Control Challenges: Solutions

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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 "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

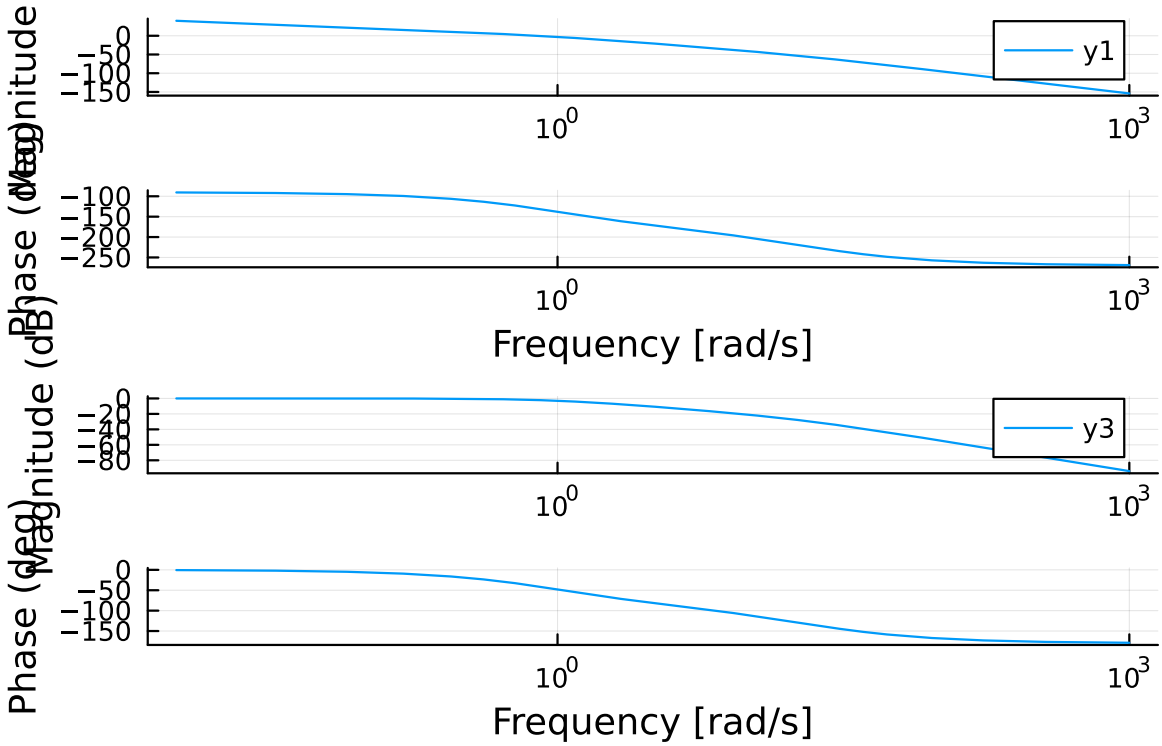


Figure 2.1: Starting Bode Plot

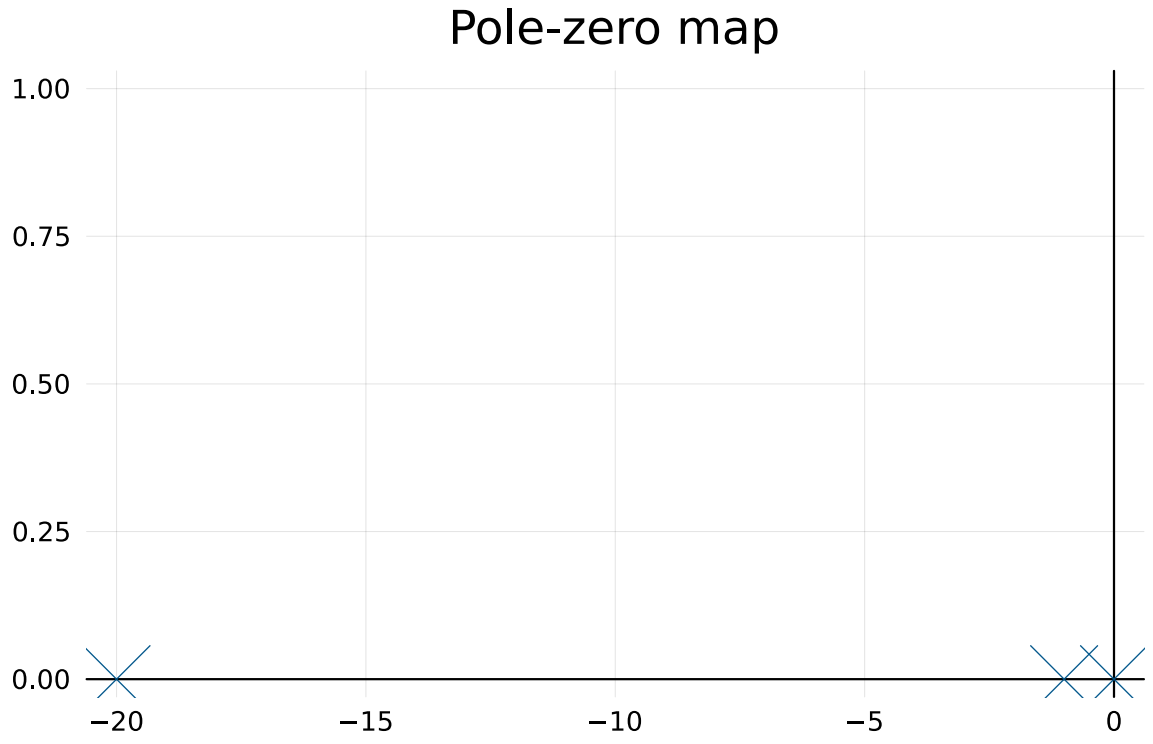
It has the shape we expect from a motor + friction. Slow pole for the mass + friction and a faster pole for the current & inductance.

Numerically they are:

In Figure 2.2 we see that we start with all the pole in the left-half plane, which is good.

```
3-element Vector{Float64}:
 -20.0
  -1.0
   0.0
```

(a) Starting PZ map



(b)

Figure 2.2

2.2 Pole Placement

We can design a controller with pole placement.

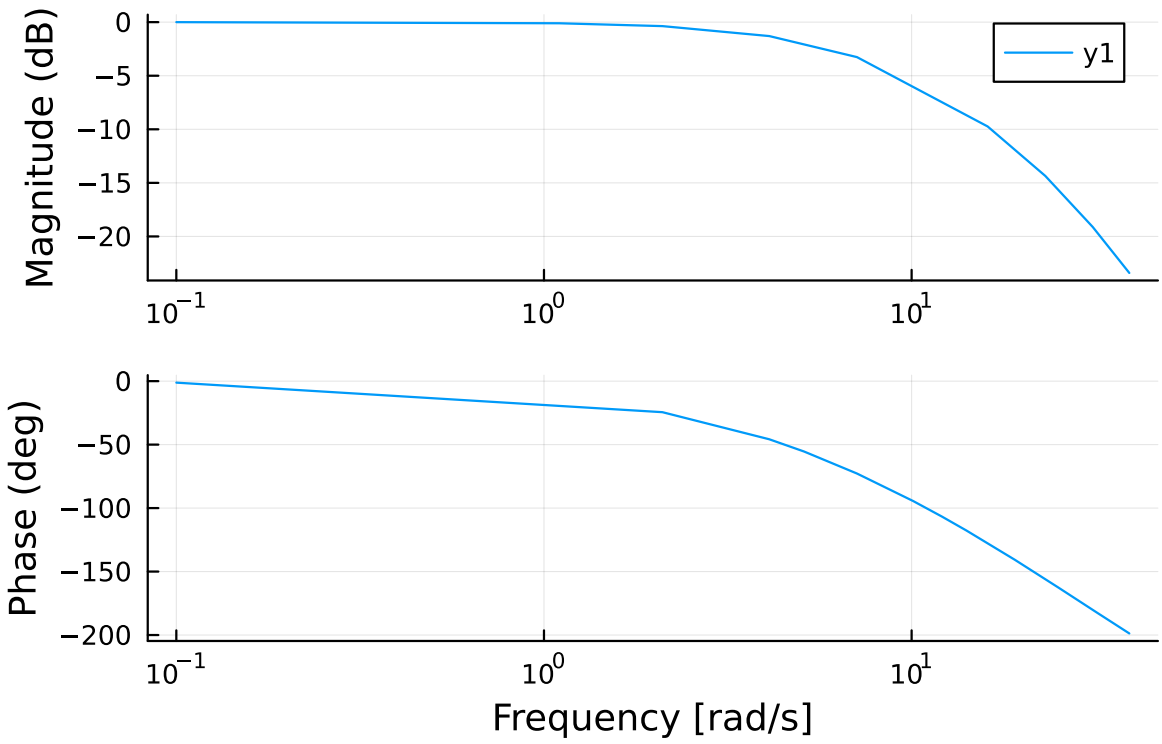
For some reason pole placement doesn't work for the observer, I use a Kalman Filter with random fast values.

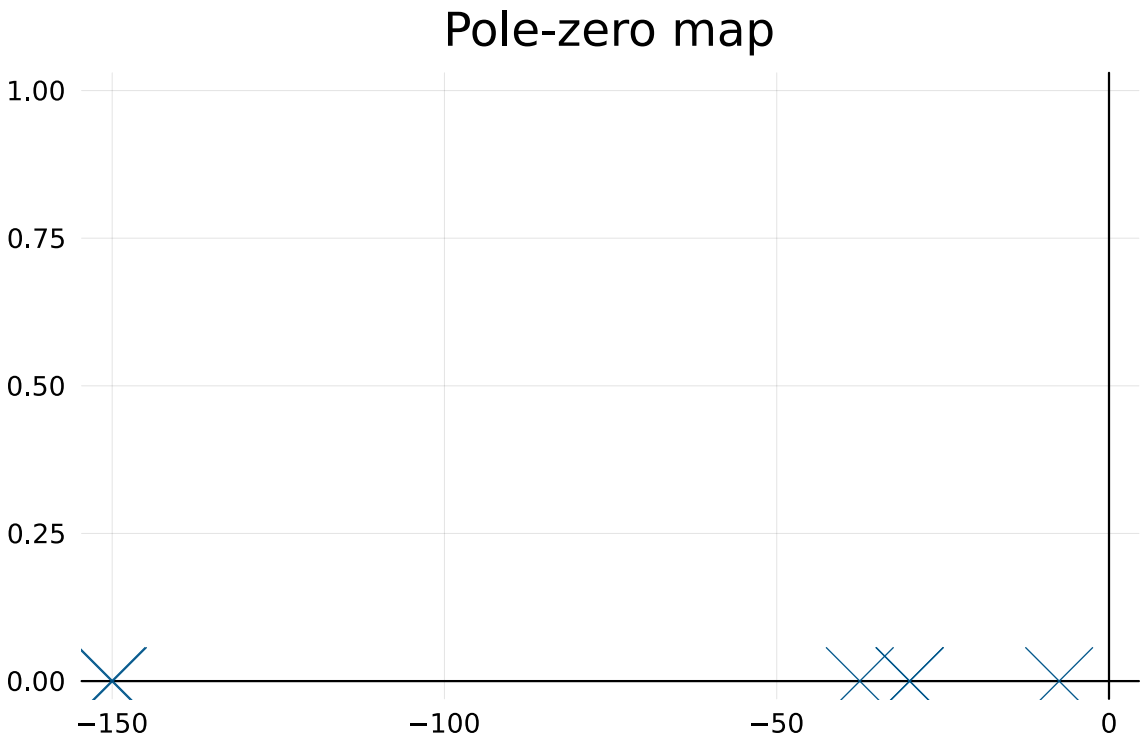
```
(isobservable = true, ranks = [3, 3, 3], sigma_min = [0.05255163155979671, 1.000000000000000
```

```
  Warning: Max iterations reached
  @ ControlSystemsBase C:\Users\icpmoles\.julia\packages\ControlSystemsBase\IeuPW\src\synthes
```

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

```
ComplexF64[-150.09999999999997 + 0.0im, -149.89999999999995 + 0.0im, -7.500000000000134 + 0.0
```



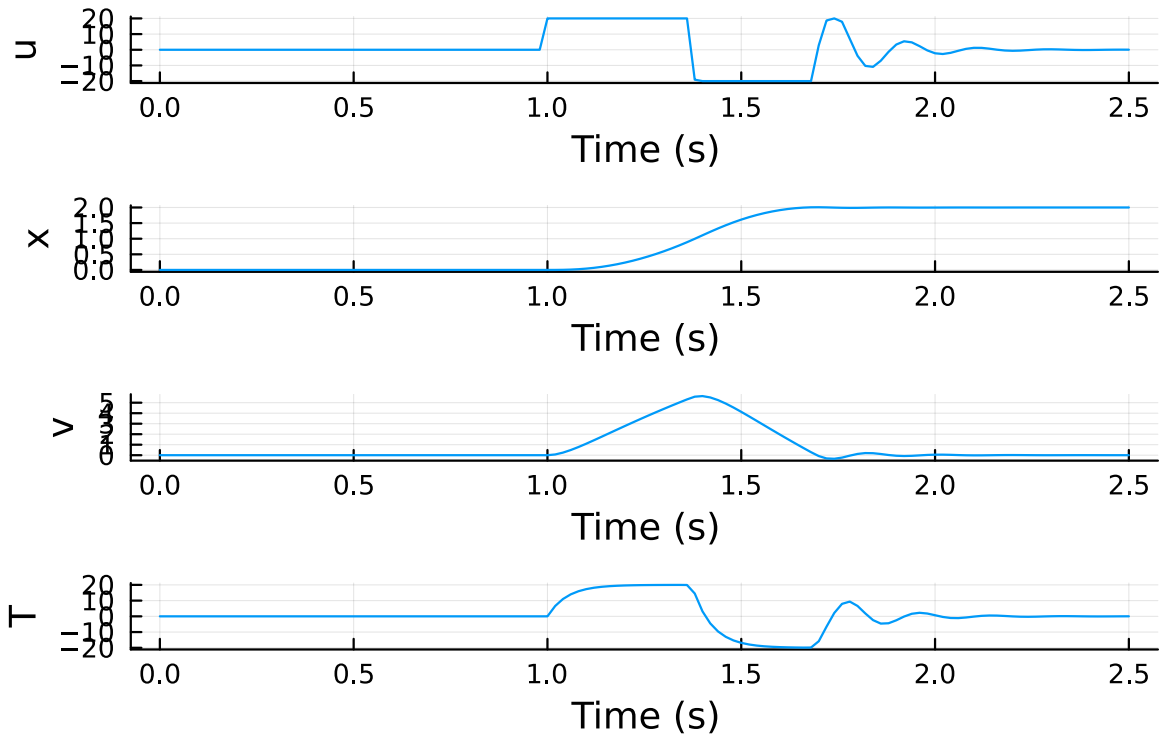


From what I understand we are interested in the dotted line in the bottom right. See how flat it is.

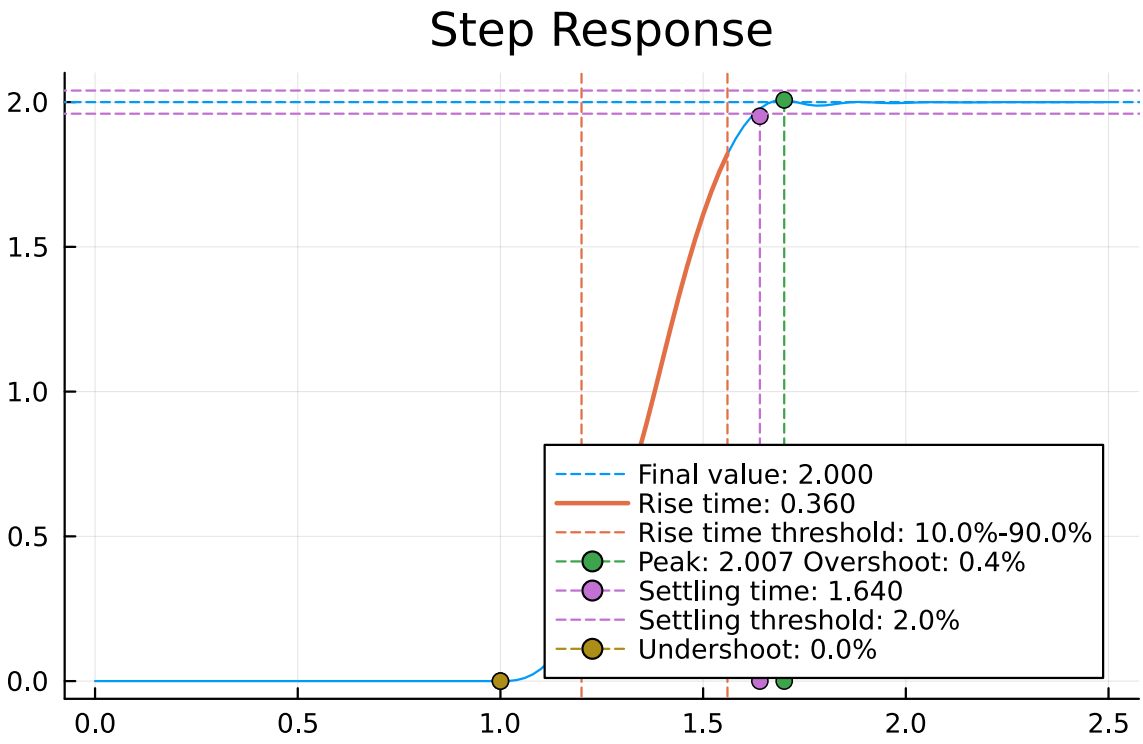
We can convert it to the standard PD gain form.

2.3 Simulation

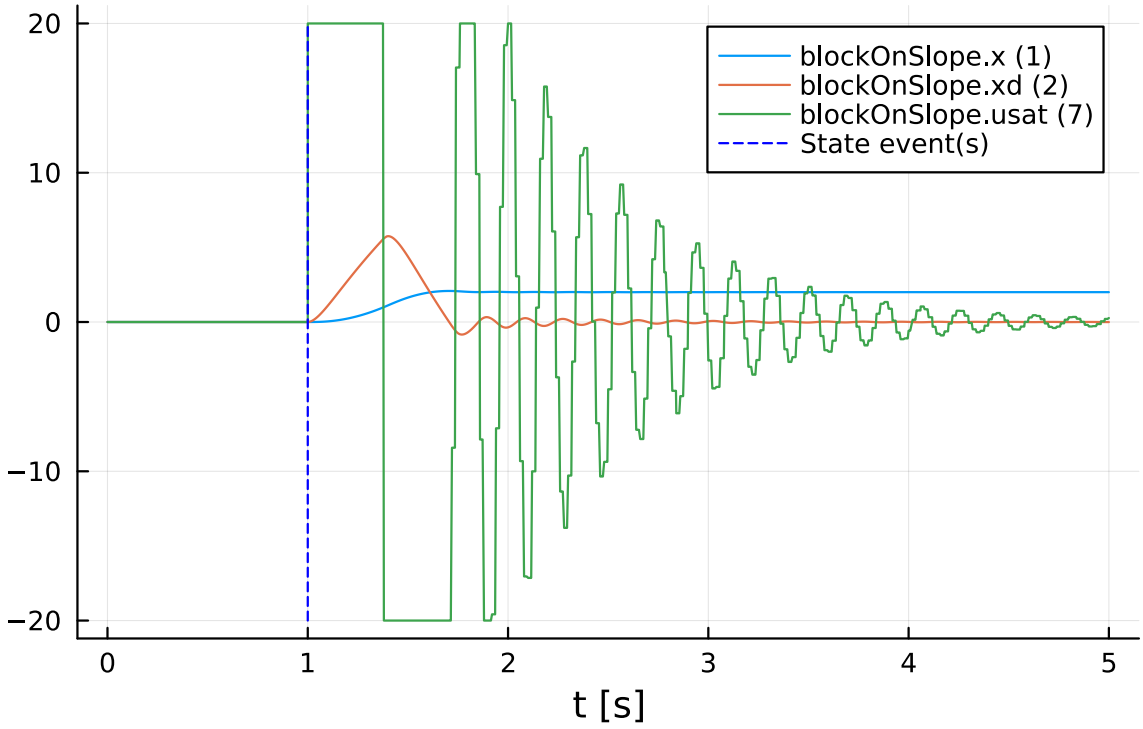
We can simulate this with a motor that only outputs the position:



For more stats:



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



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