This document focuses on the data recording for the Flight Dynamics & Control lab, mainly:

- To familiarize the user with the general structure and variables from the Simulink model
- To show how data can be recorded using the Simulink model provided
- To verify and save the recorded data for post-processing

General Simulink model structure

For the exercise of week 1, only the sensors block is required (figure 1). For week 2, models with the general structure of sensor – controller – actuator blocks will be used.
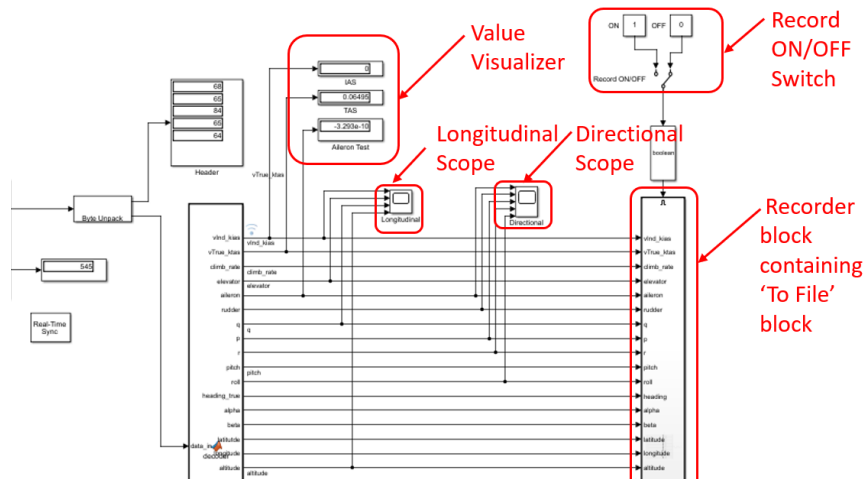

Figure 1: Sensor block labelled with values visualizer, scopes, record switch and 'To File' block.

Variables recorded

Table 1: All variables recorded by the Simulink model.

Variable name	Units	Description
vInd_kias	Knots	Indicated Airspeed
vTrue_ktas	Knots	true Airspeed
climb_rate	fpm	
q	rad/s	Pitch rate
p	rad/s	Roll rate
r	rad/s	Yaw rate
time	s	Time from start
elevator	%	Elevator % (1 = -15deg; -1=5deg)
aileron	%	Aileron %
rudder	%	Rudder % (1=-30deg; -1=30deg)
pitch	deg	Pitch angle
roll	deg	Roll angle
heading_true	deg	Heading angle

Variable name	Units	Description
alpha	deg	Angle of Attack
beta	deg	Side Slipp angle
latitude	deg	
longitude	deg	
altitude	ft	
x	m	Position
y	m	Position
z	m	Position
throttle_cmd	%	
throttle_actual	%	
eng_power	hp	
w_empty	lb	Empty weight
w_payld	lb	Payload weight
w_fuel	lb	Fuel weight

The Simulink model should have already been initialized side by side with the XPlane instructor screen shown in figure 2.
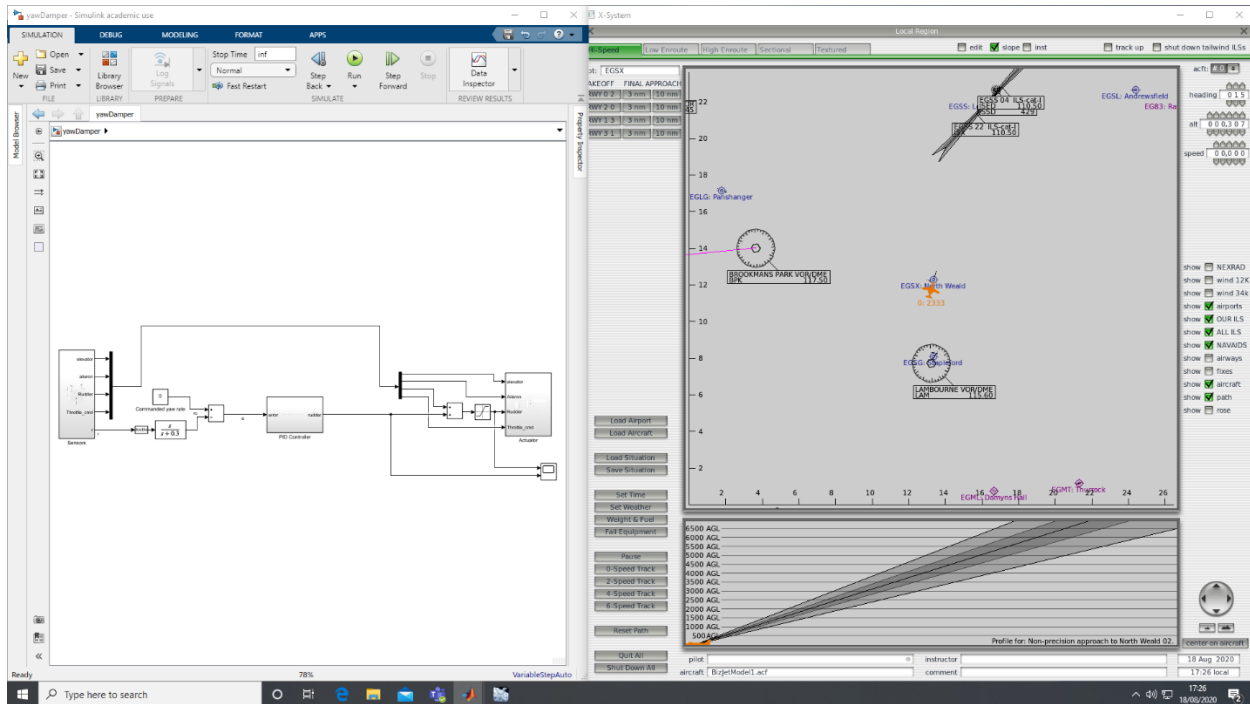

Figure2: Simulink model and XPlane instructor screen.

Step 1: Minimize the Simulink screen to access the desktop and **create a folder** with your name, you will use this folder to store your recorded data.

Step 2: **Open** the MATLAB screen which you can access from the bottom bar as shown in figure 3. **Set** the working directory to be your newly created folder in the desktop.

Figure 3: MATLAB and Simulink page access from task bar

Step 3: **Clear** any data from your workspace by typing: 'clear' in the MATLAB Command Window.

Step 4: (Only if the model is a Controller type) **Open** the Simulink model and **click** on the "sensors" block as shown in figure 4.
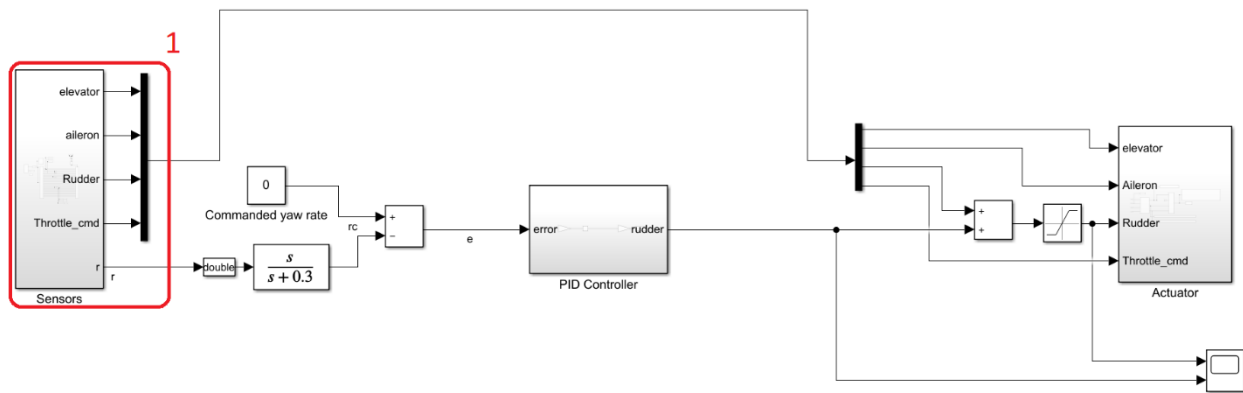
Figure 4: General controller model highlighting the "sensors" block

If you have the data recorder model open, this step is not required

Step 5: **Click** on the 'recorder block' from the sensors subsystem (shown in figure 1). Type a filename inside the "To file" (shown in figure 5) by clicking on it and typing it in the File Name parameter block as seen in figure 6.
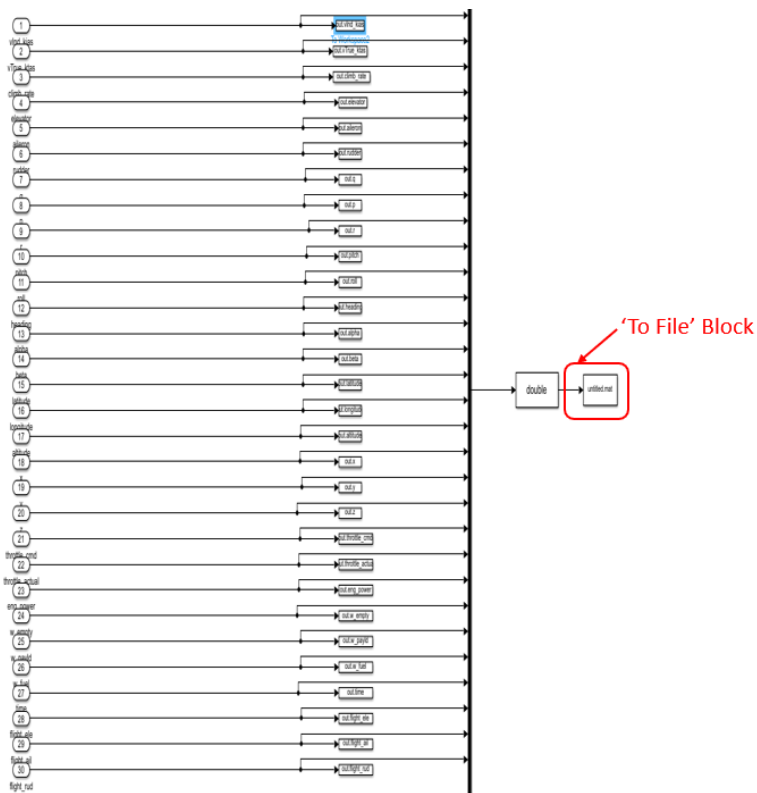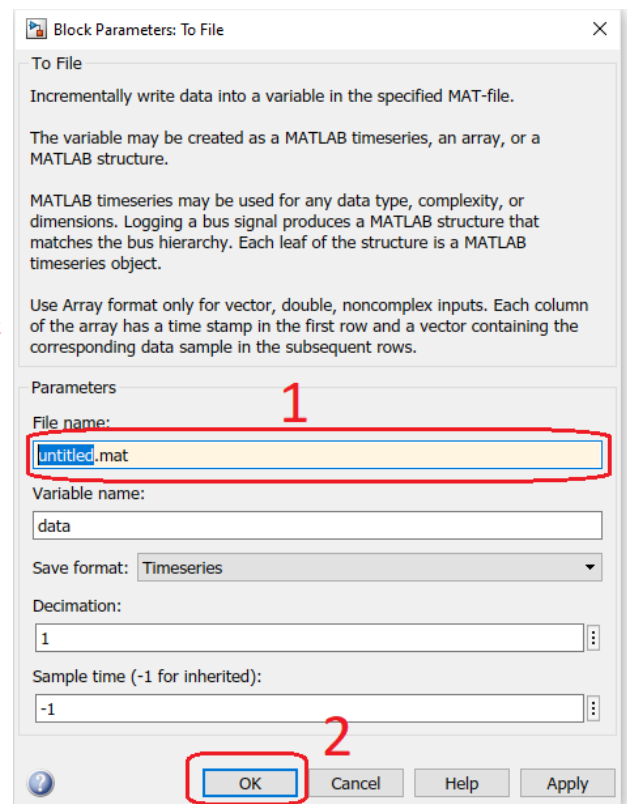

Figure 5: 'Recorder' subsystem

Figure 6: "To File" block window

Click on the Ok button once you have set the filename to which your data will be exported.

Use the "Top Arrow" on the top left corner of the matlab screen to exit the 'Recorder' subsystem (and if inside a Controller model, also from the "Sensors" subsystem block as shown in figure 7.)
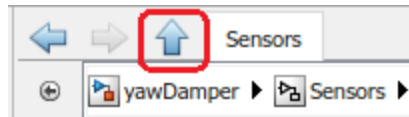

Figure 7: Exit of subsystem button.

Step 6: Click on the 'Run' button as seen in figure 8 (make sure that all switches are in required positions i.e Recording is OFF, Controller if present is off)
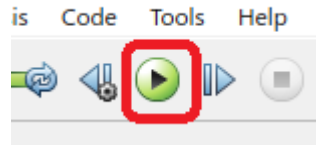

Figure 8: Simulink model Run button.

Step 7: Before letting the pilot now that he can perform the necessary control inputs, **check** that the data is being received either by looking at the value displays of speeds and aileron (figure 9) or by viewing the signals displayed on the scope (figure 10).
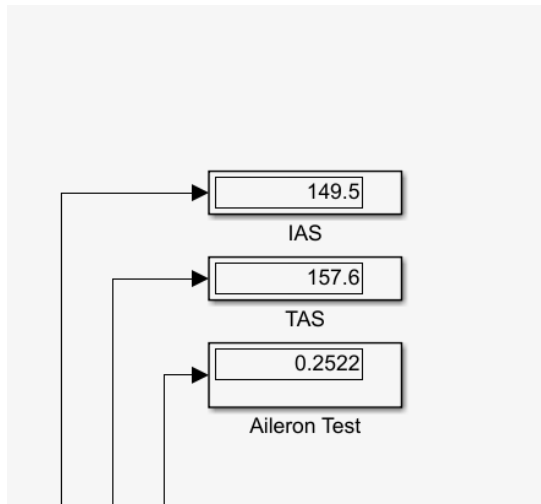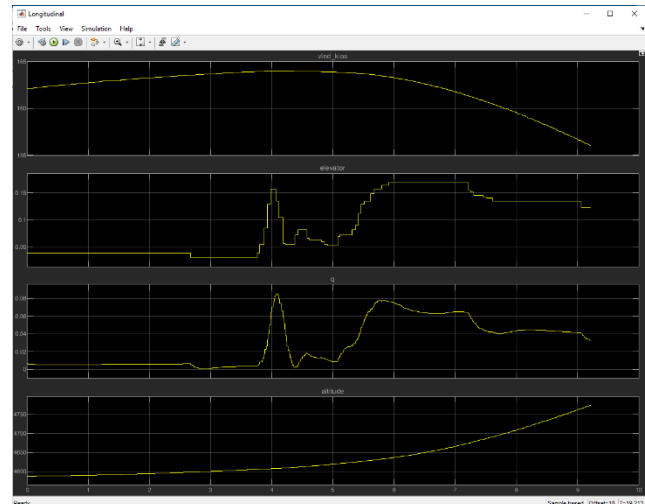

Figure 9: Value output blocks

Figure 10: Scope output

Step 8: Start recording data by **double clicking** on the "Record On/Off" switch shown in figure 11. Make sure the switch is now pointing to the left.
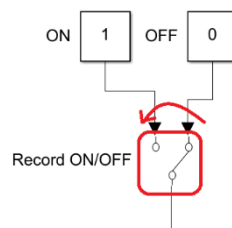

Figure 11: On/Off switch

Step 9: Once the control inputs have been given and sufficient data has been recorded, **double click** on the "Record On/Off" switch again so the switch ends up pointing again to the right.

If you need to repeat any part of the test-flight or wish to add more data, you can repeat steps 8-9. Note that your previous recorded data will remain, and any new recordings will be added to that data.

Step 10: Once the test-flight has ended, **click** on the "Stop" button (figure 12) in the top ribbon to stop the Simulink model.
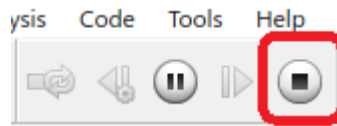

Figure 12: Stop button in Simulink model.

Verify the recorded Data

Step 11: It is recommended to **Check** that you are satisfied with your data by plotting it. In the case of the phugoid, it is custom to plot time against velocity, this can be done by typing in the Command window: `plot(out.time,out.vTrue_ktas)`

For the phugoid mode, the data should look similar to that shown in figure 13.
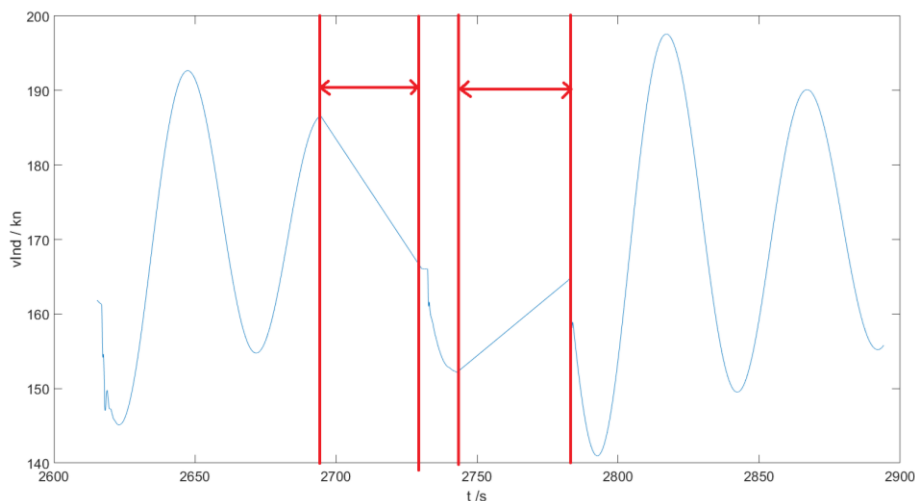

Figure 13: True airspeed vs time plot for the phugoid mode.

Note that the data between the two pairs of red lines was not being recorded. Matlab will draw a straight line between the last data point and the start value of the next recording when the the "Record On/Off" switch is flicked back to ON.

Post Processing

The ".mat" file saved from the recording uses a timeseries structure to save all 30 signals together (Simulink does not let you save individual signals together in a file). To separate them back to individual signals, use the '`dataExtractor.m`' by replacing the default filename variable in line 10 with your stored filename.