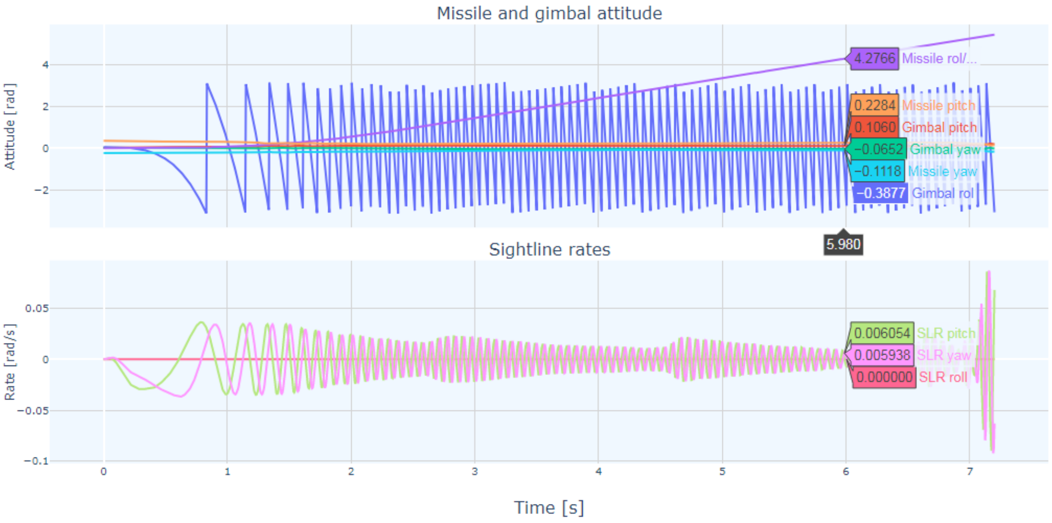

Dash Line Plot Python Graphing Utility

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ABBREVIATIONS

css cascading style sheet

csv comma-separated-values

GPL GNU General Public License

GUI Graphical User Interface

HTML Hypertext Markup Language

IDE Integrated Development Environment

LGPL Lesser General Public License

MIT Massachusetts Institute of Technology

OSSIM Optronics System Simulator

PSFL Python Software Foundation License

SVC Software Version Control

svn subversion

TUG TeX Users Group

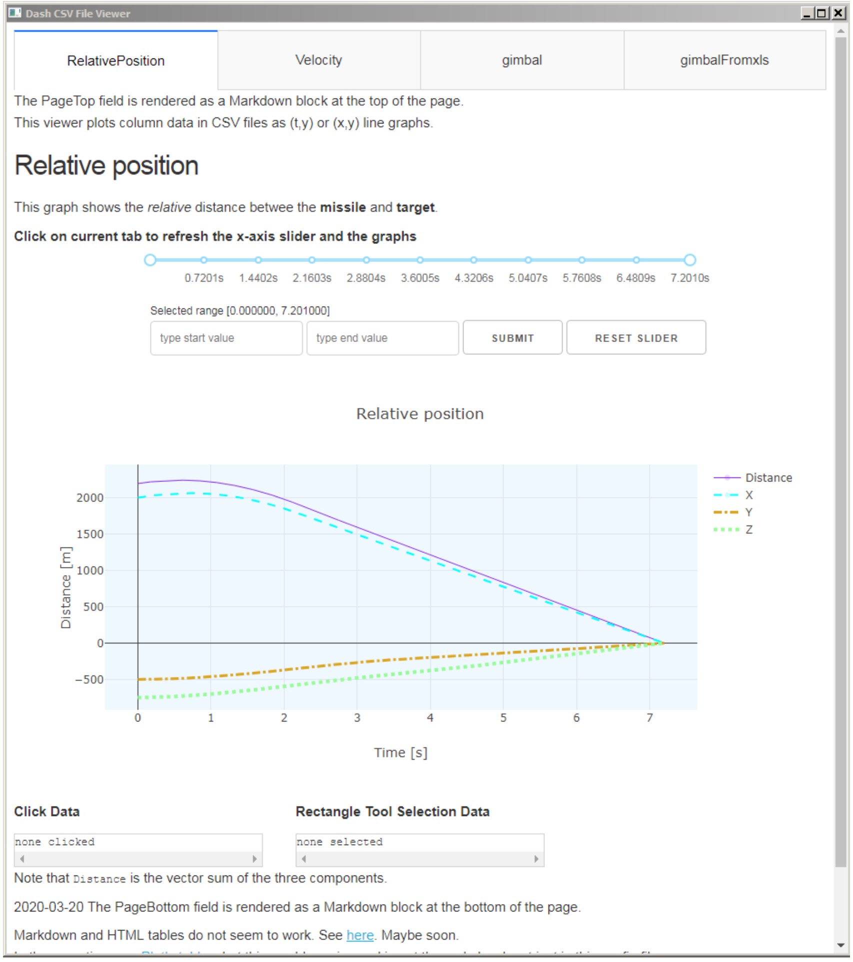
URL Uniform Resource Locator

VS Visual Studio

Chapter 1

Introduction

The Python script `dash-lineplot.py` is a general plotting utility that aids in visualisation of captured or recorded data. It reads an Excel configuration file and forms a set of Dash data structures in Hypertext Markup Language (HTML) pages. A Dash portal is created where the HTML pages are served via a Flask server. The user has full control of the graph sets that are rendered on the pages. Figure 1.1 shows an example of the Dash portal with different graph sets being rendered on several tabs.



The PageTop field is rendered as a Markdown block at the top of the page.
This viewer plots column data in CSV files as (t,y) or (x,y) line graphs.

Relative position

This graph shows the *relative* distance betwee the **missile** and **target**.

Click on current tab to refresh the x-axis slider and the graphs

Selected range [0.000000, 7.201000]

Click Data

`none clicked`

Rectangle Tool Selection Data

`none selected`

Note that `Distance` is the vector sum of the three components.

2020-03-20 The PageBottom field is rendered as a Markdown block at the bottom of the page.

Markdown and HTML tables do not seem to work. See here. Maybe soon.

Figure 1.1: Example pages rendered by the dash-lineplot.py utility Python script.

Chapter 2

Functional Description

Running the script triggers the creation of a window with one central web browser widget. The web browser widget is defined to have one page to be rendered on Uniform Resource Locator (URL):

`http://127.0.0.1:8050`.

The page is constructed as an HTML page with tagged divisions. The HTML `<Div>` tag is used to make divisions of content in the web page, e.g. images, header, footer.

A Dash portal is created where the HTML page is served via a Flask server. Dash is a productive Python framework for building web applications. Written on top of Flask, Plotly.js, and React.js, Dash is ideal for building data visualization applications with highly custom user interfaces in pure Python.

Dash starts a Flask server at the specified URL. The server is started on a daemon thread, i.e. it will run in the background until the main application is terminated. This means that once the server is running, the page can be viewed in the Dash window as used in this application, or in an external browser. After the user closed the Dash window, the URL can be typed in any web browser to view the current graph set rendered on the HTML page.

This page has several elements, all constructed from the information provided in the configuration file. If the user changes the graph definition in the configuration file, the updated page will only be rendered when the script is executed again.

The utility is configured by data entered in an Excel data file. The configuration file has any number of sheets where each sheet defines a different set of line graphs to be rendered on a separate tab in the graph page (except for the header sheet, which defines the page header.) The name of the graph sheets in the file always starts with `graph-` to serve as an identification to the script. Each graph sheet defines the height of the graphs, axes labels, one x-value column name and any number of sets of y-value column names. The graph sets can be rendered each one as a separate figure on the page, or in the subplot format. Each line has a number of attributes with default values if not supplied. The tabs on the page can be switched on/off for display purposes. Each active graph set can also be exported to an interactive HTML file for later perusal.

Data from the following file types can be displayed:

- comma-separated-values (csv) files with column names provided in the first row,
- first sheet of an Excel data file with column names provided in the first row,
- Matlab format file with data in 'DATA', variable names in 'NAM' and time base in 'TIME'.

For more detail on the user level interaction, see Chapter 5.

Chapter 3

Input and Output Data

The script requires the following input data and folders:

configuration file Excel file with configuration data for the graphing utility.

./assets This folder houses the cascading style sheet (css) file used to format the contents of the graphing utility (by default, Dash is un-styled). It contains customized, global properties for how to display the HTML elements. css files can define the size, colour, font, line spacing, indentation, borders, and location of HTML elements. An adapted style file from `https://codepen.io/chriddyp/pen/bWLwgP` is used.

./icons The icons of the various licenses of modules used are stored in this folder.

./data Optional data folder. The configuration file can be set up to read from several data files. This folder is used to store the demonstration test set of data files.

The **graphs** folder is created by the application, if it does not exist. Interactive HTML output graphs from the graphing utility are stored in this folder. Clicking on file, the graph in opened in a browser and full interactive Plotly functionality is available.

Chapter 4

Operating System, Licenses and Major Software Versions

4.1 Minimum Requirements

The software requires a 64-bit computer with either Windows 7 or 10 as operating system. If the script is used as a packaged executable, no Python distribution is required. These users can ignore Sections 4.3, 4.4 and 4.5. Software developers and advanced users working with the script code base need to take note of the requirements discussed in these sections.

4.2 Licences

The `dash-lineplot.py` script uses only open source Python modules. The following licenses are applicable:

- Python, scipy, numpy, pandas, and other ’standard’ modules are licensed under the open source Python Software Foundation License (PSFL).
- Dash and visdcc are released under the permissive Massachusetts Institute of Technology (MIT) license.
- PySide and Ot are released under the Lesser General Public License (LGPL). Note that PyQt5 is not used due to stricter licensing conditions.
- PyInstaller is distributed under the GNU General Public License (GPL). This software is not distributed to a client, i.e. only used to package the application.

4.3 Requirements for Software Developers and Python Script Users

Software required for developers and users working with the code base:

- Python 3.7. The preferred distribution is Anaconda 4.7 or higher.
- Python modules not included in the Anaconda distribution:
  - PySide (Python Qt bindings) with major version 2 on Python 3.7.

- Dash visualisation framework with major version 1.
- visdcc (run javascript with module Run_js) version 0.0.40.
- PyInstaller, bundles a Python application and its dependencies into a single package, version 3.5.

4.4 Preparing the Software Developer Environment

A personal computer with the minimum requirements listed in Section 4.1 is required. Install the required software listed in the rest of this section. Obtain the `dash-lineplot.py` code and data from the relevant subversion (svn) repository.

4.4.1 Installing Anaconda

Anaconda is a free open-source distribution of Python that aims to simplify package management and deployment. Package versions are managed by the package management system *conda*.

Obtain the latest version of Anaconda from:

https://www.anaconda.com/distribution/

When installing Anaconda you are given the option to install for all users or for my user only. Installing for all users seems to require admin rights when updating or installing packages. It seems that installing for my user has less such issues. If you find 'write permission' problems, try performing the task using Admin rights.

It is preferred to have the Anaconda/Python paths permanently in the system PATH environment variable. This enables you to open Python from any command window, without using the Anaconda menus settings (When using the Anaconda menu, the paths are set for the one command window instance only). To enforce this option, ensure that you tick the box on the Anaconda install Graphical User Interface (GUI) that adds the paths to the Anaconda installation. A convenient Windows tool to inspect the path variables is https://www.rapidee.com/en/about.

Some installations had difficulty finding the required version of 'libiomp5md.dll'. It appears that one installation (using Anaconda3–2019.07–Windows–x86_64.exe) had two (different?) versions of the file:

```
 where libiomp5md.dll
C:\ProgramData\Continuum\anaconda3\Library\bin\libiomp5md.dll
C:\Program Files (x86)\Common Files\Intel\Shared Files\cpp\Bin\Intel64\\libiomp5md.dll
```

Make sure that the Anaconda path comes first, above the other instances. Note that this may break the other application using the other instance.

4.4.2 Installing Python Packages not included in Anaconda

conda-forge is a community effort that provides *conda* packages not included in Anaconda. Registration of the *conda-forge* channel as a package source for *conda* might be required.

```
conda config --add channels conda-forge
```

Install the required packages not included in the Anaconda distribution from a Windows Console:

```
conda update conda

conda install -c conda-forge dash
conda install -c conda-forge pyside2
conda install -c conda-forge pyinstaller
conda install -c conda-forge visdcc
```

Online installation of additional packages, as well as updates to the Anaconda distribution is preferred. A recent off-line install required the following packages to be manually installed.

```
conda install dash-0.39.0-py_0.tar.bz2
conda install flask-compress-1.4.0-py_0.tar.bz2
conda install plotly-4.1.1-py_0.tar.bz2
conda install dash-html-components-0.14.0-py_0.tar.bz2
conda install dash-core-components-0.44.0-py_0.tar.bz2
conda install dash-table-3.6.0-py_0.tar.bz2
conda install dash-daq-0.1.4-py_0.tar.bz2
conda install plotly-orca-1.2.1-1.tar.bz2
conda install retrying-1.3.3-py37_1.tar.bz2
conda install dash-renderer-0.20.0-py_0.tar.bz2
conda install visdcc-0.0.40-pyh516909a_0.tar.bz2
conda install pyside2-5.13.1-py37hfa7ce6d_6.tar.bz2
```

Install PyInstaller only if final packaging of the application is required.

4.4.3 Developer Software Tools

A software version control system provides a centralised storage and management of the code base and supporting data files. It keeps track of all changes and allows recovery of previous versions of the code and data. The software and supporting data files are under the Optronics System Simulator (OSSIM) svn Software Version Control (SVC) at URL:

`svn://localhost/cms/trunk/green/red/user/tools/python/dash-lineplot`

The Windows GUI client TortoiseSVN, available from

`https://tortoisesvn.net/downloads.html`

is recommended. It's intuitive and easy to use, since it doesn't require the svn command line client to run. It is free to use, even in a commercial environment. If you prefer hands-on command line svn interaction, tick the command line client installation box during installation.

Any text editor can be used to edit the Python code. Visual Studio (VS) Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages (such as C++, C#, Java, Python, PHP, Go) and runtimes (such as .NET and Unity). Download VS Code from

`https://code.visualstudio.com/`

This document was generated using the LaTeX typesetting system. It is recommended that the MikTeX distribution be used on Windows. Download from `www.miktex.org` or from the TeX Users Group (TUG) web site at `https://tug.org/`. Suitable specialised editing tools include WinEdt (commercial but inexpensive) at `www.winedt.com`, or use VS Code as Integrated Development Environment (IDE).

4.5 Packaging for User Distribution

PyInstaller reads a Python script and analyses the code to discover every other module and library the script needs in order to execute. It finds the imported modules and looks in them for *import* statements, and so on recursively, until it has a complete list of modules the script may use. Some Python scripts import modules in ways that PyInstaller cannot detect. If the script requires files that PyInstaller does not know about, it can be specified in various ways:

- Specify additional files on the command line.

- Specify additional import paths on the command line.
- Modify the spec file created by PyInstaller.

After analyses, it collects copies of all the files, including the active Python interpreter, and puts them with the script in a single folder, or optionally in a single executable file.

The bundled application does not include any source code. PyInstaller bundles compiled Python scripts (.pyc files). These could in principle be decompiled to reveal the logic of the code. Python byte code can be obfuscated with AES256 by specifying an encryption key on PyInstaller's command line.

On the first run of PyInstaller, with the main script as input parameter, a spec file, with the same name as the input script, is generated.

```
pyinstaller options myscript.py
```

The spec file tells PyInstaller how to process the script. It encodes the script names and command line options provided to the PyInstaller command. The spec file is actually executable Python code. PyInstaller builds the bundled application by executing the contents of the spec file.

There are certain cases where it is useful to modify the spec file:

- When you want to bundle data files with the application.
- When you want to include run-time libraries (.dll or .so files) that PyInstaller does not know about from any other source.
- When you want to add Python run-time options to the executable.
- When you want to create a multiprogram bundle with merged common modules.

For more on this topic, see https://pyinstaller.readthedocs.io/en/stable/spec-files.html.

4.5.1 Bundling to a single folder

Initial usage, bundling to a folder, resulted in the first dash-lineplot.spec file:

```
pyinstaller dash-lineplot.py
```

Data files and folders required by the script are added in the spec file, see the added_files list in the listing below. It was necessary to use local copies of the following packages used in the application: platforms, dash, plotly, visdcc and some qt packages related to the QtWebEngineProcess used in the graphing display. These packages are included in the pyInstaller folder in the application source tree.

An example spec file for the dash-lineplot.py script:

```
block_cipher = None

added_files = [
         ( 'icons', 'icons' ),
         ( 'assets', 'assets'),
         ( 'data', 'data'),
         ( 'dash-config.xlsx', '.'),
         ( 'pyInstaller\\platforms', 'platforms' ),
         ( 'pyInstaller\\dash\\dash_core_components', 'dash_core_components'),
         ( 'pyInstaller\\dash\\dash_html_components', 'dash_html_components'),
         ( 'pyInstaller\\dash\\dash_renderer', 'dash_renderer'),
         ( 'pyInstaller\\dash\\dash', 'dash'),
         ( 'pyInstaller\\plotly', 'plotly'),
         ( 'pyInstaller\\qt\\translations', 'translations'),
         ( 'pyInstaller\\qt\\resources', 'resources'),
         ( 'pyInstaller\\qt\\qt.conf', '.'),
         ( 'pyInstaller\\qt\\QtWebEngineProcess.exe', '.'),
         ( 'pyInstaller\\visdcc', 'visdcc'),
         ( 'pyInstaller\\startPlotTool.bat', '.'),
         ]

a = Analysis(['dash-lineplot.py'],
             pathex=['C:\\Temp'],
             datas=added_files,
             hiddenimports=['PyQt5.QtWebEngineWidgets','PyQt5.QtNetwork',
             'PyQt5.QtWebEngineCore', 'PyQt5.QtWebChannel','PyQt5.QtPrintSupport'],
             hookspath=[],
             runtime_hooks=[],
             excludes=['tkinter'],
             win_no_prefer_redirects=False,
             win_private_assemblies=False,
             cipher=block_cipher,
             noarchive=False)
pyz = PYZ(a.pure, a.zipped_data,
             cipher=block_cipher)
exe = EXE(pyz,
          a.scripts,
          [],
          exclude_binaries=True,
          name='dash-lineplot',
          debug=False,
          bootloader_ignore_signals=False,
          strip=False,
          upx=True,
          console=True )
coll = COLLECT(exe,
               a.binaries,
               a.zipfiles,
               a.datas,
               strip=False,
               upx=True,
               upx_exclude=[],
               name='dash-lineplot')
```

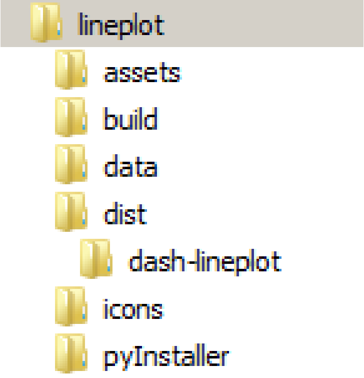
Bundled to a folder, PyInstaller creates a folder with the same name as the main Python script. This folder contains all the script dependencies, an executable file named after the Python script and any files or folders required by the script specified in the `spec` file.

Experimentation with PyInstaller showed that there might be a second copy of the `QtWebEngineProcess` executable in a folder `dist/dash-lineplot/PyQt5/Qt/bin/`. Removing this file ensures correct operation. A batch script `runPyInstaller.bat`, is available in the application top level folder for packaging of the application:

```
@echo off

pyInstaller dash-lineplot.spec

echo .
echo .
echo Removing QtWebEngineProcess.exe from the PyQt5\Qt\bin\ path if present.
echo .
```

```
del dist\dash-lineplot\PyQt5\Qt\bin\QtWebEngineProcess.exe

set /p DUMMY=done, hit ENTER to exit
```

Running this script in a folder named `lineplot` results in the folder structure depicted in Figure 4.1. Note that the distribution folder is inside the `dist` folder.



```
lineplot
  assets
  build
  data
  dist
    dash-lineplot
  icons
  pyInstaller
```

Figure 4.1: Folder structure in bundling `dash-lineplot.py` with PyInstaller to a distribution folder.

The `dash-lineplot` folder can now be compressed to `dash-lineplot.zip` and transmitted to the user computer. Installation on the user computer is a simple unzip of the `zip` file. The user runs the application by opening the folder and launching the `dash-lineplot` executable by running the `startPlotTool.bat` script in the top-level folder:

```
@echo off

echo Starting the Dash Line Plot Graphing Tool ....
echo.
echo.

cd dash-lineplot

if [%1]==[] dash-lineplot.exe
if not [%1]==[] dash-lineplot.exe --configfile=%1

set /p DUMMY=done, hit ENTER to exit
```

4.5.2 Bundling to a single file

The code can also be bundled to one file:

```
pyinstaller --onefile dash-lineplot.py
```

In this case `dash-lineplot.py` script and all its dependencies are bundled into a single executable named `dash-lineplot.exe`. One single (very large!) file is distributed to the client. When started it creates a temporary folder in the appropriate temp-folder location for the operating system. The folder is named _`MEIxxxxxx`, where `xxxxxx` is a random number. The boot loader uncompresses the support files and writes copies into the temporary folder. This can take a little time. That is why a one-file application distribution is slower to start than a one-folder distribution. After creating the temporary folder, the boot loader proceeds exactly as for the one-folder bundle, in the context of the temporary folder. When the bundled code terminates, the boot loader deletes the temporary folder.

Chapter 5

User-level Description

5.1 Starting the Dash Line Plot Graphing Utility

The application is distributed

- either as a Python script, i.e. `dash-lineplot.py`,
- or as an executable file, i.e. `dash-lineplot.exe`.

Double-clicking on any one of these files will start the application. If the computer is not set up to associate `.py` files with the Python interpreter, open a windows command prompt window and type the following:

```
python dash-lineplot.py
```

Working in a command prompt window is recommended. Warning and error messages output to the screen are published to the console. This can aid in tracing unexpected errors.

Working in an environment where the script was packaged to an executable, start the application from a console by typing

```
dash-lineplot.exe
```

An easy, and recommended way of opening a command prompt at the correct folder location, is by following the steps:

- Open the File Explorer.
- Navigate to the folder where the application Python script or executable is housed.
- Click in die File Explorer address bar.
- Type `cmd` into the address bar.
- Hit enter.

Hint: See https://www.howtogeek.com/235101/10-ways-to-open-the-command-prompt-in-windows-10/ for other ways to open a command prompt on Windows 10.

For ease of use a Windows batch script, `startPlotTool.bat`, is available in both environments. This script simply encapsulates the above commands:

```
@echo off

echo Starting the Dash Line Plot Graphing Tool ...
echo.
echo.

if [%1]==[] python dash-lineplot.py
if not [%1]==[] python dash-lineplot.py --configfile=%1

set /p DUMMY=done, hit ENTER to exit
```

or

```
@echo off

echo Starting the Dash Line Plot Graphing Tool ....
echo.
echo.

cd dash-lineplot

if [%1]==[] dash-lineplot.exe
if not [%1]==[] dash-lineplot.exe --configfile=%1

set /p DUMMY=done, hit ENTER to exit
```

Starting the script with no commandline arguments results in loading the default `dash-config.xlsx` configuration file. A configuration file name can be specified on the commandline, using any of the following options:

```
python dash-lineplot.py --configfile=anotherFileName.xlsx

dash-lineplot.exe --configfile=anotherFileName.xlsx

startPlotTool.bat anotherFileName.xlsx
```

Note that using the packaged version, the batch file starting the application is distributed at one folder level up from the actual distribution. This is done to give easy access to the script. The configuration file must be specified relative to the actual distribution folder. Figure 5.1 shows the position of the startup script relative to the distribution folder. In the script the directory is changed to the `dash-lineplot` folder and only then is the executable started. The configuration file is therefore always found on the path relative to folder `dash-lineplot`.

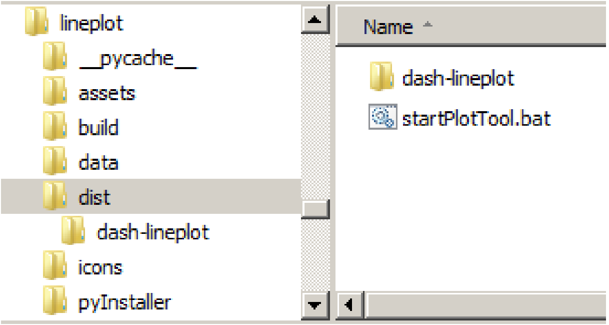
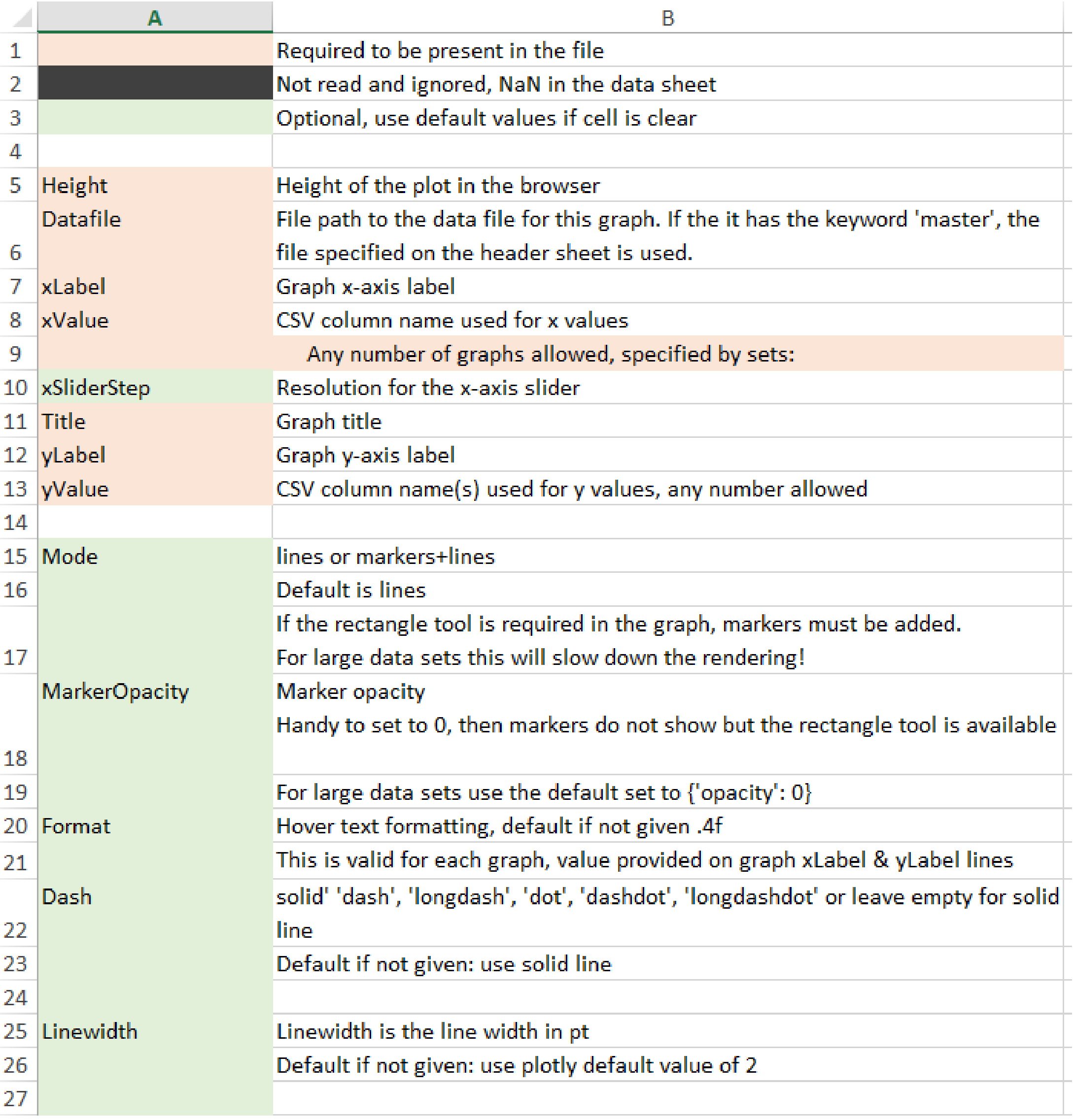


Figure 5.1: Distribution folder structure showing the location of the startup batch script.

5.2 Setup and Usage

5.2.1 Configuration File and Page Layout

Figures 5.2 and 5.3 show the documentation sheet of the Excel plotting configuration file. A short description of variables are provided on this sheet. Refer to the information presented in these figures, no further details are provided in this document.



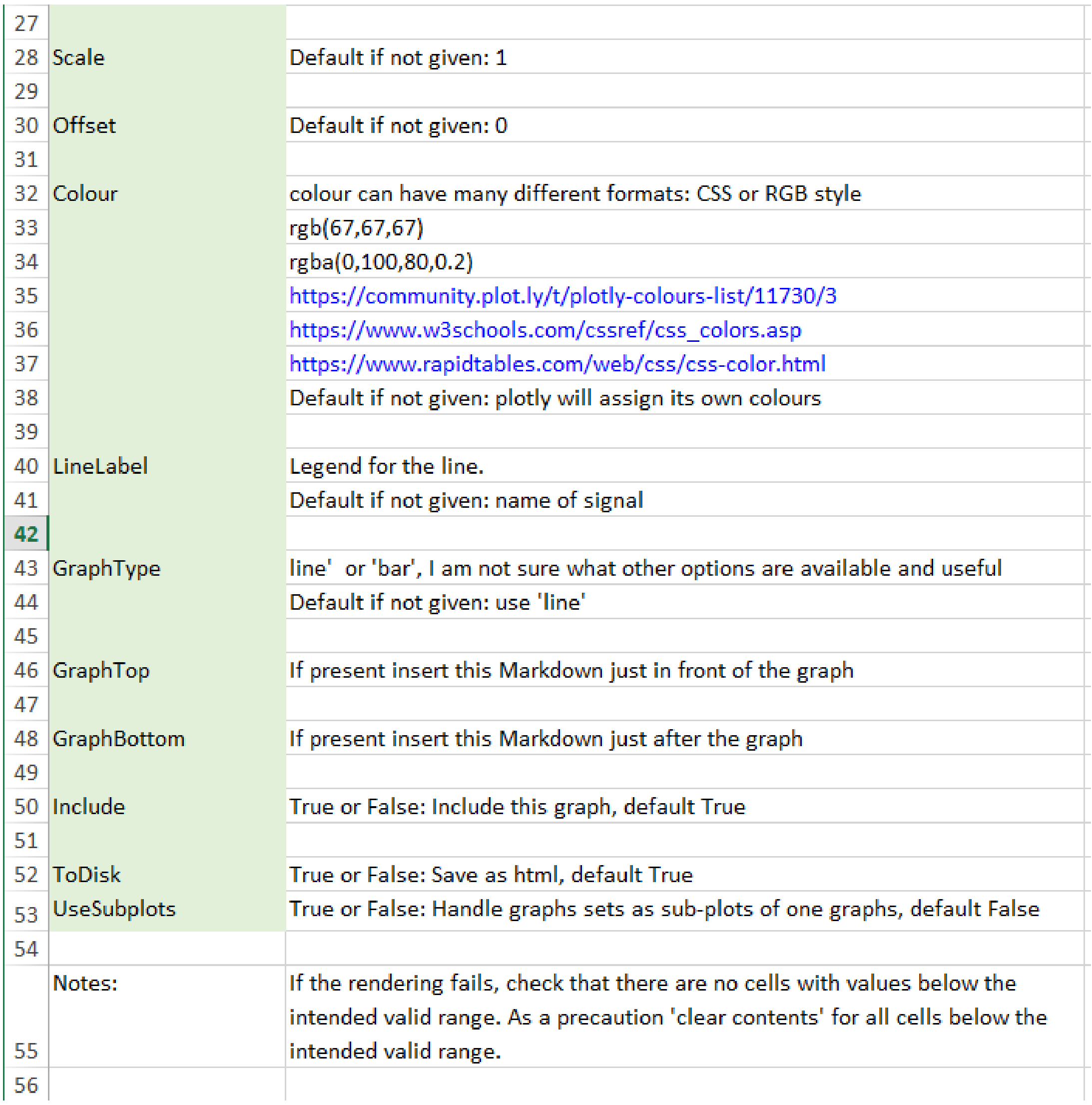
	A	B
1	🟧	Required to be present in the file
2	⬛	Not read and ignored, NaN in the data sheet
3	🟩	Optional, use default values if cell is clear
4		
5	Height	Height of the plot in the browser
6	Datafile	File path to the data file for this graph. If the it has the keyword 'master', the file specified on the header sheet is used.
7	xLabel	Graph x-axis label
8	xValue	CSV column name used for x values
9		Any number of graphs allowed, specified by sets:
10	xSliderStep	Resolution for the x-axis slider
11	Title	Graph title
12	yLabel	Graph y-axis label
13	yValue	CSV column name(s) used for y values, any number allowed
14		
15	Mode	lines or markers+lines
16		Default is lines
17		If the rectangle tool is required in the graph, markers must be added. For large data sets this will slow down the rendering!
18	MarkerOpacity	Marker opacity Handy to set to 0, then markers do not show but the rectangle tool is available
19		For large data sets use the default set to {'opacity': 0}
20	Format	Hover text formatting, default if not given .4f
21		This is valid for each graph, value provided on graph xLabel & yLabel lines
22	Dash	solid' 'dash', 'longdash', 'dot', 'dashdot', 'longdashdot' or leave empty for solid line
23		Default if not given: use solid line
24		
25	Linewidth	Linewidth is the line width in pt
26		Default if not given: use plotly default value of 2
27		

Figure 5.2: Documentation sheet of the Excel plotting configuration file.

The header sheet in the configuration file, see annotated Figure 5.4, provides general information published on each page of the display. The user can provide a data file name on this sheet for general use. Sheets can refer to this file with the keyword `master` in the `Datafile Value` entry.

Figures 5.5 and 5.6 are two example setup sheets specifying data configuration for plotting. The setup shown in Figure 5.5 results in each set of traces to be plotted on a separate Plotly figure. The setup in Figure 5.6 makes use of Plotly subplots. Using subplots enables hover data on traces to be displayed simultaneously for all traces defined on the sheet, see example in Figure 5.7. Exactly the same graph set plotted without the use of subplot is shown in Figure 5.8.

Figure 5.7 links the entries in the configuration file (refer to Figure 5.6) to the format of the graph page.



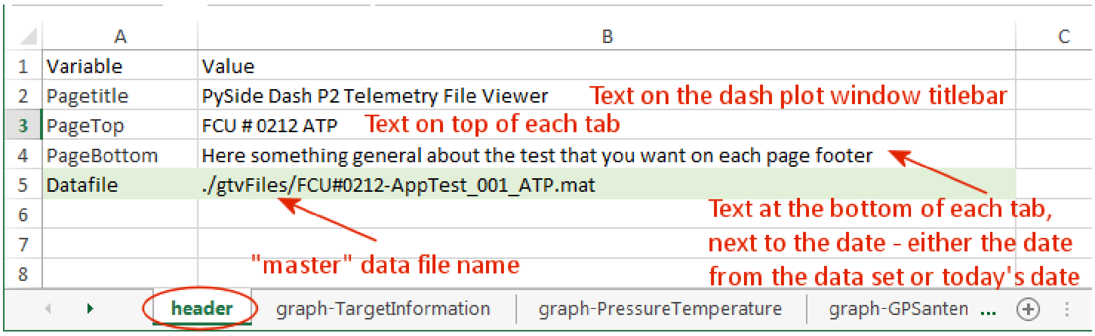
27		
28	Scale	Default if not given: 1
29		
30	Offset	Default if not given: 0
31		
32	Colour	colour can have many different formats: CSS or RGB style
33		rgb(67,67,67)
34		rgba(0,100,80,0.2)
35		https://community.plot.ly/t/plotly-colours-list/11730/3
36		https://www.w3schools.com/cssref/css_colors.asp
37		https://www.rapidtables.com/web/css/css-color.html
38		Default if not given: plotly will assign its own colours
39		
40	LineLabel	Legend for the line.
41		Default if not given: name of signal
42		
43	GraphType	line' or 'bar', I am not sure what other options are available and useful
44		Default if not given: use 'line'
45		
46	GraphTop	If present insert this Markdown just in front of the graph
47		
48	GraphBottom	If present insert this Markdown just after the graph
49		
50	Include	True or False: Include this graph, default True
51		
52	ToDisk	True or False: Save as html, default True
53	UseSubplots	True or False: Handle graphs sets as sub-plots of one graphs, default False
54		
55	Notes:	If the rendering fails, check that there are no cells with values below the intended valid range. As a precaution 'clear contents' for all cells below the intended valid range.
56		

Figure 5.3: Documentation sheet of the Excel plotting configuration file (continued).

Note the following:

- The tab name corresponds to the sheet name in the configuration file, omitting the leading `graph-` phrase.
- The header and footer at the top and bottom of the page are from the `header` sheet.
- The text entries just below and above these are the `GraphTop` and `GraphBottom` `Value` entries on the sheet.
- Two sets of traces are defined on the sheet, using subplots. Usage of the subplot option enables hover data to be displayed on all traces simultaneously.
- The hover data format is specified for the x-axis and two y-axis separately.
- The subplot titles, y-axis and x-axis labels are as provided in the `graph-IMUrates` sheet of the configuration file.

The same data is displayed in Figure 5.8, not using the subplot functionality.



	A	B	C
1	Variable	Value	
2	Pagetitle	PySide Dash P2 Telemetry File Viewer	
3	PageTop	FCU # 0212 ATP	
4	PageBottom	Here something general about the test that you want on each page footer	
5	Datafile	./gtvFiles/FCU#0212-AppTest_001_ATP.mat	
6			
7			
8			

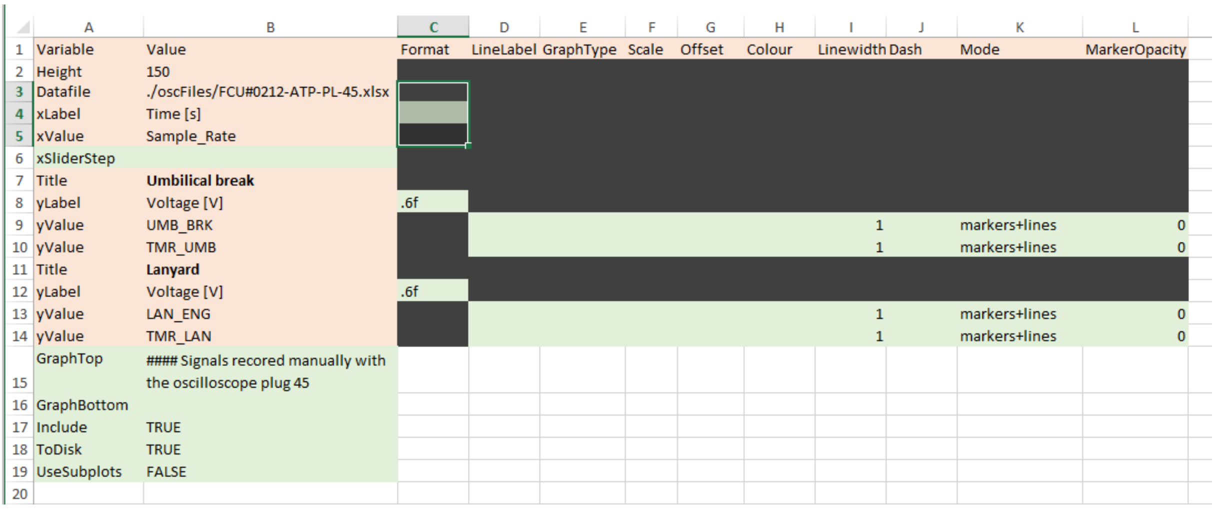
Text on the dash plot window titlebar

Text on top of each tab

Text at the bottom of each tab, next to the date - either the date from the data set or today's date

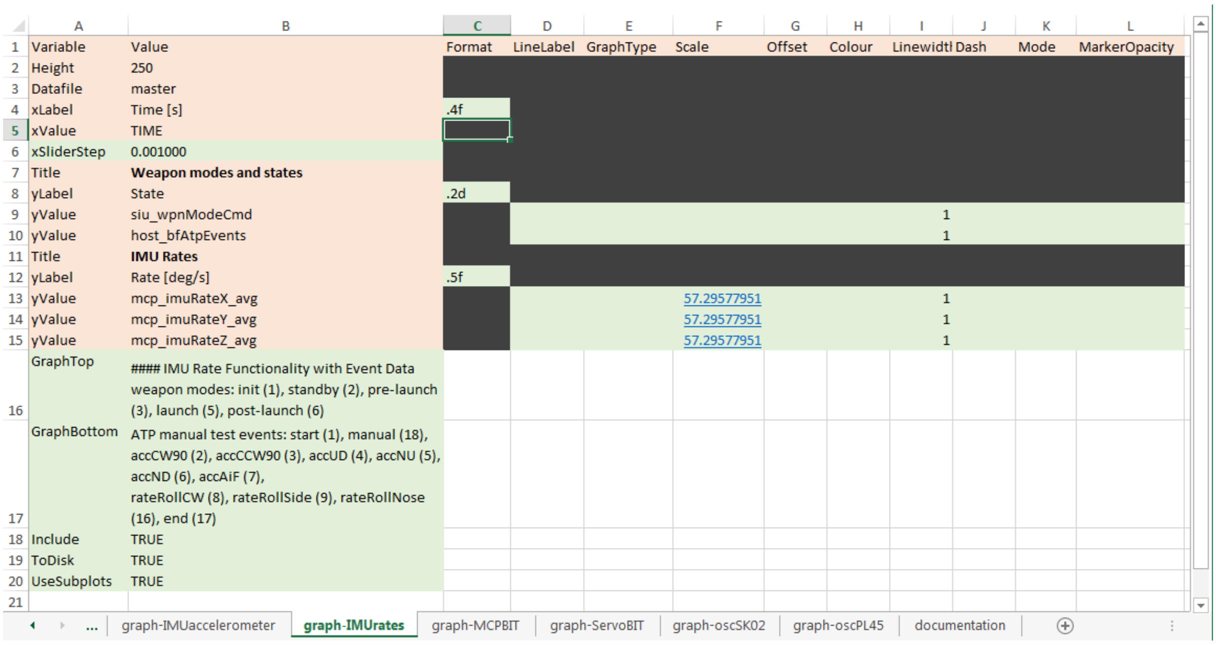
"master" data file name

Figure 5.4: Header sheet in the configuration file.



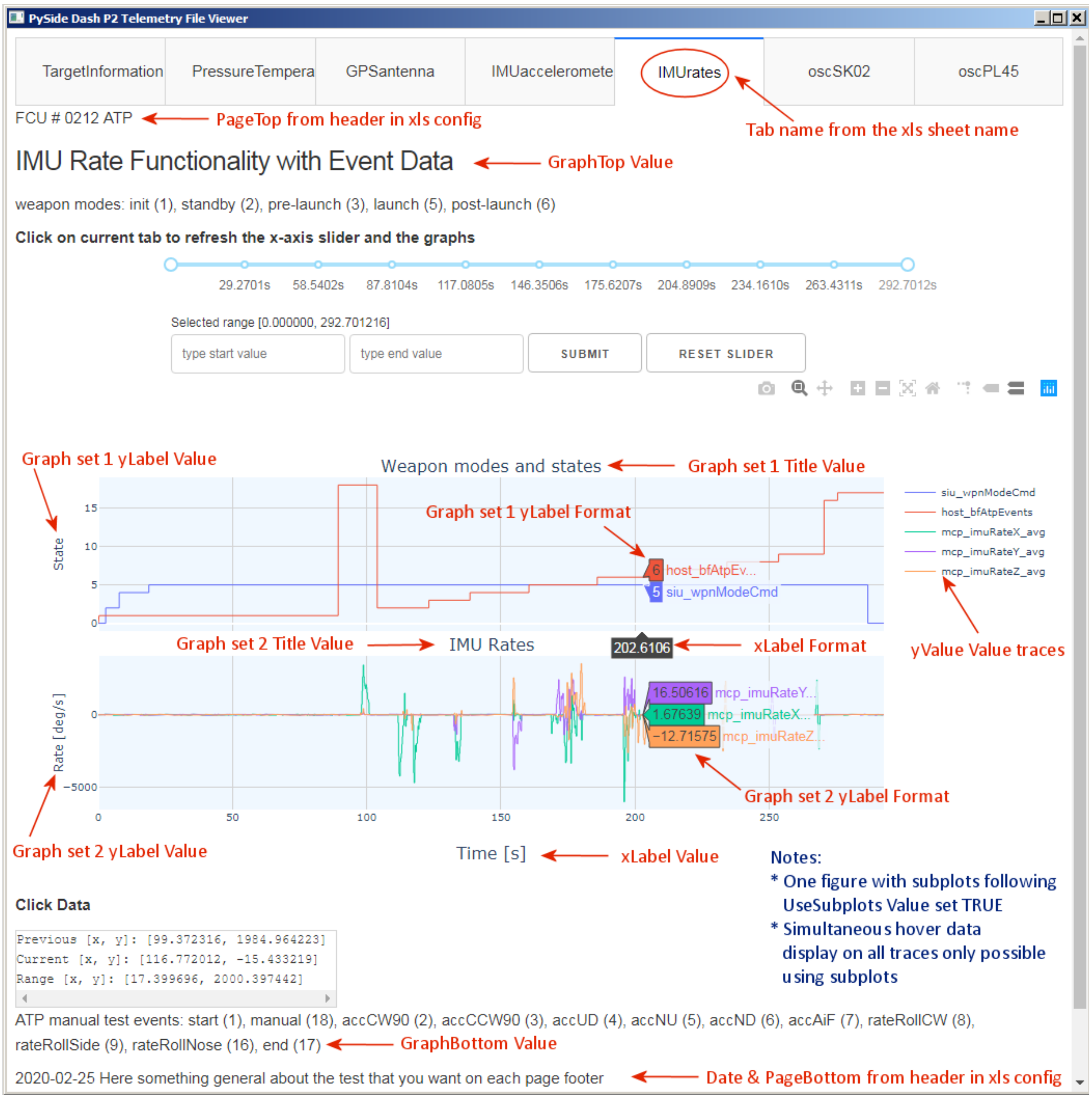
	A	B	C	D	E	F	G	H	I	J	K	L
1	Variable	Value	Format	LineLabel	GraphType	Scale	Offset	Colour	Linewidth	Dash	Mode	MarkerOpacity
2	Height	150										
3	Datafile	./oscFiles/FCU#0212-ATP-PL-45.xlsx										
4	xLabel	Time [s]										
5	xValue	Sample_Rate										
6	xSliderStep											
7	Title	**Umbilical break**										
8	yLabel	Voltage [V]	.6f									
9	yValue	UMB_BRK							1		markers+lines	0
10	yValue	TMR_UMB							1		markers+lines	0
11	Title	**Lanyard**										
12	yLabel	Voltage [V]	.6f									
13	yValue	LAN_ENG							1		markers+lines	0
14	yValue	TMR_LAN							1		markers+lines	0
15	GraphTop	#### Signals recored manually with the oscilloscope plug 45										
16	GraphBottom											
17	Include	TRUE										
18	ToDisk	TRUE										
19	UseSubplots	FALSE										
20												

Figure 5.5: Example graph setup where subplots are not used, transparent markers are used and hover data format is specified.



	A	B	C	D	E	F	G	H	I	J	K	L
1	Variable	Value	Format	LineLabel	GraphType	Scale	Offset	Colour	Linewidtl	Dash	Mode	MarkerOpacity
2	Height	250										
3	Datafile	master										
4	xLabel	Time [s]	.4f									
5	xValue	TIME										
6	xSliderStep	0.001000										
7	Title	**Weapon modes and states**										
8	yLabel	State	.2d									
9	yValue	siu_wpnModeCmd							1			
10	yValue	host_bfAtpEvents							1			
11	Title	**IMU Rates**										
12	yLabel	Rate [deg/s]	.5f									
13	yValue	mcp_imuRateX_avg				57.29577951			1			
14	yValue	mcp_imuRateY_avg				57.29577951			1			
15	yValue	mcp_imuRateZ_avg				57.29577951			1			
16	GraphTop	#### IMU Rate Functionality with Event Data weapon modes: init (1), standby (2), pre-launch (3), launch (5), post-launch (6)										
17	GraphBottom	ATP manual test events: start (1), manual (18), accCW90 (2), accCCW90 (3), accUD (4), accNU (5), accND (6), accAiF (7), rateRollCW (8), rateRollSide (9), rateRollNose (16), end (17)										
18	Include	TRUE										
19	ToDisk	TRUE										
20	UseSubplots	TRUE										
21												

Figure 5.6: Example setup where subplots are used, the IMU rates are scaled, no markers are used and hover data format is specified.



FCU # 0212 ATP ← PageTop from header in xls config

Tab name from the xls sheet name

IMU Rate Functionality with Event Data ← GraphTop Value

weapon modes: init (1), standby (2), pre-launch (3), launch (5), post-launch (6)

Click on current tab to refresh the x-axis slider and the graphs

Selected range [0.000000, 292.701216]

Graph set 1 yLabel Value

Weapon modes and states ← Graph set 1 Title Value

Graph set 1 yLabel Format

yValue Value traces

Graph set 2 Title Value → IMU Rates

202.6106 ← xLabel Format

Graph set 2 yLabel Format

Graph set 2 yLabel Value

Time [s] ← xLabel Value

Notes:
* One figure with subplots following UseSubplots Value set TRUE
* Simultaneous hover data display on all traces only possible using subplots

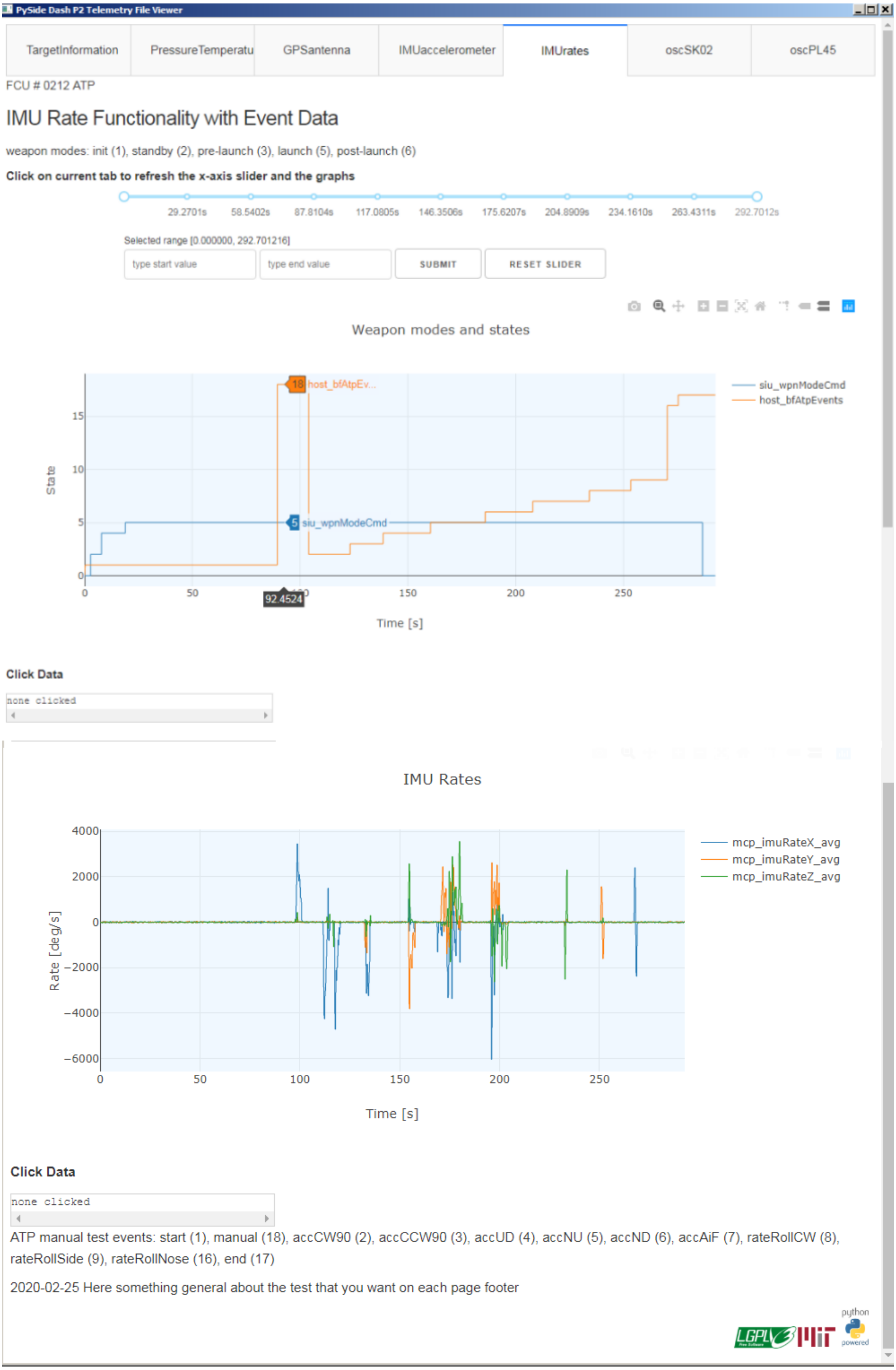
Click Data

```
Previous [x, y]: [99.372316, 1984.964223]
Current  [x, y]: [116.772012, -15.433219]
Range [x, y]: [17.399696, 2000.397442]
```

ATP manual test events: start (1), manual (18), accCW90 (2), accCCW90 (3), accUD (4), accNU (5), accND (6), accAiF (7), rateRollCW (8), rateRollSide (9), rateRollNose (16), end (17) ← GraphBottom Value

2020-02-25 Here something general about the test that you want on each page footer ← Date & PageBottom from header in xls config

Figure 5.7: Plot tab the IMU rates graph setup example, using subplots.



FCU # 0212 ATP

IMU Rate Functionality with Event Data

weapon modes: init (1), standby (2), pre-launch (3), launch (5), post-launch (6)

Click on current tab to refresh the x-axis slider and the graphs

Selected range [0.000000, 292.701216]

Click Data

```
none clicked
```

Click Data

```
none clicked
```

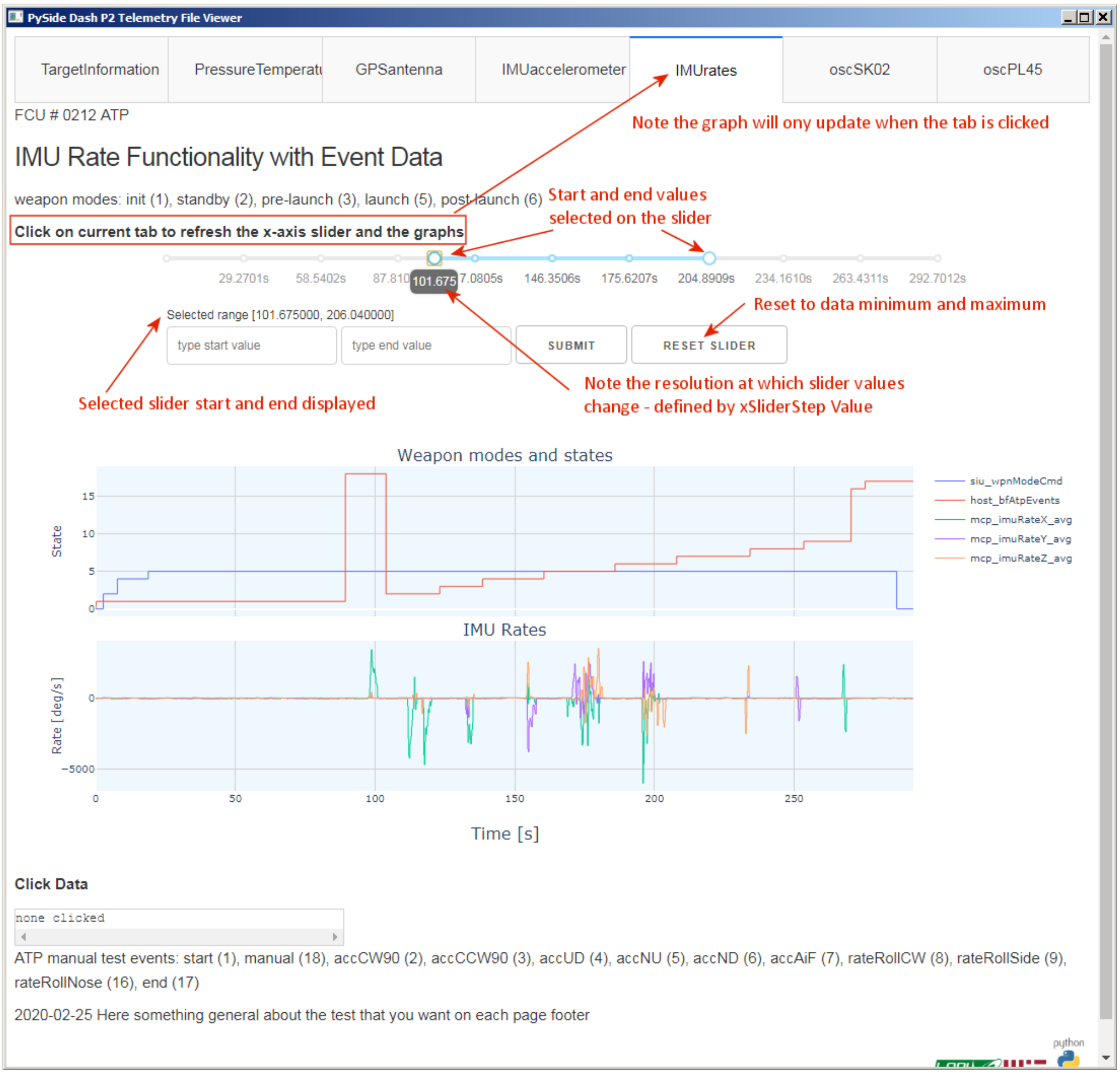
ATP manual test events: start (1), manual (18), accCW90 (2), accCCW90 (3), accUD (4), accNU (5), accND (6), accAiF (7), rateRollCW (8), rateRollSide (9), rateRollNose (16), end (17)

2020-02-25 Here something general about the test that you want on each page footer

Figure 5.8: Plot tab the IMU rates graph setup example, not using subplots.

5.2.2 Slider Usage

An x-axis slider is available at the top of each page, covering the data set x-axis data range. Refer to Figure 5.9. The user sets the minimum and maximum value of the x-axis with the slider handles. The text box immediately displays the selected range. The increments at which the slider values change are controlled by the specification from the configuration file. The user however has to click on the current page tab before the graphs are redrawn to display only data in the selected x-axis range, see Figure 5.10. The reset button will reset the x-axis limits to that of the data set.



FCU # 0212 ATP

IMU Rate Functionality with Event Data

weapon modes: init (1), standby (2), pre-launch (3), launch (5), post-launch (6)

Click on current tab to refresh the x-axis slider and the graphs

Selected range [101.675000, 206.040000]

```
none clicked
```

ATP manual test events: start (1), manual (18), accCW90 (2), accCCW90 (3), accUD (4), accNU (5), accND (6), accAiF (7), rateRollCW (8), rateRollSide (9), rateRollNose (16), end (17)

2020-02-25 Here something general about the test that you want on each page footer

Note the graph will ony update when the tab is clicked

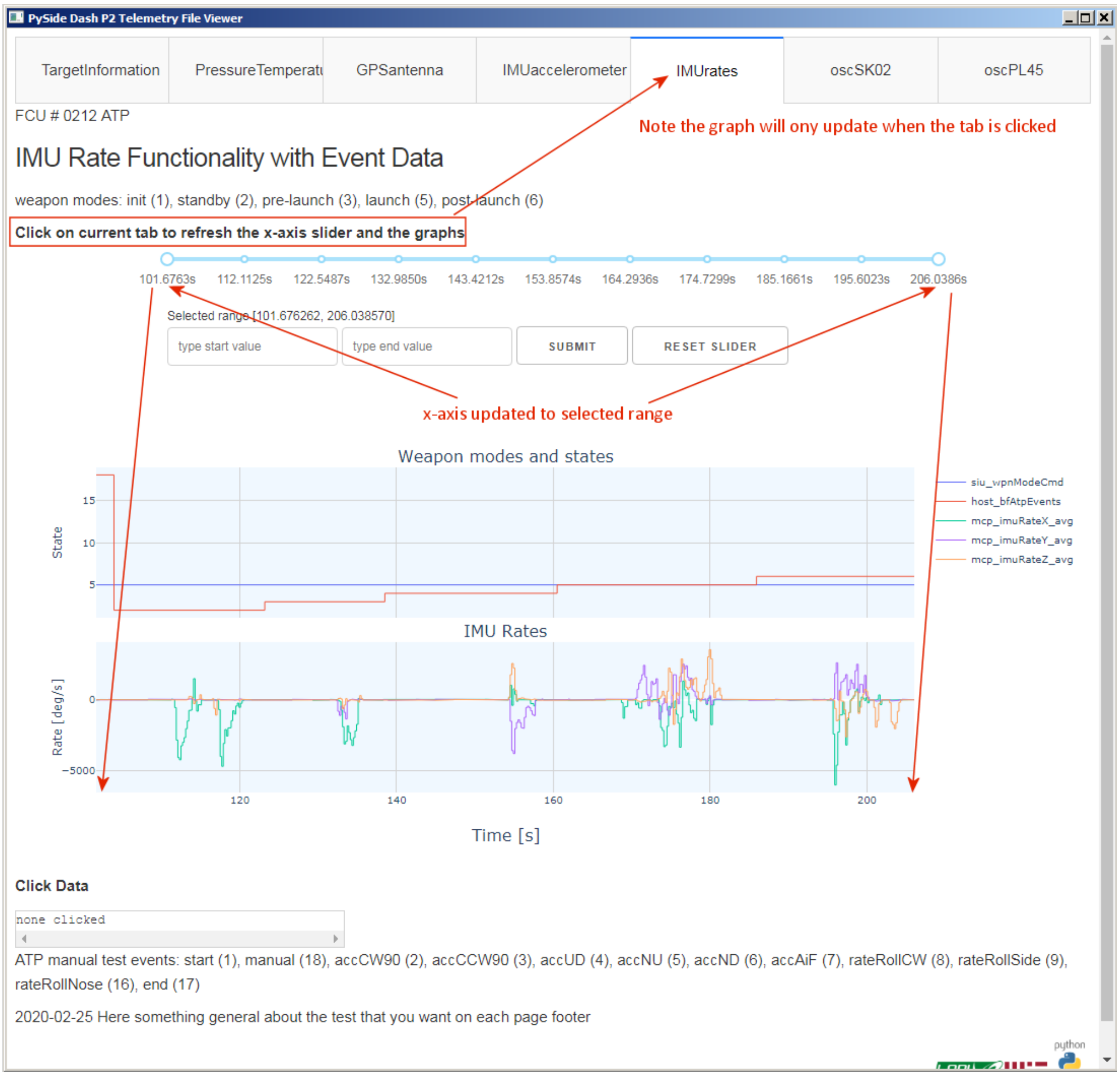
Start and end values selected on the slider

Reset to data minimum and maximum

Note the resolution at which slider values change - defined by xSliderStep Value

Selected slider start and end displayed

Figure 5.9: The x-axis slider at the top of the page provides the capability to zoom the complete data set to a user selected x-range.



FCU # 0212 ATP

IMU Rate Functionality with Event Data

Note the graph will ony update when the tab is clicked

weapon modes: init (1), standby (2), pre-launch (3), launch (5), post-launch (6)

Click on current tab to refresh the x-axis slider and the graphs

Selected range [101.676262, 206.038570]

x-axis updated to selected range

Click Data

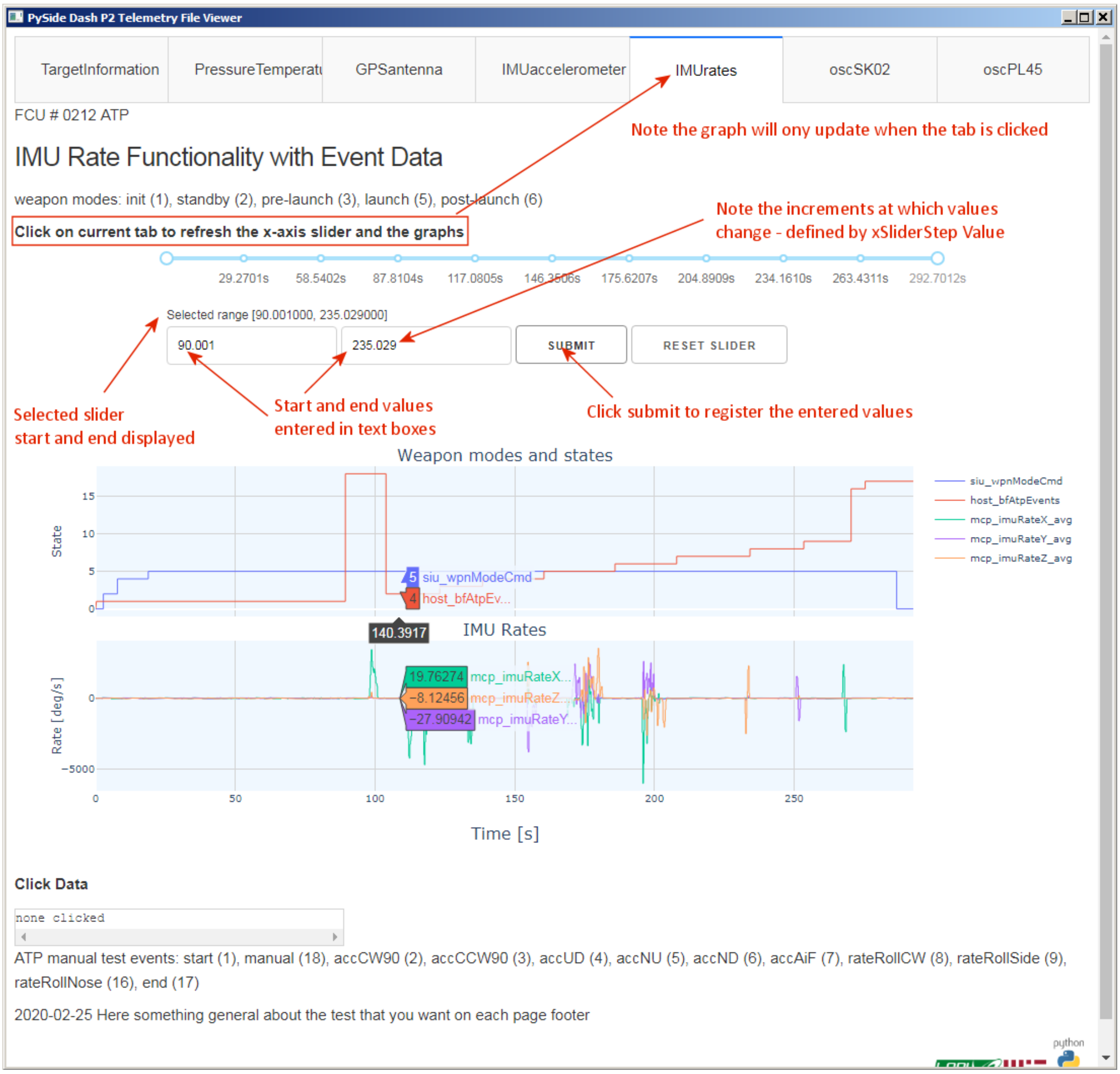
```
none clicked
```

ATP manual test events: start (1), manual (18), accCW90 (2), accCCW90 (3), accUD (4), accNU (5), accND (6), accAiF (7), rateRollCW (8), rateRollSide (9), rateRollNose (16), end (17)

2020-02-25 Here something general about the test that you want on each page footer

Figure 5.10: A click on the current page tab triggers the redraw of the page, using only data in the x-axis range selected by the user.

The x-axis range can also be set by typing values in the text boxes just below the slider. Refer to Figure 5.11. The submit button records these selected values and activates the display of the selected range in the dedicated text box. A click on the tab will trigger an update to the graph data displayed.



FCU # 0212 ATP

IMU Rate Functionality with Event Data

weapon modes: init (1), standby (2), pre-launch (3), launch (5), post-launch (6)

Click on current tab to refresh the x-axis slider and the graphs

Note the graph will ony update when the tab is clicked

Note the increments at which values change - defined by xSliderStep Value

Selected range [90.001000, 235.029000]

Selected slider start and end displayed

Start and end values entered in text boxes

Click submit to register the entered values

Click Data

none clicked

ATP manual test events: start (1), manual (18), accCW90 (2), accCCW90 (3), accUD (4), accNU (5), accND (6), accAiF (7), rateRollCW (8), rateRollSide (9), rateRollNose (16), end (17)

2020-02-25 Here something general about the test that you want on each page footer

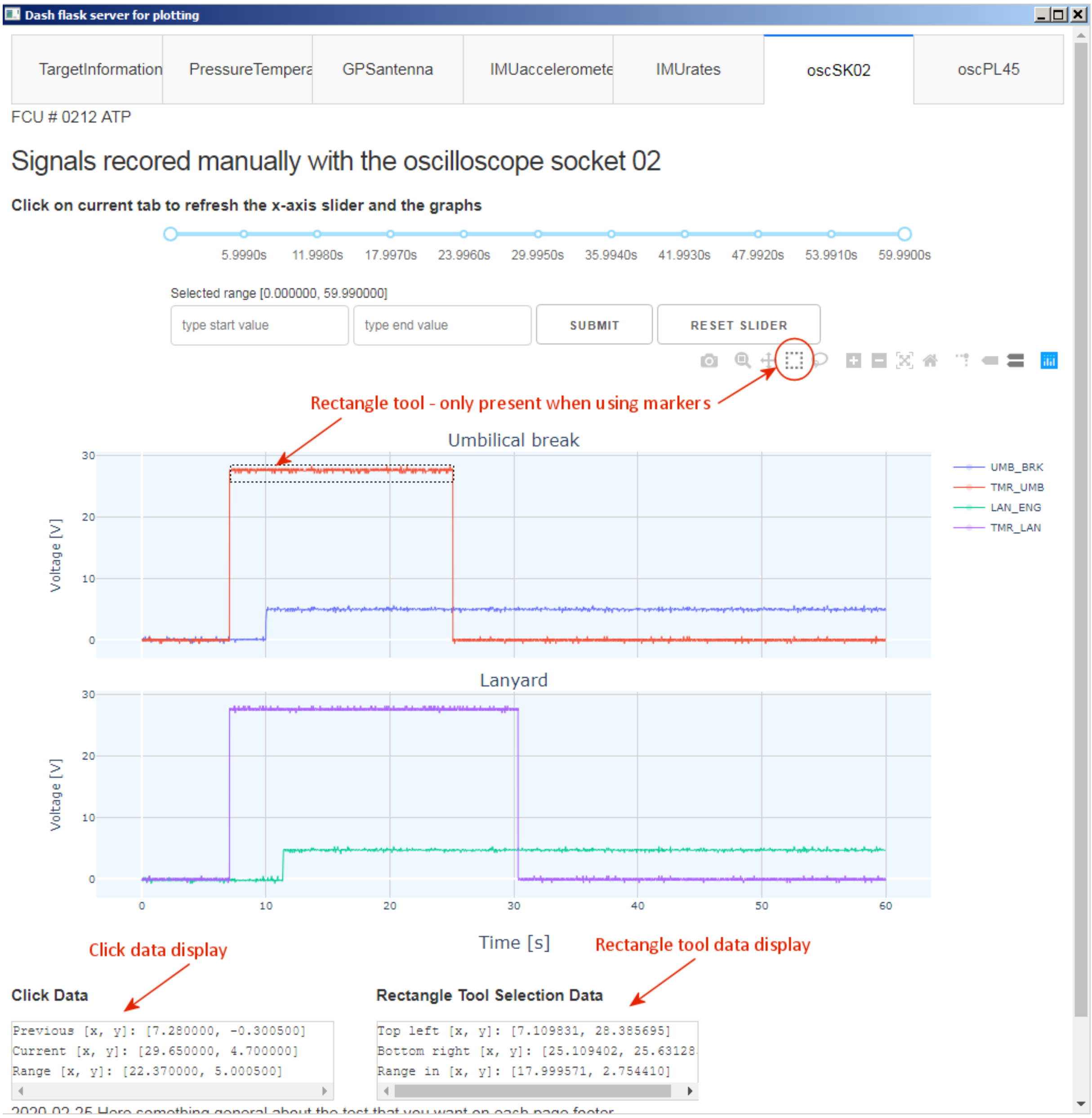
Figure 5.11: The user can specify the start and end values of the x-axis using the text boxes provided. The submit button will register the values for use when redrawing the graphs.

5.2.3 Range Measurements on Graphs

Two methods are available to do a measurement on the graphs (see Figure 5.12):

Click Data: The user can click on any trace to record the clicked point in the `Click Data` box below the relevant graph. When a second data point is clicked, the range in x and y are reflected in the display text box. This functionality is available for individual Plotly figures, as well as subplot figures. The click functionality can be used in conjunction with the standard Plotly zoom functionality.

Rectangle Tool Selection Data: The Plotly rectangle tool will only appear in the toolbar of the figure if markers are used for one or more traces in the figure. For large data sets, usage of this tool is not recommended since it slows down the drawing process. If the user prefers to use this tool, the opacity of the markers can be set to 0 in order to not clutter the graph. To measure using the rectangle tool, click on the tool in the toolbar, then draw the rectangle on the graph using the mouse. The top-left, bottom-right and range in x and y are displayed in the `Rectangle Tool Selection Data` text box to below the relevant graph. This functionality can also be used in conjunction with the Plotly zoom functionality.



FCU # 0212 ATP

Signals recored manually with the oscilloscope socket 02

Click on current tab to refresh the x-axis slider and the graphs

Selected range [0.000000, 59.990000]

Click Data

```
Previous [x, y]: [7.280000, -0.300500]
Current [x, y]: [29.650000, 4.700000]
Range [x, y]: [22.370000, 5.000500]
```

Rectangle Tool Selection Data

```
Top left [x, y]: [7.109831, 28.385695]
Bottom right [x, y]: [25.109402, 25.63128
Range in [x, y]: [17.999571, 2.754410]
```

2020.02.25 Here something general about the test that you want on each page footer

Figure 5.12: Using the Click and Rectangle tools to do measurements on the data set.

Appendix A

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Version 3, 29 June 2007

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