Control Challenges: Solutions

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Table of contents

# 1. Introduction

## 1.1 What is this?

This is a collection of write ups on how to solve the various problems presented by [Github user](https://janismac.github.io/ControlChallenges/) “Janismac”.

# 2. Block With Friction

## 2.1 State Space representation

We can convert the set of ODE into a state space representation. The final bode plot of the block position is: [Figure 2.1](#fig-bode)

|  |
| --- |
| Figure 2.1: Starting Bode Plot |

It has the shape we expect from a motor + friction. Slow pole for the mass + friction and a faster pole for the current & inductance.

Numerically they are:

|  |  |  |
| --- | --- | --- |
| |  | | --- | | 3-element Vector{Float64}:  -20.0  -1.0  0.0  (a) Starting PZ map |  |  | | --- | | (b) |   Figure 2.2 |

In [Figure 2.2](#fig-pzmap) we see that we start with all the pole in the left-half plane, which is good.

## 2.2 Pole Placement

We can design a controller with pole placement.

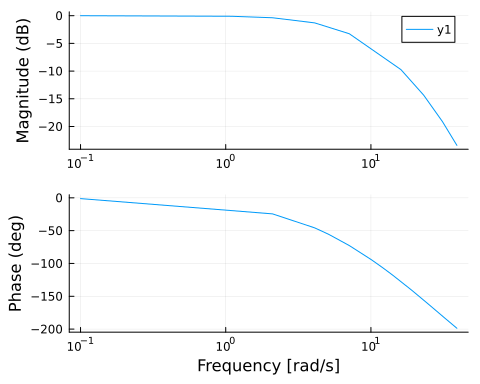
For some reason pole placement doesn’t work for the observer, I use a Kalman Filter with random fast values.

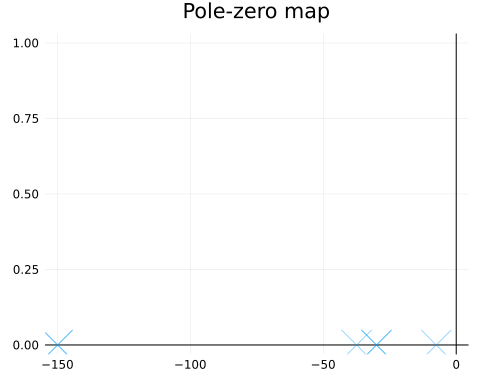
(isobservable = true, ranks = [3, 3, 3], sigma\_min = [0.05255163155979671, 1.0000000000000002, 1.0])(iscontrollable = true, ranks = [3, 3, 3], sigma\_min = [18.82217025796643, 0.7247734159618929, 0.46815777001494974])

┌ Warning: Max iterations reached  
└ @ ControlSystemsBase C:\Users\icpmoles\.julia\packages\ControlSystemsBase\IeuPW\src\synthesis.jl:310

We can check the effect of the new controller on the loop

ComplexF64[-150.09999999999997 + 0.0im, -149.89999999999995 + 0.0im, -7.500000000000134 + 0.0im, -29.979999999868912 + 0.0im, -30.020000000130636 + 0.0im, -37.50000000000044 + 0.0im]



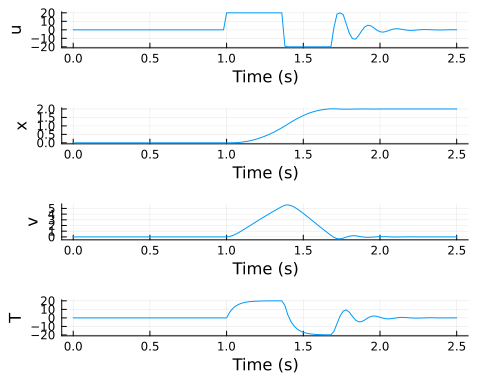


From what I understand we are interested in the dotted line in the bottom right. See how flat it is.

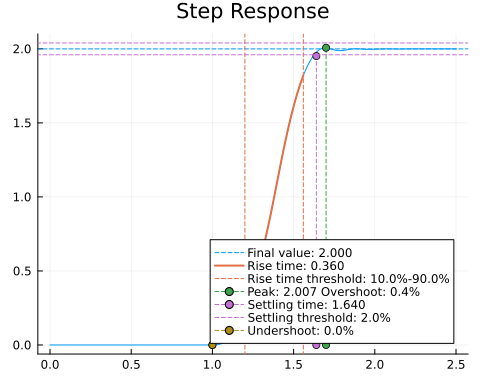
We can convert it to the standard PD gain form.

## 2.3 Simulation

We can simulate this with a motor that only outputs the position:

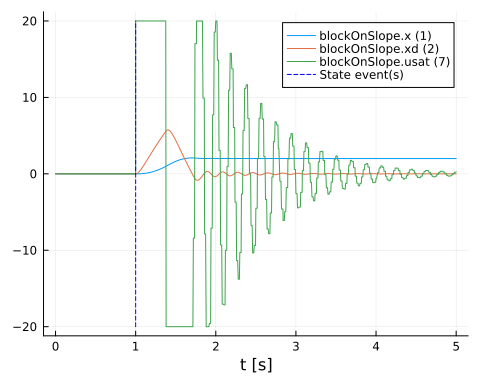


For more stats:



We can also simulate it in a SIMULINK-like environment:

Simulating ME-FMU ... 0%|█ | ETA: N/ASimulating ME-FMU ... 100%|██████████████████████████████| Time: 0:00:11



There is a slight difference between the lsim simulation and the FMU simulation. I need to recheck some stuff.