This course has already ended.

Exercises round 5

Hint

This round is different from other rounds. You will submit only one pdf report that contains solutions for all exercises in this round.

Exercise 1: Revolution speed controller (300 points)

a) Design a revolution speed controller for a variable-inertia load. The nominal inertia of the load is J = 1, but it can vary ± 50 %.

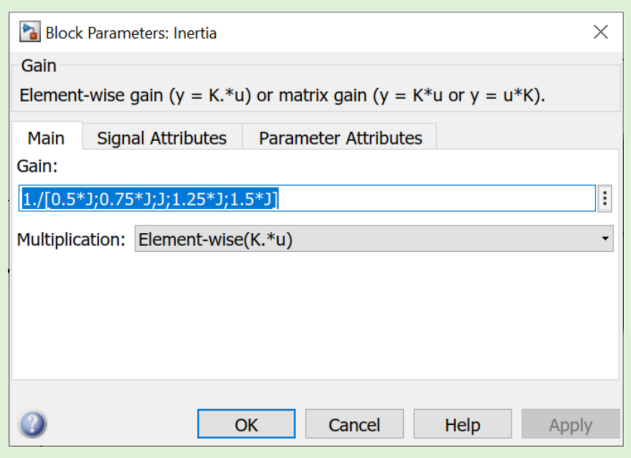
> i. Design the system time constant τ = 0.1 s with nominal inertia. Report the Simulink model and your controller design

b) Analyse the system at the points - 50 %, - 25 %, 0 %, + 25 %, + 50 % of the nominal inertia. Report the step responses for the varying inertia [0.5*J;0.75*J;J;1.25*J;1.5*J].

c) What you need to do in order to have non-varying response?

Hint

Watch lectures. We speak quite a bit about speed control. You can run simulations all together by using gain vector in Matlab/Simulink as shown below. Notice "1./" means element-wise division.



Exercise 2: Revolution speed controller (300 points)

a) Modify the model in Task 1 to represent a position servo control with a constant inertia J = 1. Report the modified model.

b) Design a controller with a short rise time (fast response), report the controller and the ways you can increase rise time.

c) Design a controller with no overshoot, report the controller and the ways you can prevent overshoot.

Exercise 3: Quadcopter control (400 points)

Watch the following videos, Tech Talk on Minidrone by Brian Douglas:

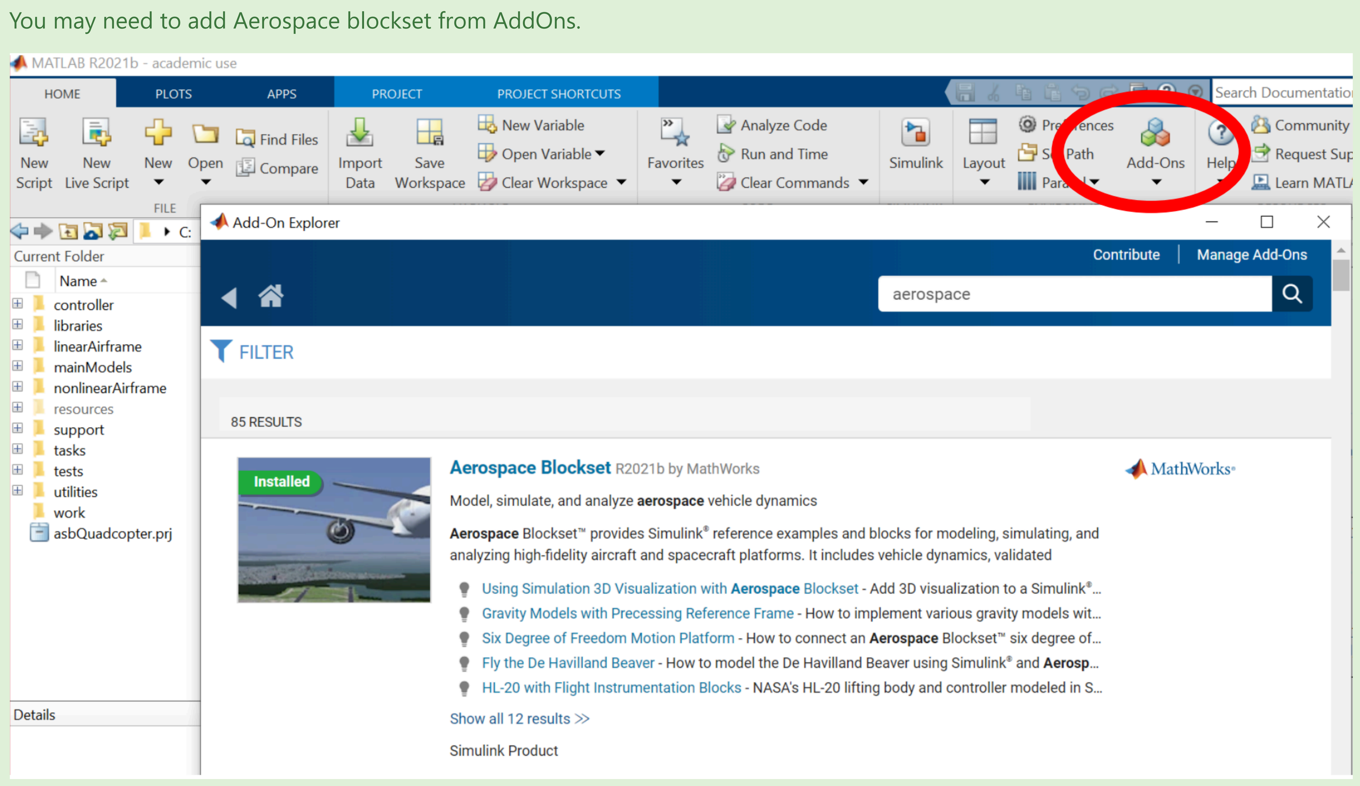
- Part 1: https://se.mathworks.com/videos/drone-simulation-and-control-part-1-setting-up-the-control-problem-1539323440930.html
- Part 2: https://se.mathworks.com/videos/drone-simulation-and-control-part-2-how-do-you-get-a-drone-to-hover--1539323448303.html
- Part 3: https://se.mathworks.com/videos/drone-simulation-and-control-part-3-how-to-build-the-flight-code-1539323453258.html
- Part 4: https://se.mathworks.com/videos/drone-simulation-and-control-part-4-how-to-build-a-model-for-simulation-1539585112546.html
- Part 5: https://se.mathworks.com/videos/drone-simulation-and-control-part-5-tuning-the-pid-controller-1540450868204.html

Hint

openExample('aeroblks_quad/QuadcopterProjectExample') openProject('asbQuadcopter');

Hint

You may need to add Aerospace blockset from AddOns.



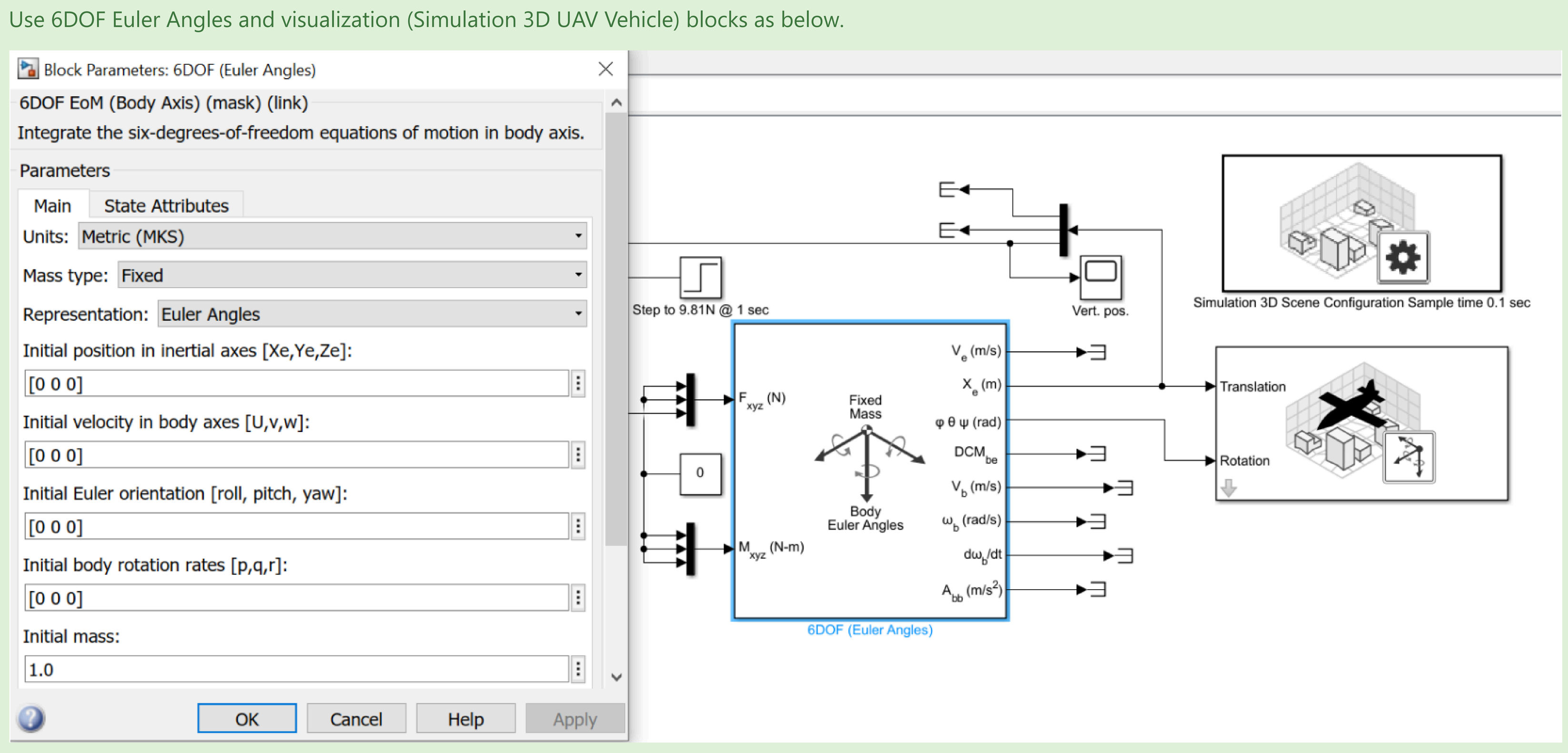
a) Generate a Simulink model on a simplified system. You can omit all the other degrees-offreedom, but develop vertical controller for hovering the drone at 1 m height. Examine carefully the picture below. Essentially, you need to develop speed controller for four thruster units. The vertical thrust is generated by four thrusters each 0.2 N/1000 rpm. The drone mass is 1.0 kg. The default parameters in block 6DOF (Euler angles) were used. Report the Simulink model including the controller and model.

b) Run a step response where position command rises from zero to 1 m at the time of 1 s. Simulate from 0 s to 10 s. Report the step response and final value of rpm command.

c) According to the videos: what you need to remember wear when testing the drone in practice?

Hint

Use 6DOF Euler Angles and visualization (Simulation 3D UAV Vehicle) blocks as below.



Return pdf report of your solutions below.

Points 0 / 1000 My submissions 0 / 6 Deadline Tuesday, 13 February 2024, 09:00 To be submitted alone

The deadline for the assignment has passed (Tuesday, 20 February 2024, 09:00).

Submit file

Submit pdf.

Choose File No file chosen

Submit

Return all your .m and .slx files below.

Points 0 / 0 My submissions 0 / 10 Deadline Tuesday, 13 February 2024, 09:00 To be submitted alone

The deadline for the assignment has passed (Tuesday, 20 February 2024, 09:00).

Select your files for grading

exercise5_files.zip

Choose File No file chosen

Submit