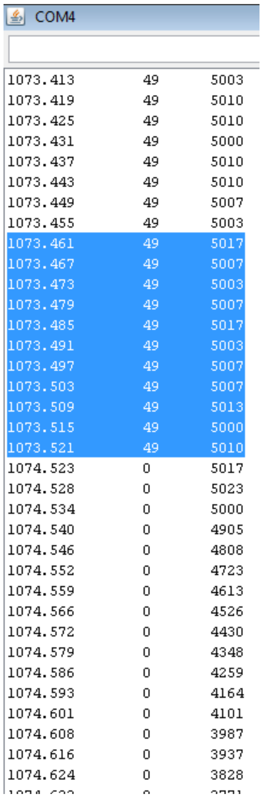
Importing Data to the MATLAB Workspace

Purpose:

The purpose of this guide is to go through the step-by-step process of importing data from the Arduino COM window or an Excel spreadsheet, into the MATLAB workspace. The Arduino IDE has a built-in serial monitor that can be used to communicate with an Arduino board. This window is used to control the motor throttle setting value of the Uno, which is then sent to the ESC using the Motor Testing Program. You can copy and paste the resulting data into MATLAB for analysis, or save them as a text file if you so choose. While recording data readings from a digital scale, such as during thrust and torque tests, it is convenient to record the data into an Excel spreadsheet for later import into MATLAB.

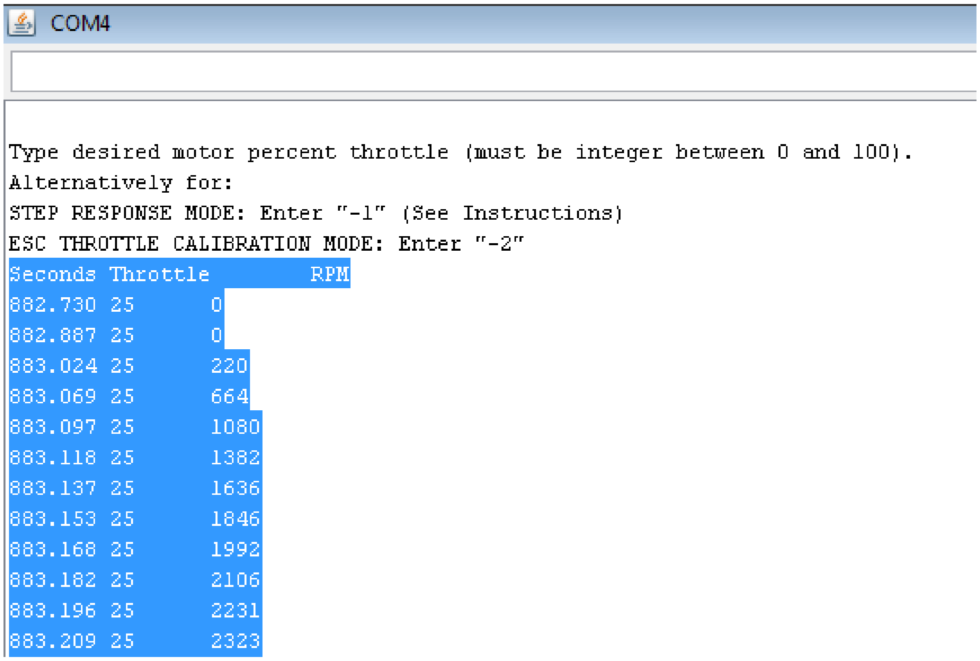
Step 1: Once a data run is complete, scroll to the bottom of the COM window and select all of the test data. Data we don't want can be filtered out later manually or using the Data Analysis program, but it is sometimes helpful to exclude data at this stage.



```
1073.413        49      5003
1073.419        49      5010
1073.425        49      5010
1073.431        49      5000
1073.437        49      5010
1073.443        49      5010
1073.449        49      5007
1073.455        49      5003
1073.461        49      5017
1073.467        49      5007
1073.473        49      5003
1073.479        49      5007
1073.485        49      5017
1073.491        49      5003
1073.497        49      5007
1073.503        49      5007
1073.509        49      5013
1073.515        49      5000
1073.521        49      5010
1074.523        0       5017
1074.528        0       5023
1074.534        0       5000
1074.540        0       4905
1074.546        0       4808
1074.552        0       4723
1074.559        0       4613
1074.566        0       4526
1074.572        0       4430
1074.579        0       4348
1074.586        0       4259
1074.593        0       4164
1074.601        0       4101
1074.608        0       3987
1074.616        0       3937
1074.624        0       3828
```

Figure 1. Selecting data from the COM window

Step 2: Hold “Shift” (or equivalent for your computer) and click to select all the way up to the top of the data. As seen below in Figure 2, make sure to include the column headings in the selection. This makes MATLAB correctly name the columns during import, saving you some time.



```
Type desired motor percent throttle (must be integer between 0 and 100).
Alternatively for:
STEP RESPONSE MODE: Enter "-1" (See Instructions)
ESC THROTTLE CALIBRATION MODE: Enter "-2"
Seconds Throttle        RPM
882.730 25      0
882.887 25      0
883.024 25      220
883.069 25      664
883.097 25      1080
883.118 25      1382
883.137 25      1636
883.153 25      1846
883.168 25      1992
883.182 25      2106
883.196 25      2231
883.209 25      2323
```

Figure 2. Selecting the rest of the data from the COM window (including headings)

Step 3: “Ctrl + C” (or equivalent) to copy the data, and Right-click + Paste into the MATLAB workspace window. This can be seen below in Figure 3.

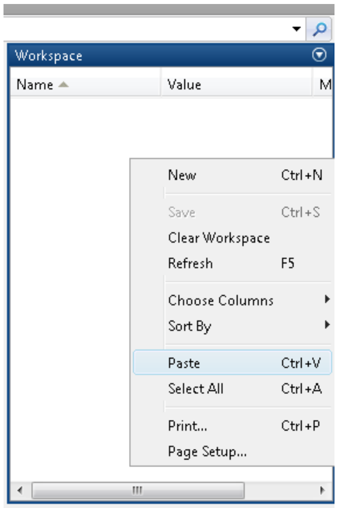
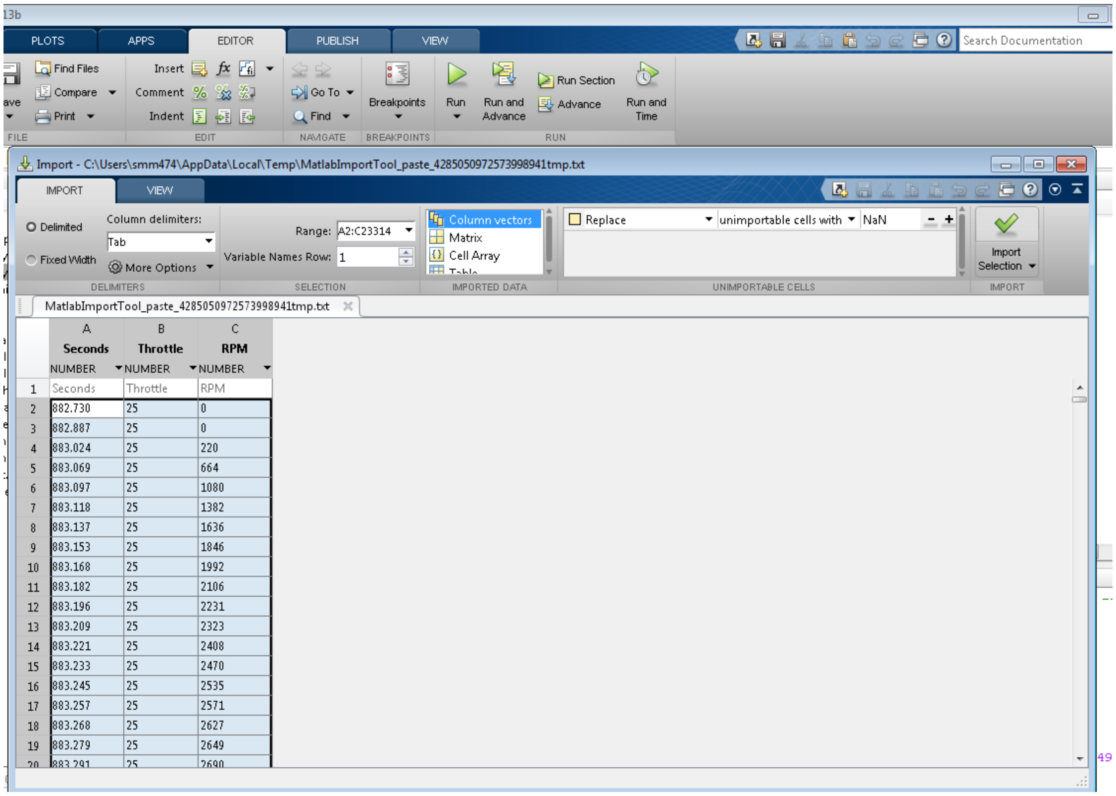


Figure 3. Pasting data into the MATLAB workspace

<u>Step 4</u>: The “Import” window will open, as seen below in Figure 4. MATLAB is able to automatically populate the column headings as well (if not, columns <u>must</u> be labeled “**Seconds**”, “**Throttle**”, and “**RPM**”). Select the green checkbox “Import Selection” at the top right of the Import window and MATLAB will import and parse the data (Figure 5).



Import - C:\Users\smm474\AppData\Local\Temp\MatlabImportTool_paste_4285050972573998941tmp.txt

● Delimited ○ Fixed Width

Column delimiters: Tab

More Options

Range: A2:C23314

Variable Names Row: 1

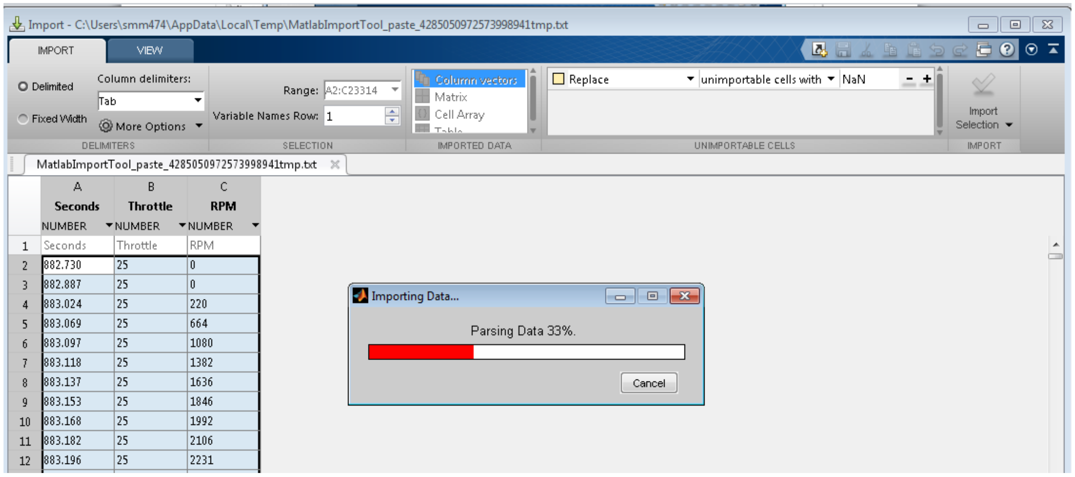
Column vectors / Matrix / Cell Array / Table

□ Replace unimportable cells with NaN

MatlabImportTool_paste_4285050972573998941tmp.txt

	A	B	C
	Seconds	Throttle	RPM
	NUMBER	NUMBER	NUMBER
1	Seconds	Throttle	RPM
2	882.730	25	0
3	882.887	25	0
4	883.024	25	220
5	883.069	25	664
6	883.097	25	1080
7	883.118	25	1382
8	883.137	25	1636
9	883.153	25	1846
10	883.168	25	1992
11	883.182	25	2106
12	883.196	25	2231
13	883.209	25	2323
14	883.221	25	2408
15	883.233	25	2470
16	883.245	25	2535
17	883.257	25	2571
18	883.268	25	2627
19	883.279	25	2649
20	883.291	25	2690

Figure 4. Importing the selection into the workspace



Import - C:\Users\smm474\AppData\Local\Temp\MatlabImportTool_paste_4285050972573998941tmp.txt

● Delimited ○ Fixed Width

Column delimiters: Tab

More Options

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MatlabImportTool_paste_4285050972573998941tmp.txt

	A	B	C
	Seconds	Throttle	RPM
	NUMBER	NUMBER	NUMBER
1	Seconds	Throttle	RPM
2	882.730	25	0
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4	883.024	25	220
5	883.069	25	664
6	883.097	25	1080
7	883.118	25	1382
8	883.137	25	1636
9	883.153	25	1846
10	883.168	25	1992
11	883.182	25	2106
12	883.196	25	2231

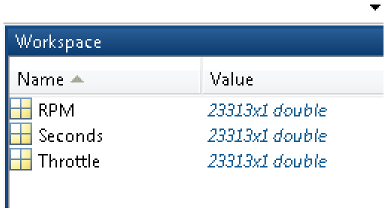
Importing Data...

Parsing Data 33%.

Cancel

Figure 5. Parsing the data

The data is now imported to the MATLAB workspace (Figure 6) as individual column vectors.

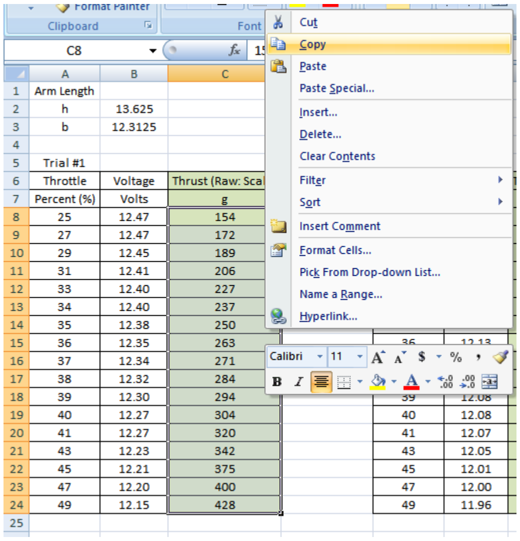


Workspace

Name	Value
RPM	23313x1 double
Seconds	23313x1 double
Throttle	23313x1 double

Figure 6. Data imported to workspace

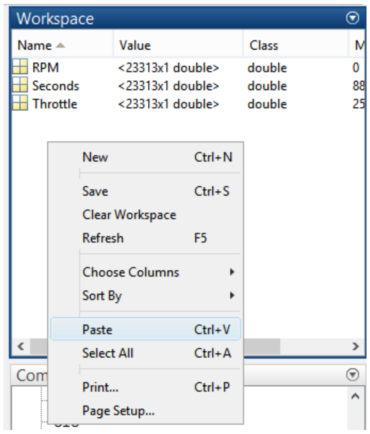
Step 5: Copy raw scale measurements from an Excel sheet, as seen below in Figure 7. If Excel was not used, you can manually enter a column vector of measurements.



	A	B	C			
1	Arm Length					
2	h	13.625				
3	b	12.3125				
4						
5	Trial #1					
6	Throttle	Voltage	Thrust (Raw: Scal			
7	Percent (%)	Volts	g			
8	25	12.47	154			
9	27	12.47	172			
10	29	12.45	189			
11	31	12.41	206			
12	33	12.40	227			
13	34	12.40	237			
14	35	12.38	250			
15	36	12.35	263		36	12.13
16	37	12.34	271			
17	38	12.32	284			
18	39	12.30	294		39	12.08
19	40	12.27	304		40	12.08
20	41	12.27	320		41	12.07
21	43	12.23	342		43	12.05
22	45	12.21	375		45	12.01
23	47	12.20	400		47	12.00
24	49	12.15	428		49	11.96
25						

Figure 7. Copying data from Excel sheet

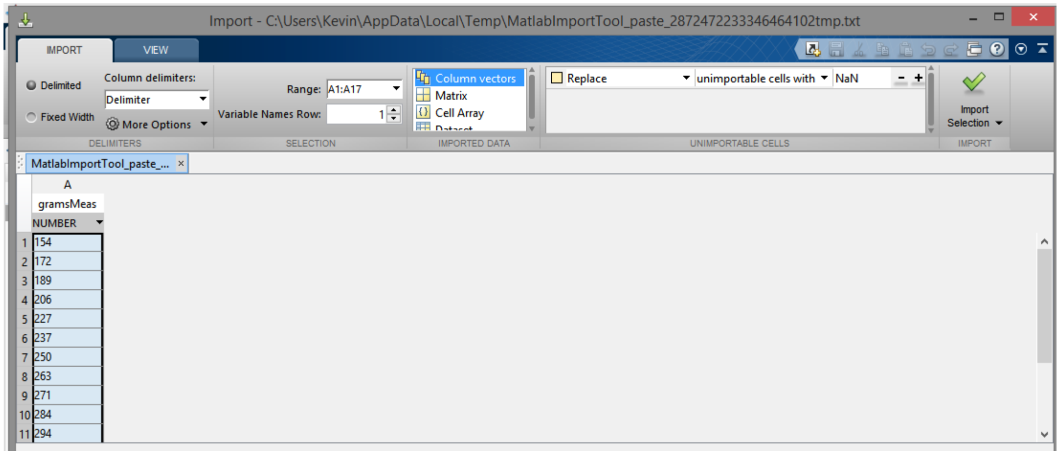
Step 6: This data from Excel can now be pasted into the MATLAB workspace along with the data from the Arduino COM window. This can be seen in Figure 8.



Name	Value	Class	M
RPM	<23313x1 double>	double	0
Seconds	<23313x1 double>	double	88
Throttle	<23313x1 double>	double	25

Figure 8. Pasting data into workspace

Step 7: This step is important, as the analysis tools we provide require that the measurements from the scale be stored as a vector with a specific name. After selecting "Paste" into the workspace, MATLAB's Import window will once again open, except that MATLAB now doesn't know what to call the column heading. For this case, we must call the column heading "**gramsMeas**". Once the heading is labeled, you can select "Import Selection" at the top right of the screen and MATLAB will import this data from Excel into a vector called "**gramsMeas**". This is seen below in Figure 9.



Import - C:\Users\Kevin\AppData\Local\Temp\MatlabImportTool_paste_2872472233346464102tmp.txt

Range: A1:A17

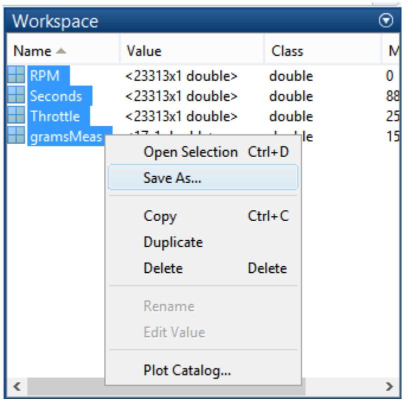
Variable Names Row: 1

□ Replace unimportable cells with NaN

	A
	gramsMeas
	NUMBER
1	154
2	172
3	189
4	206
5	227
6	237
7	250
8	263
9	271
10	284
11	294

Figure 9. Importing the data into vector called "gramsMeas"

Step 8: Finally, we are able to save all of this workspace data as a .mat file into a location of our choice for later use in the data analysis programs. Select all (4) variables in the workspace window, right click, "Save As…" and Save the data into the desired folder with a meaningful name (date, tests performed, variables of interest, etc.). See Figure 10 below.



Name	Value	Class	M
RPM	<23313x1 double>	double	0
Seconds	<23313x1 double>	double	88
Throttle	<23313x1 double>	double	25
gramsMeas	[illegible]	le	15

Figure 10. Saving the data