PyDAQviewer Tutorial

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Abstract : The VLF PyDAQviewer (Python Data Acquisition data viewer) is a Python program designed to make it easier to view and analyze data acquired with your AWESOME receiver. This program is inspired from the matlab DAQviewer developped by Benjamin Cotts at Stanford University and distribuded for the use of AWESOME-VLF community at the ISWI network.

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1 The VLF PyDAQviewer

The program is broken up into three main sections:

- 1. Selecting data
- 2. Loading and ploting data
- 3. Viewing and interacting with data

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2 Which Data to Plot

Narrowband data consist in the amplitude and phase of specific transmitter frequencies received at a given location. The size of the dataset is reasonable, in the order of 100 MB per day & per site, and can be easily transmitted from remote field sites over the internet. In other words, these data can be archived continuously.

The data are saved in a Matlab V4 format, allowing an ease read with Matlab. The format consists of a header with basic information, followed by the data itself. The specific format is detailed below, so that it is machine-readable in any digital application.

2.1 Narrowband data file naming convention

Narrowband filename convention is similar to that used in the International Space Weather Initiative (ISWI) Data Policy (version 1.3.1) for AWESOME receiver.

 ${\tt XXYYMMDDHHMMSSZZZ}_{A}CCT.mat$

- XX Station ID
- YY Year
- MM Month
- DD Day
- HH Hour
- MM Minute
- SS Second
- ZZZ Transmitter call sign
- A Not relevant (0)
- CC 00 for N/S channel, 01 for E/W channel
- T Type of data
 - A is low resolution (1 Hz sampling rate) amplitude
 - B is low resolution (1 Hz sampling rate) phase
 - C is high resolution (50 Hz sampling rate) amplitude
 - D is high resolution (50 Hz sampling rate) phase
 - F is high resolution (50 Hz sampling rate) effective group delay

Example : TN18050300000DHO₀01A.mat

- TN stands for Tunisia
- 180503000000 = 18/05/03 at 00:00:00
- DHO is for a German transmitter
- 01 is for E/W orientation
- A is for low resolution (1 Hz sampling rate) amplitude

2.2 Folder Path Convention: working directory

After running the PyDAQviewer.py script, the working directory that is used to store your Narrowband data is set by default to : 'C:/NarrowbandData/'. See the user interface in Figure 1.

PyDAQviewer							?	×
Date 25-April-20	18 V Patř	n to Na	arrowband Data	C:/Nar	rowbandData/			
Subplots								
Subplot Nº 1	Tunisia	•	NAA-NS	•	Low Res/(High Res)	Ampl	itude/(Pha	se)
Subplot N° 2	Tunisia	•	NAA-NS	•	Low Res/(High Res)	Ampl	itude/(Pha	se)
Subplot Nº 3	Tunisia	~	NAA-NS	T	Low Res/(High Res)	Ampl	itude/(Pha	se)
Subplot Nº 4	Tunisia	~	NAA-NS	v	Low Res/(High Res)	Ampl	itude/(Pha	se)
Subplot N° 5	Tunisia	~	NAA-NS	~	Low Res/(High Res)	Ampl	itude/(Phas	se)
Subplot Nº 6	Tunisia	Ţ	NAA-NS	Ţ	Low Res/(High Res)	Ampl	itude/(Pha	se)
			Plo	t				
You are looking for:	['TN 180425*NAA_	000A.	mať, 'TN180425	*NAA_()00A.mať]			

Figure 1: PyDAQviewer GUI after running the PyDAQviewer.py script.

The path to your data will be something like: 'C:/NarrowbandData/SiteName/Year/MM/DD/' (e.g. 'C:/NarrowbandData/Tunisia/2018/03/25/'). Note that this can be on any drive root drive: C-Z including DVD drives etc. So if you burn data to a DVD burn it in the same folder and the PyDAQviewer will be able to find them.

Select Narrowband Data Folder (NarrowbandData) X							
← → ∽ ↑ 🖕 > This PC > Local Disk (C:) > 🗸 🖸 Search Local Disk (C:) 🔎							
Organize 🔻 New folder 🛛 🕮 👻 😮							
GeomagneticAc 🔨	Name	Date modified	Туре ^				
PyDAQviewer		07/04/2018 12:12	File folde				
Desktop	OneDriveTemp	07/04/2018 09:58	File folde				
St Dropbox	Windows	30/03/2018 22:52	File folde				
	Windows.old	23/03/2018 17:04	File folde				
	📙 Program Files	12/03/2018 02:47	File folde				
astrophoto		12/03/2018 02:47	File folde				
Documents	PerfLogs	12/03/2018 02:36	File folde				
_ Images	ProgramData	11/03/2018 19:05	File folde				
Musique	Users	11/03/2018 18:19	File folde				
Pièces jointes		09/03/2018 21:32	File folde				
Ahmed Ammar	SGetCurrent	09/03/2018 20:46	File folde				
This DC	📙 program1	17/11/2017 23:07	File folde 🗸				
			>				
Folder:	NarrowbandData						
Select Folder Cancel							

Figure 2: Select NarrowbandData folder.

2.3 Select date from calander

After locating the working directory, the user can select AWESOME's data recording date by using a calendar widget as shown in Figure 3.

2.4 Receiver-Transmitter Information

This file is simply a Python file (Source code below: SiteInfo.py) in which you will enter two dictionaries. The first one is $Rx_I Dindicating the AWESOM Ereceiver locations and their IDs. These areas and the interval of the second second$

```
# -*- coding: utf-8 -*-
#SiteInfo.py
,,,
Purpose: Save VLF Receivers (Rx) and Transmitters (Tx) Info
,,,
# Rx info
Rx_ID = {
    "Tunisia":"TN",
    "Algeria":"AL",
    "France":"FR",
    "Japan":"JP",
    "NewYork":"NY",
    "Boulder":"B0",
```

🌒 PyDi	AQviev	ver						? ×
6 1	% (
Date	25-Apr	il-2018	~	Path t	o Narrov	vband D	ata C:	/NarrowbandData/
	0		Ap	pri <mark>l, 2</mark> 0	18		•	
Subpl	Sun	Mon	Tue	Wed	Thu	Fri	Sat	
🗹 Su	25	26	27	28	29	30	31	▼ Low Res/(High Res) Amplitude/(Phase)
🖂 Su	1	2	3	4	5	6	7	▼ □ Low Res/(High Res) □ Amplitude/(Phase)
□ Su	8	9	10	11	12	13	14	Low Res/(High Res) Amplitude/(Phase)
	15	16	17	18	19	20	21	Low Res/(High Res) Amplitude/(Phase)
	22	23	24	25	26	27	28	
L Su	29	30	1	2	3	4	5	Low Res/(High Res) Amplitude/(Phase)
Sul	bplot N	°6 Tur	nisia		▼ NA	A-NS		Low Res/(High Res) Amplitude/(Phase)
							Plot	
You are l	looking	for: ['TN	180425	*NAA_00	00A.mať	, 'TN 180)425*NA	NA_000A.mat']

Figure 3: Select date of the recorded data from the calendar.

	"Cheyenne":"CH", "Walsenburg":"WS", "LasVegas":"LV",
	}
# Tx info Tx ID = {	
	"NAA-NS": "NAA_000", "NAA-EW": "NAA_001", "NRK-NS": "NRK_000", "NRK-EW": "NRK_000", "NLK-EW": "NLK_000", "NLK-EW": "NAL_000", "NAU-SW": "NAU_000", "NAU-SW": "NAU_000", "NAU-SW": "NAU_000", "NPM-NS": "NPM_000", "NPM-SW": "NPM_000", "NPM-EW": "NPM_001", "ICV-NS": "ICV_000", "ICV-SW": "ICV_000", "ICV-EW": "ICV_000", "NSC-EW": "ICV_000", "SCC-SS": "NSC_000", "GDD-SW": "GDD_000", "GBZ-NS": "GBZ_001", "DHO-NS": "DHO_000",

	"HWU-NS":"HWU "HWU-EW":"HWU "JXN-NS":"JXN "JXN-EW":"JXN "ISR-NS":"ISR "ISR-EW":"ISR_ }	000", 001", 000", 001", 000", 001"		
PyDAQviewer				?
Date 25-April-20	18 V Path to Na	arrowband Data	C:/NarrowbandData/	
	Turini -		- Dian Baa (Aliah Baa)	Amplitude //Dhace)
Subplot Nº 2			Low Res/(High Res)	Amplitude/(Phase)
Subplot N° 3	France	NAA-NS	Low Res/(High Res)	Amplitude/(Phase)
Subplot Nº 4	NewYork Boulder	NAA-NS	 Low Res/(High Res) 	Amplitude/(Phase)
Subplot N° 5	Cheyenne Walsenburg	NAA-NS	▼ Low Res/(High Res)	Amplitude/(Phase)
Subplot Nº 6	LasVegas	NAA-NS	✓ Low Res/(High Res)	Amplitude/(Phase)
		Plo		

"DHO-EW":"DHO_001",

Figure 4: Select AWESOME station.

PyDAQviewer							?	×
Date 25-April-20	18 ~	Path to Na	rrowband Data	C:/Nar	rowbandData/			
Subplot N° 1 Subplot N° 2 Subplot N° 3 Subplot N° 4 Subplot N° 5 Subplot N° 6	Tunisia Tunisia Tunisia Tunisia Tunisia Tunisia	* * * *	NAA-NS NAA-EW NRK-NS NRK-EW NLK-NS NLK-EW NAU-NS NAU-EW NPM-NS NPM-EW	•	Low Res/(High Res)	Ampi	litude/(Pha litude/(Pha litude/(Pha litude/(Pha litude/(Pha litude/(Pha	se) se) se) se) se)
			Plo	t				
You are looking for:	['TN180425*1	NAA_000A.r	nať, 'TN 180425	*NAA_(000B.mať]			

Figure 5: Select VLF transmitter.

3 Reproducing the Lightning-Induced Electron Precipitation (LEP) Tutorial

Now that you have a basic understanding of how the DAQviewer works, it's time to put it to the test and try out all the features. To do this we'll be reproducing a few of the plots you made by hand in the LEP tutorial.

To start edit the SiteInfo.py file to include the Rx_IDs : Cheyenne, Boulder, Walsenburg, and LasVegas(net LasVegas).

The output of this configuration is in below:

-				
PyDAQviewer				? ×
Date 28-January	7-2006 ∨ Path to I	Narrowband Data	C:/NarrowbandData/	
Subplots				
Subplot Nº 1	Boulder 🔹	NAA-EW	▼ Low Res/(High Res)	Amplitude/(Phase)
Subplot N° 2	Walsenburg 🔹	NAA-EW	▼ Low Res/(High Res)	Amplitude/(Phase)
Subplot Nº 3	Cheyenne 🔻	NAA-EW	▼ Low Res/(High Res)	Amplitude/(Phase)
Subplot Nº 4	Tunisia	NAA-NS	▼ Low Res/(High Res)	Amplitude/(Phase)
Subplot N° 5	Tunisia	NAA-NS	▼ Low Res/(High Res)	Amplitude/(Phase)
Subplot Nº 6	Tunisia	NAA-NS	▼ Low Res/(High Res)	Amplitude/(Phase)
		Plo	ot	
				3
You are looking for:	[BO060128*NAA_001	A.mať, 'WS06012	8*NAA_001A.mat', 'CH060128*N	IAA_001A.mať]

Figure 6: Example working on data from LEP tutorial.



Figure 7: Generated figure.



Figure 8: Zoomed figure.