etc…). However, the responses are not smooth as the first simulation.

Need to find why we have differences with simulations.

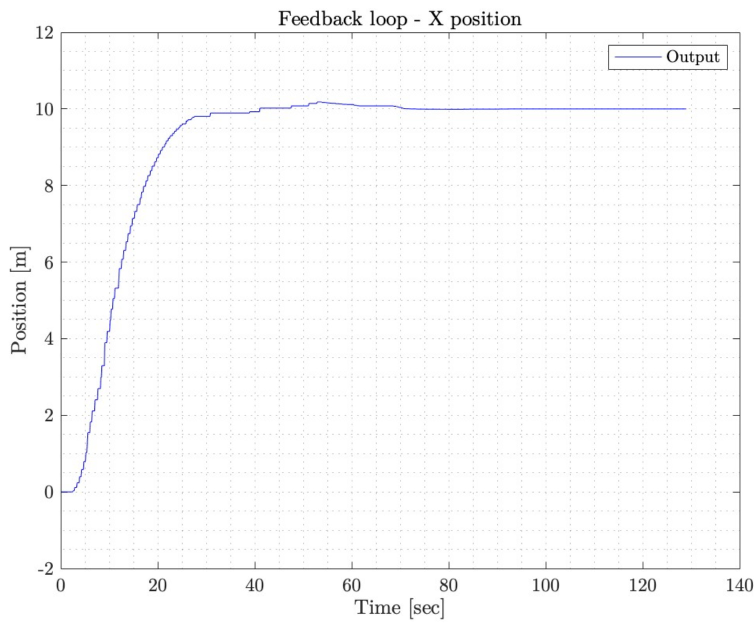
Note: With a real robot, we would have the same response each time, the non-smoothness responses are related to the <u>simulations</u> only

Feedback loop – X position



This is a simple Closed loop Block diagram for X position by controlling the linear speed of the robot in the X direction.
Here in this example, we want to make the robot go from the origin to $x = 15\ [m]\ , y = 0\ [m]$.
For the first simulations, I only implement a Proportional gain with $K = 1$.

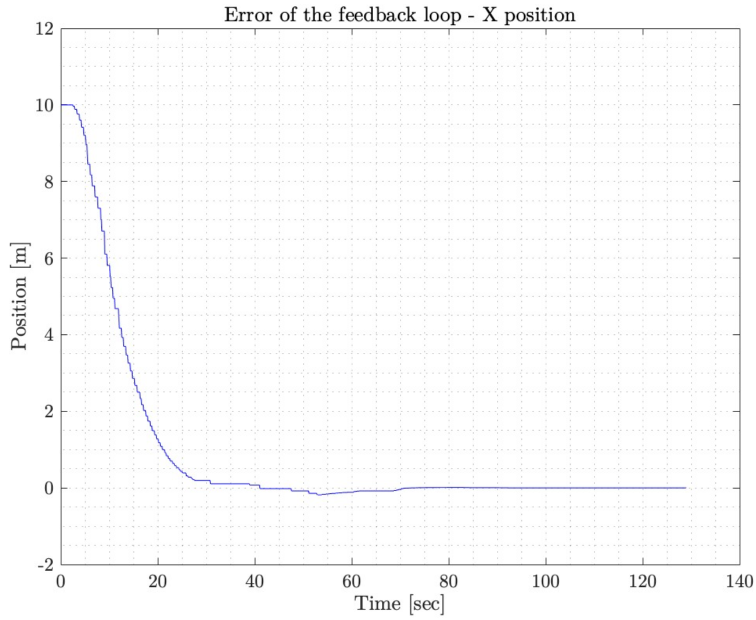
As previous, I got various non-smooth responses (in the simulation only). However, at the end, the robot gets to the exact reference input every time **(zero steady state error).** (See attached video in the mail)



Simulation #1

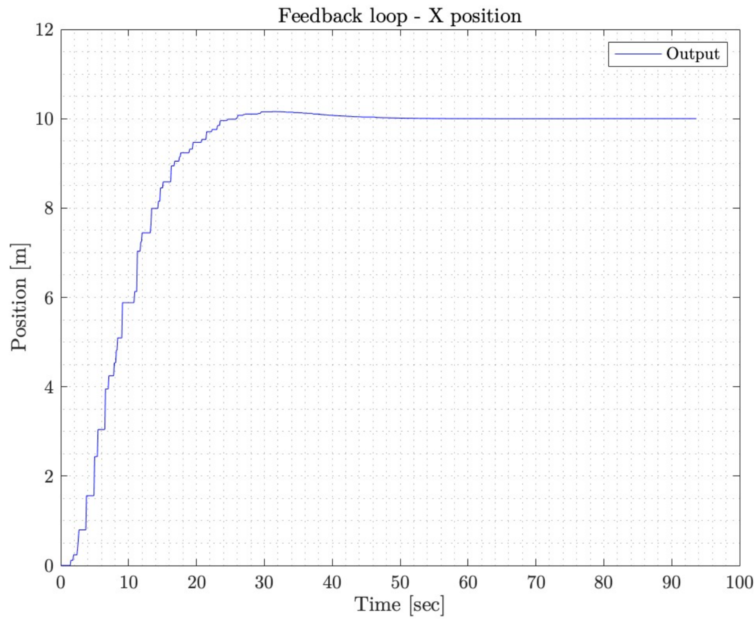
This is the best response I got from the simulations. We can see that we have a tiny overshoot in the response.

Note: For some reason, it says that it took 70 $[sec]$ to the robot to get to steady state position. In reality (see video attached), it only took a few seconds to the robot.



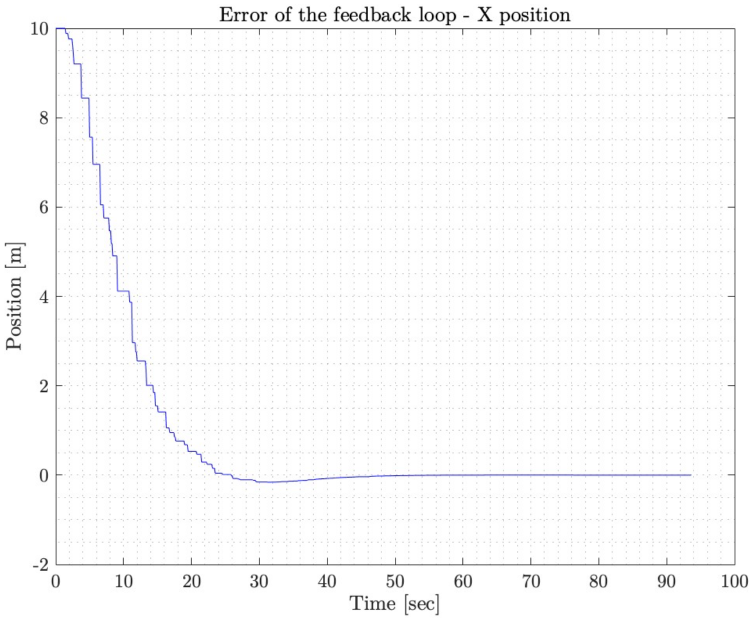
Simulation #1

This is the plot of the error from the Simulation #1. As you can see, we indeed get to zero error at steady state.



Simulation #2

As previous, we have more or less the same steady state response. However, the rise phase is jerky.
I think that even with such non-smoothness, we can retrieve the second order transfer function from the response.



Simulation #2

As previous, we also have zero steady state error.