

Control Arm Simulations

ASEN 2003

Spring 2020

Install Simulink Animation 3D

- Type 'ver' into MATLAB command prompt
 - If Simulink 3D Animation is installed skip this step.

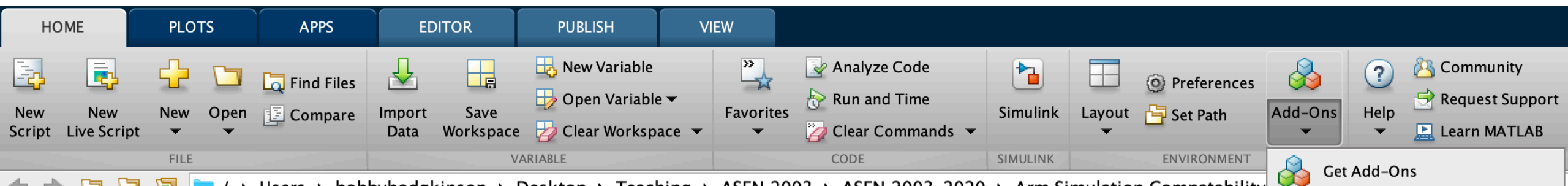
```
>> ver
```

```
MATLAB Version: 9.6.0.1150989 (R2019a) Update 4
MATLAB License Number: 361635
Operating System: Mac OS X Version: 10.15.4 Build: 19E266
Java Version: Java 1.8.0_181-b13 with Oracle Corporation Java HotSpot(TM) 64-Bit Server VM mixed mode
```

MATLAB	Version 9.6	(R2019a)
Simulink	Version 9.3	(R2019a)
Aerospace Blockset	Version 4.1	(R2019a)
Aerospace Toolbox	Version 3.1	(R2019a)
Computer Vision Toolbox	Version 9.0	(R2019a)
Control System Toolbox	Version 10.6	(R2019a)
DSP System Toolbox	Version 9.8	(R2019a)
Embedded Coder	Version 7.2	(R2019a)
Image Processing Toolbox	Version 10.4	(R2019a)
Instrument Control Toolbox	Version 4.0	(R2019a)
MATLAB Coder	Version 4.2	(R2019a)
MATLAB Compiler	Version 7.0.1	(R2019a)
MATLAB Compiler SDK	Version 6.6.1	(R2019a)
MATLAB Report Generator	Version 5.6	(R2019a)
Optimization Toolbox	Version 8.3	(R2019a)
Robotics System Toolbox	Version 2.2	(R2019a)
Signal Processing Toolbox	Version 8.2	(R2019a)
Simulink 3D Animation	Version 8.2	(R2019a)
Simulink Coder	Version 9.1	(R2019a)

If Simulink 3D Animation is not installed..

- Open Add-On Explorer
 - Home -> Add-ons -> Get add-ons



- Search 'Simulink 3D Animation'
 - Click install
 - Restart MATLAB

Open rigid_main.m

The screenshot displays the MATLAB IDE interface. On the left, the 'Current Folder' browser shows a list of files, with 'rigid_main.m' selected. Below the file list, a summary of the script's sections is provided. The main editor window on the right shows the code for 'rigid_main.m'.

Current Folder:

- second_files
- slprj
- ~\$Instructions.pptx
- flexible.slx
- flexible.slxc
- flexible_2020.wrl
- flexible_2020.wrl.thumbnail.png
- flexible_comp.slx
- flexible_comp.slxc
- flexible_main.m
- Instructions.pdf
- Instructions.pptx
- parameters.m
- rigid.slx
- rigid.slxc
- rigid_2020.wrl
- rigid_2020.wrl.bak
- rigid_2020.wrl.thumbnail.png
- rigid_comp.slx
- rigid_comp.slx.r2017b
- rigid_comp.slxc
- rigid_main.m**

rigid_main.m (Script):

- User inputs – control gains
- User inputs – simulation parameters
- run the parameters.m script to load the parameters to the workspace for simulink
- Load the simulink and Run it

rigid_main.m Code:

```
1 %Bobby Hodgkinson
2 %3/31/2020
3 %Load parameters for simulink model to matlab workspace.
4
5
6 clc; clear all;
7
8 beep off %turns off the annoying beep from simulink completion
9
10 %% User inputs – control gains
11 Kpt = 10; %Proportional gain theta
12 Kdt = 0; %Derivative gain theta
13 Kpd = 0; %Proportioanl gain displacement (tip)
14 Kdd = 0; %Derivative gain displacement (tip)
15
16 %% User inputs – simulation parameters
17 Sim_time = 5; %[Seconds] Simulation run time
18 saturation = 10; %[Volts] Motor saturation voltage. Default = 10
19 Amplitude = 0.1; %[Rads] Amplitude of hub reference step command
20 Frequency = 0.5; %[Hz] Frequency of hub reference step command
21
22
23 %% run the parameters.m script to load the parameters to the workspace for simulink
24 evalin('base','parameters')
25
26 %% Load the simulink and Run it
27
28 handle = load_system('rigid_comp'); %Load the rigid simulink simulation. The handle argument prevents the model from opening
29 open_system('rigid_comp/Hub Angle'); %Opens the Hub Angle scope
30 open_system('rigid_comp/Motor V'); %Opens the Motor Voltage scope
31
32 myworld = vrworld('rigid_2020.wrl');
33 view(myworld);
34 bobby = get(myworld);
35
36 %vrview('rigid_2020.wrl','-internal'); %Opens the 3D VR animation. The handle prevents the entire model from opening.
37 %open_system('rigid/VR_Rigid');
38
39 data = sim('rigid_comp'); %This will save the data from the workspace to 'data'
```

Input parameters

```
Editor - /Users/bobbyhodgkinson/Desktop/Teaching/ASEN 2003/ASEN 2003_2020/Arm Simulation Compatability/rigid
rigid_main.m  x  +
1  %Bobby Hodgkinson
2  %3/31/2020
3  %Load parameters for simulink model to matlab workspace.
4
5
6  clc; clear all;
7
8  beep off %turns off the annoying beep from simulink completion
9
10 %% User inputs - control gains
11 Kpt = 50; %Proportional gain theta
12 Kdt = 0; %Derivative gain theta
13 Kpd = 0; %Proportioanl gain displacement (tip)
14 Kdd = 0; %Derivative gain displacement (tip)
15
16 %% User inputs - simulation parameters
17 Sim_time = 5; %[Seconds] Simulation run time
18 saturation = 10; %[Volts] Motor saturation voltage. Default = 10
19 Amplitude = 0.25; %[Rads] Amplitude of hub reference step command
20 Frequency = 0.5; %[Hz] Frequency of hub reference step command
21 dead_zone = 0; %[Volts] Motor dead zone voltage. Default = 0.25
22
23 %% run the parameters.m script to load the parameters to the workspace for simulink
24 evalin('base','parameters')
25
26 %% Load the simulink and Run it
27
28 handle = load_system('rigid_comp'); %Load the rigid simulink simulation. The handle argument p
29 open_system('rigid_comp/Hub Angle'); %Opens the Hub Angle scope
30 open_system('rigid_comp/Motor V'); %Opens the Motor Voltage scope
31
32 myworld = vrworld('rigid_2020.wrl');
33 view(myworld);
34 bobby = get(myworld);
35
36 data = sim('rigid_comp'); %This will save the data from the workspace to 'data'
37 %% Comment the following line to disable autoclose of the VR Animation
38 close(bobby.Figures);
39
40 %Time (ms)  Hubangle(Theta in rad)  Tip Deflection(m)  Hub Angular Velocity (rads/s)  Tip Veloci
41
```

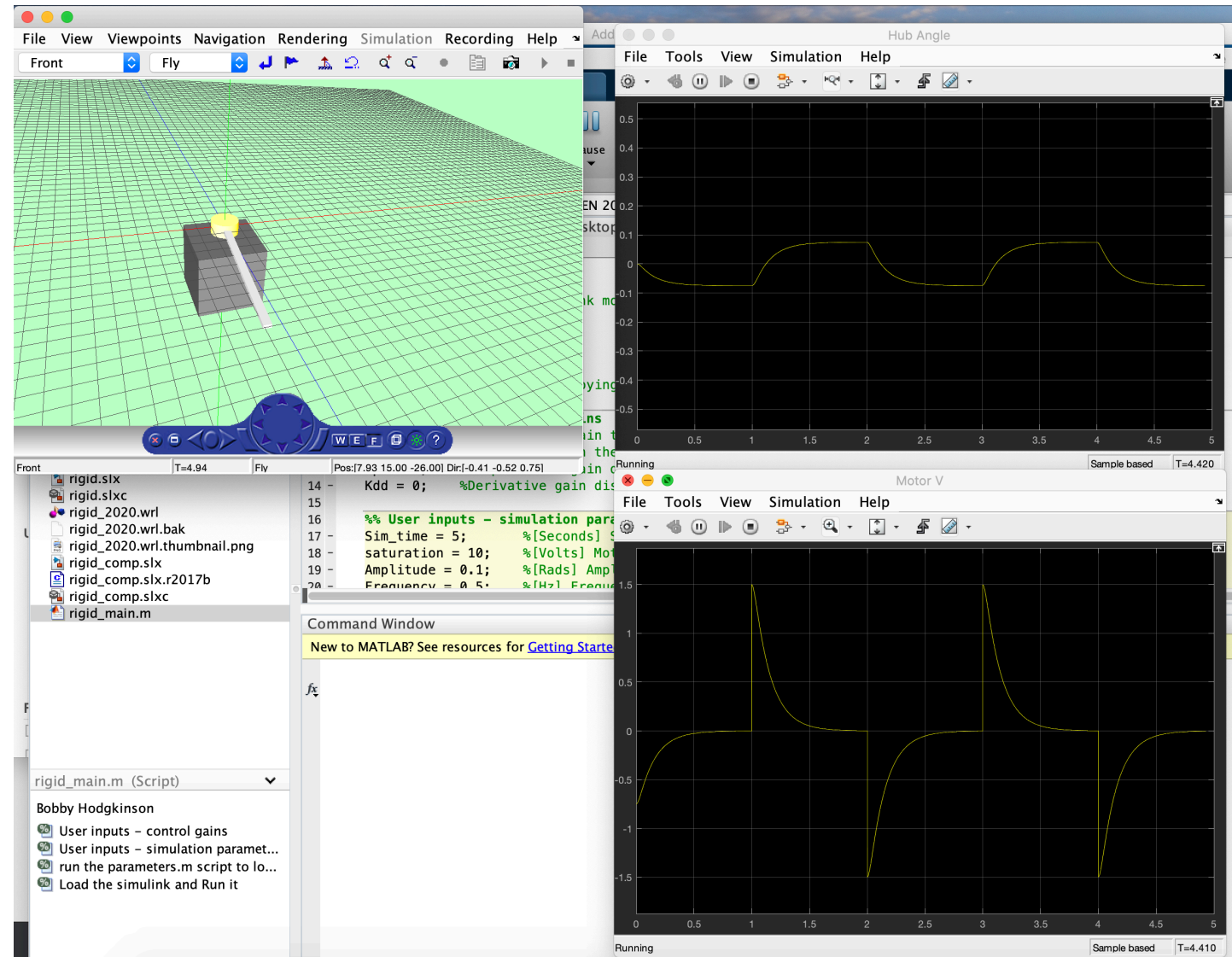
Control Gains. Change these as desired.

Simulation Parameters. Change these as desired

Simulation Calls. Change these if necessary

Click 'run'

- The simulation will run and display a plot of the Hub Angle and Motor Voltage as well as a 3D VR Animation

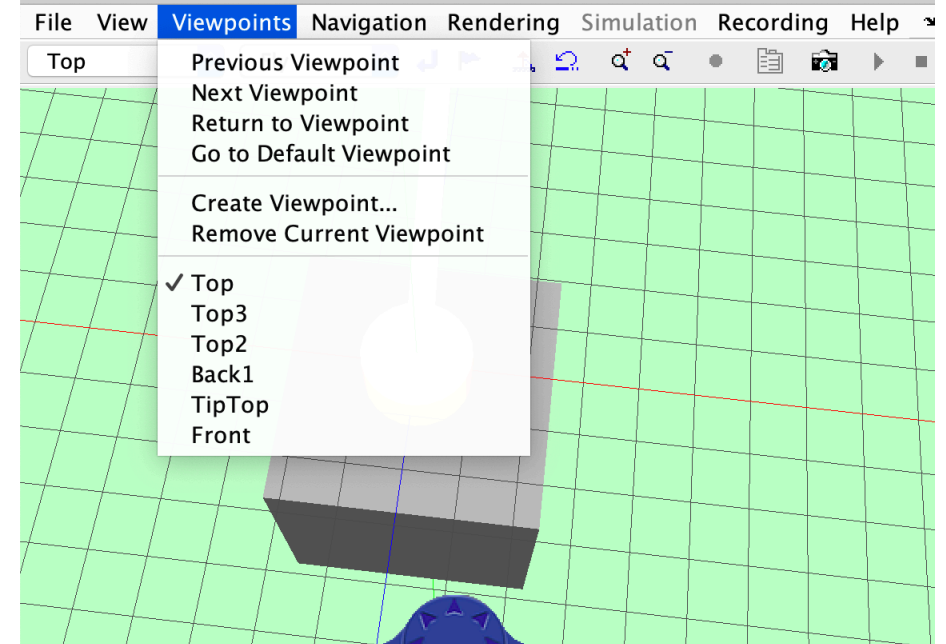


3D Animation and Change Viewpoint

- The .m file automatically closes the 3D VR Animation after completion
 - Multiple runs will open multiple VR Animations unless manually closed
 - This slows down subsequent runs due to processor load
 - To disable the auto-close feature comment out the following line of code:

```
38  
39 - data = sim('rigid_comp');  
40 %close(bobby.Figures);  
41
```

- Change viewpoints by clicking 'Viewpoints'
 - Select new viewpoint



Simulation Data

- The variable 'data' contains experimental data from the simulation
- Same format as the hardware experimental data
 - %Time(ms) Hubangle(Theta in rad) Tip Deflection (m) ...
- Access by data.simout.Data

```
>> time = data.simout.Data;
```


Flexible

- Open flexible_main.m
- Same procedure

Current Folder

