User Manual

Semi-Supervised Structured Noise Detection

Farhan Asif Chowdhury

Introduction:

This is an user manual for the MATLAB program “Structured Noise Detection” which performs “Semi-supervised Structured Noise Detection” on Well pressure change derivative data.

Purpose: Structured noise detection in transient Well pressure change derivative data.

For Whom: People who will perform real time Pressure Transient Analysis for Well property identification.

Overview:

In this semi supervised method, we first select the Deviation Threshold parameter value, which is the only parameter of our method, by empirically observing the noise detection performance on a “Structured Noise affected” PBU data of an Well for variable Deviation threshold values. We select the threshold value which provides “optimal” performance and use that fixed threshold for Structured Noise Detection among the rest of the PBUs of that Well.

In brief, we use only one PBU per Well for selecting the threshold parameter, that is why we call our method semi supervised.

Getting started:

Set-up: Our whole program is inside a main home folder named “Structured Noise Detection”. In case you received a zipped version, unzip it first and put it in any directory/folder. Inside this main folder there are four other folders, a pdf file named user_manual (this file) and a readme file. The readme file will direct you to this user manual.

There four folders are CODE, DATA, DOCUMENTATION and RESULT. All the code of this program are inside the CODE folder. You need to copy your Well PBU Data inside the DATA folder. You should copy all the PBU data of an Well (in CSV format) in a single folder (this folder. name should refer to the Well name) and then copy it inside the DATA folder. This way you will be able to process all the PBU data of an Well altogether and save them in a single folder too.

All your noise detection result will be stored inside the RESULT folder. There will be subfolders inside RSEULT folder whose name will be same as the Well data folders and they will store results for corresponding Well data. Inside this subfolder you will find all the saved figures for that well.

Inside the documentation folder you will find description of the main functions and other sub functions used in this program. You can use these documentation as Developers Guide for understanding the workflow of the program better. Also, all the program codes of this method are accompanied by extensive commenting, from which we generated the documentation

Using the system:

There are three main functionalities or tasks of this program that you can use. These are:

1. Select an Well PBU data folder and plot all the PBU figures for observing the nature of pressure change and derivative.

2. Select a particular PBU data from an Well PBU data folder for choosing a Threshold parameter value to be used on the rest of the PBU data of that well by "empirically observing and evaluating" the noise detection performance for variable threshold values on that PBU.

3. Select an Well and perform automatic structured noise detection using a fixed threshold selected from step 2.

For task 1, run the 'plot_pbu_figure.m' program in Matlab command window. A folder selection dialogue will pop up to select an Well data folder from the DATA folder. Select the Well Data folder which you want to observe. After your folder selection, the program will plot pressure change value and derivative value for all the PBU data of

that Well and will display & save them based on your selected preference (For figure display and saving options see below in the “Options” segment).

For task 2, run the ‘single_sample_threshold_selection.m’ program in Matlab command window. A folder selection dialogue will pop up to select an Well data folder from the DATA folder. Select the Well Data folder for which you want to perform “Single Sample Threshold Selection”. After Well data folder selection another dialogue will pop up to specify a particular PBU number using which you want to select the threshold. After you have entered a PBU number from the given range, the program will perform noise detection on that PBU data for variable threshold values and will display & save them based on your selected preference (For figure display and saving options see below in the “Options” segment).

For task 3, run the ‘automatic_noise_detection.m’ program in Matlab command window. A folder selection dialogue will pop up to select an Well data folder from the DATA folder. Select the Well Data folder for which you want to perform “Automatic Noise Detection”. To perform task 3 on an Well PBU data, you need to perform task 2 on one of the PBU data of that Well to select a Threshold value. After

Well data folder selection another dialogue will pop up to specify a Deviation Threshold value that you have already selected from task 2. After you have entered the selected threshold value, the program will perform automatic noise detection on all the PBU data of that Well and will display & save them based on your selected preference (For figure display and saving options see below in the “Options” segment).

Other options:

Figure display and saving options: In the very beginning of all the three main programs (plot_pbu_figure.m, single_sample_threshold_selection.m, automatic_noise_detection.m) for the three main tasks, there are options for figures display and saving that you need to change manually.

You can opt for displaying all the figures through Matlab figure window or not displaying. Set the variable value of ‘make_figure_visibile’ to ‘on’ if you want to display the figures. Set it to ‘off’ otherwise (default is ‘off’).

You can save each figure individually in a separate single pdf file or append all the figure in a single pdf. In order to save all of them in a

single pdf file you need to have ghostscript (www.ghostscript.com) installed in your system. If you don't have ghostsceript installed or want to opt for saving each of them individually in a separate single pdf file, set the variable value of 'ghostscript_available' to false(1,1). If you have Ghostscript installed in you system and want to save all the figures in a single pdf, set the variable value of 'ghostscript_available' to true(1,1) (default is false(1,1)).

Observing the Result:

While the program is running it will display 'Running…' in the Matlab command window and when program has finished it will display 'Finished'.

Once you see the 'Finished' displayed in the MATLAB command line, you can go to the RESULT folder and then go to the specific Well Result folder (the same name as your selected Well Data Folder with an extension of _RESULT in the end) to observe the saved figures.

For, task 1, the individual pdf file names will be :

'Well_Data_Folder_Name'+'_PLOT_'+%pbu_no%

the appended single pdf file name will be :

'Well_Data_Folder_Name'+'_PLOT_'+'ALL'

For, task 2, the individual pdf file names will be :

'Well_Data_Folder_Name'+'_THRESHOLD_SELECTION_'+ %pbu_no%+'_T_'+%dev_thresh%

the appended single pdf file name will be :

'Well_Data_Folder_Name'+'_THRESHOLD_SELECTION_PBU_'+ %pbu_no%+'_ALL'

For, task 3, the individual pdf file names will be :

'Well_Data_Folder_Name'+'_AUTO_NOISE_T_'+%dev_thresh% +'_PBU_'+%pbu_no%

the appended single pdf file name will be :

'Well_Data_Folder_Name'+'_AUTO_NOISE_T_'+%dev_thresh% +'_ALL

Description of the Input Data:

File name convention:

· PBUXX_log10dP.csv: CSV file of Log_{10} (Δt) vs. Log_{10} (Δp)

· PBUXX_RM.csv: CSV file Log_{10} (Δt) vs. Log_{10} (derivative)

· XX denotes Pressure Buildup number

File format: PBUXX_log10dP.csv

· Column 1

Base 10 logarithm of Δt (= shut-in time in hours, i.e. elapsed time from the start of shut-in of the well)

· Column 2

Base 10 logarithm of Δp (=shut-in pressure in psi, i.e. change in pressure from the start of shut-in)

· No data value (NDV) = -999

· 1st row is used for data label

File format: PBUXX_RM.csv

· Column 1

Base 10 logarithm of Δt (= shut-in time in hours, i.e. elapsed time from the start of shut-in of the well)

· Column 2

Base 10 logarithm of semilog-derivative $d(\Delta p)/d(\ln \Delta t)$ (= derivative of shut-in pressure Δp with respect to natural logarithm of shit-in time Δt)

· No data value (NDV) = -999

· 1st row is used for data label

Troubleshooting and support:

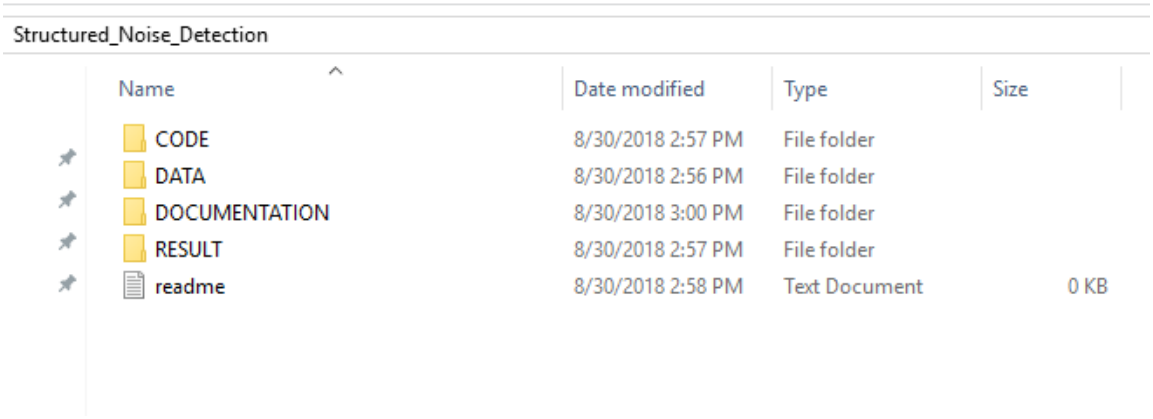
Please contact at aumyfarhan@gmail.com for any comments/ suggestion/troubleshooting.

Please note that, "All communication will be on non-confidential basis, Please do not send any confidential data or information".

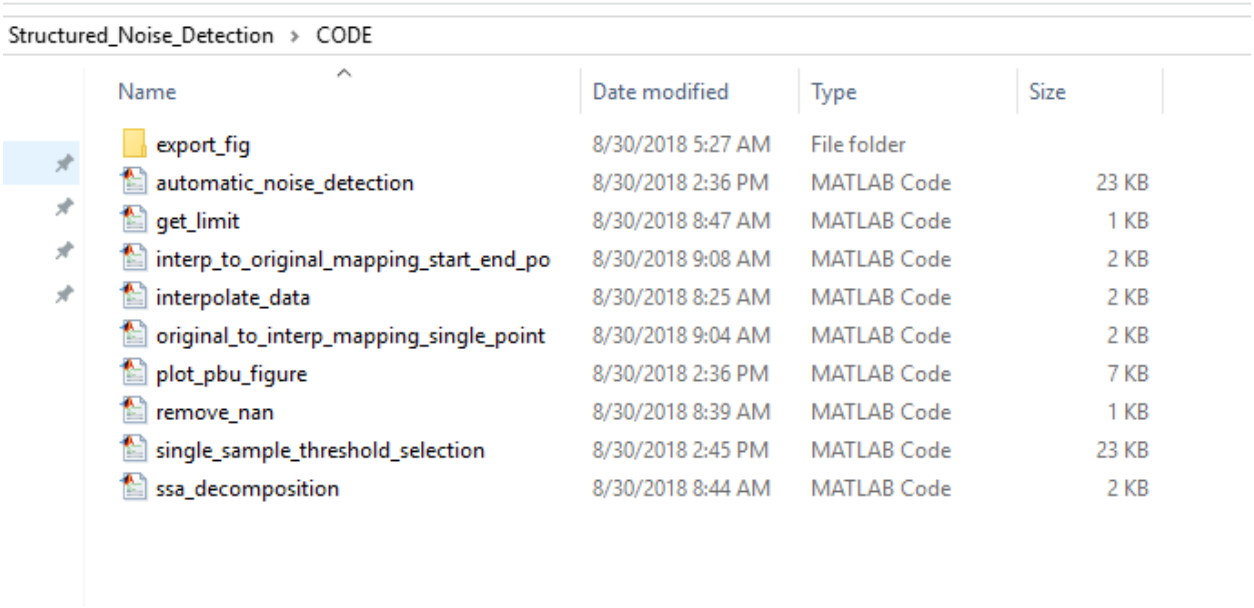
Practical Demo:

A Demo of this program's use has been given below with adequate screenshots:

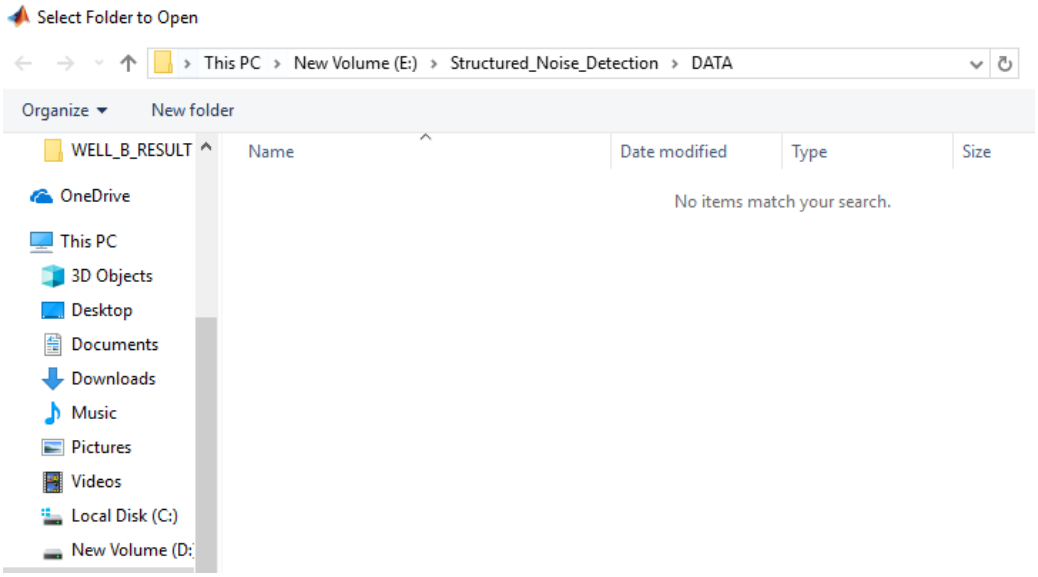
This is the main folder/home directory.



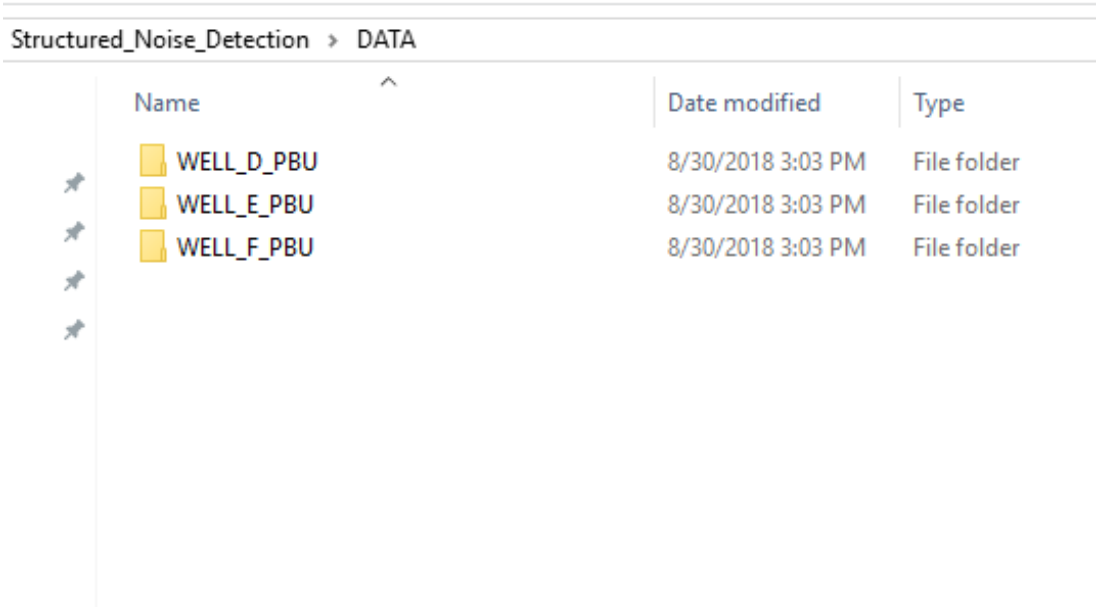
Inside CODE.



In the beginning there is no data in the DATA folder.



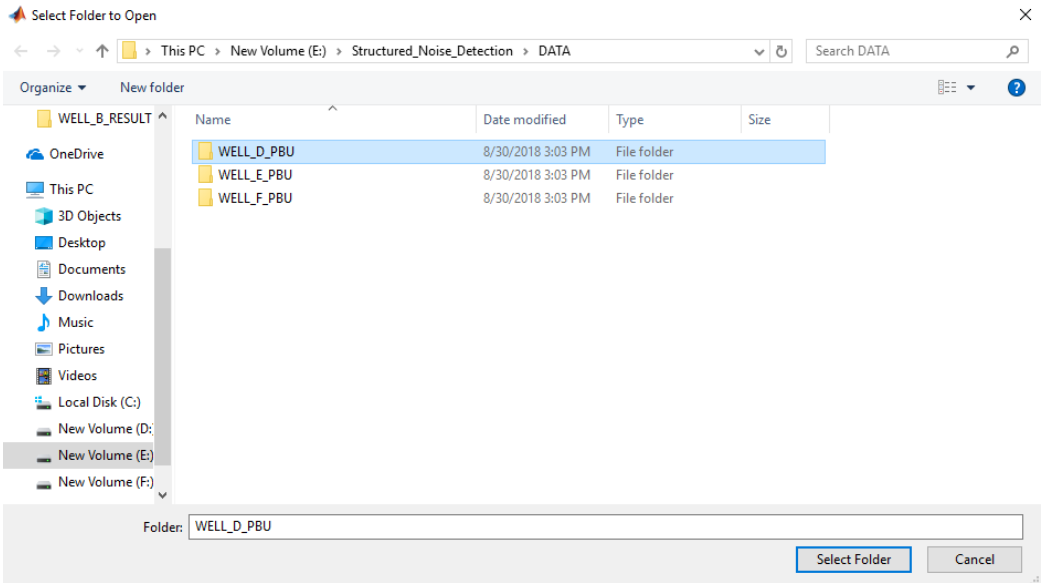
Copy data into DATA folder



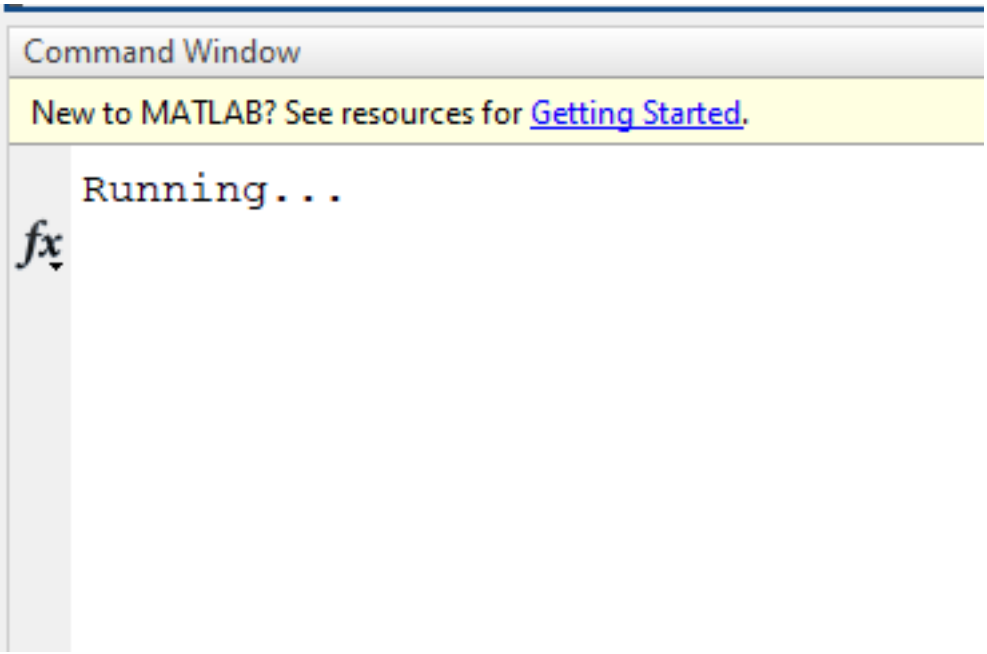
Task 1: PBU figure plotting.

Run ‘plot_pbu_figure.m.

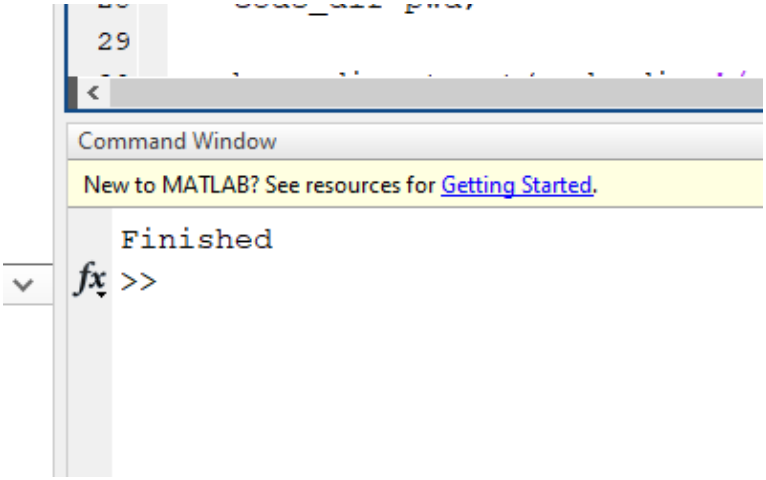
Prompt pop up for data folder selection:



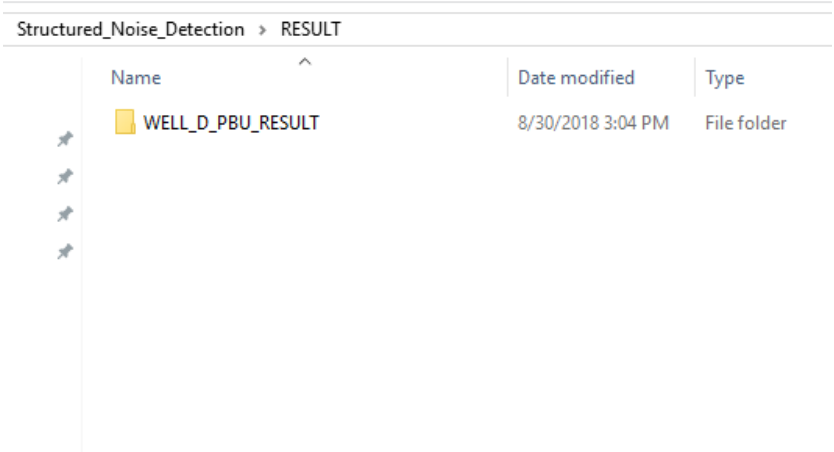
After selecting folder ‘WELL_D_PBU’ the program is running.



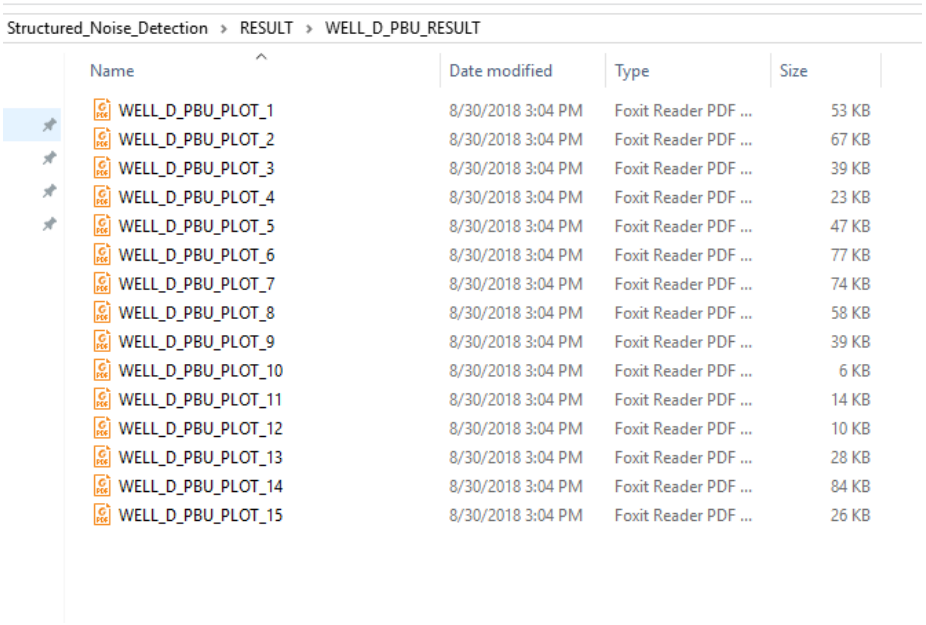
After a while (few seconds) program will be finished.



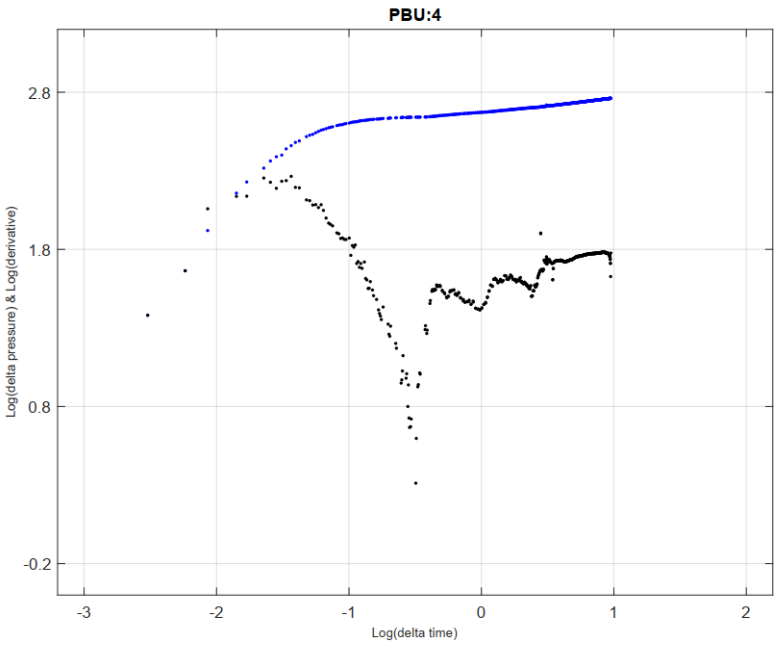
There is now a WELL_D_PBU_RESULT folder inside the RESULT folder.



Inside WELL_D_PBU_RESULT folder there are pdfs for PBU figure.



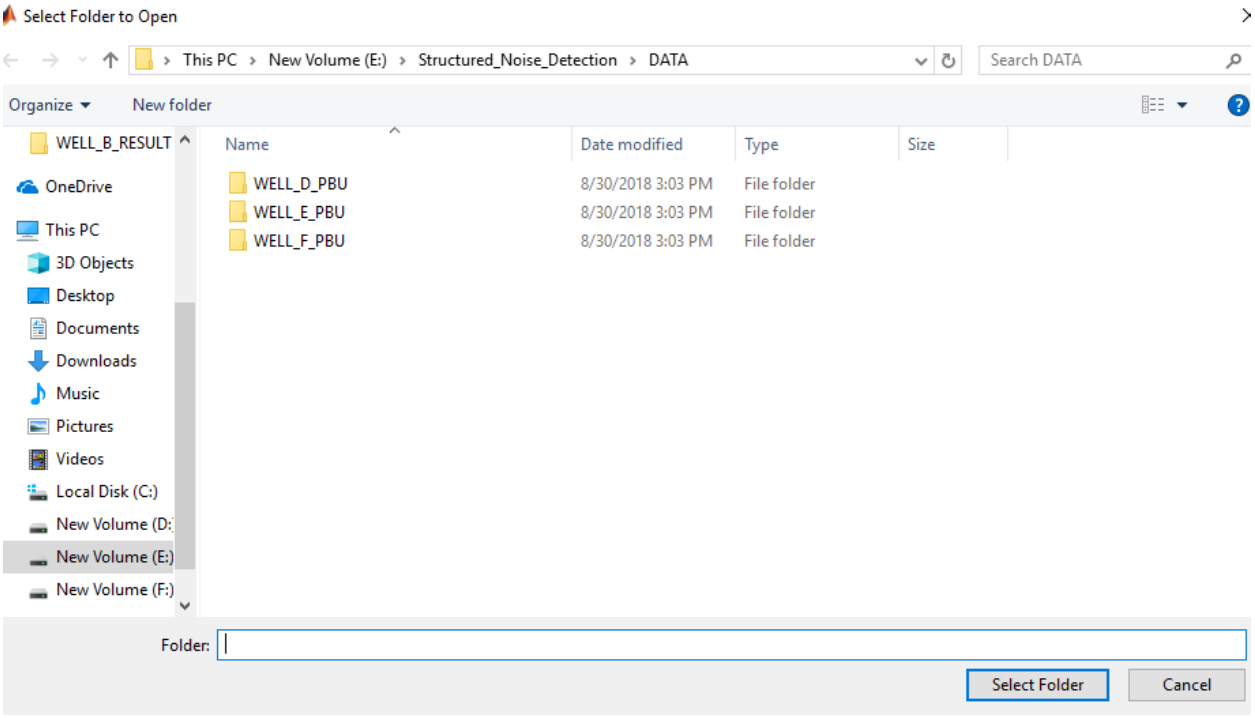
One sample plot figure.



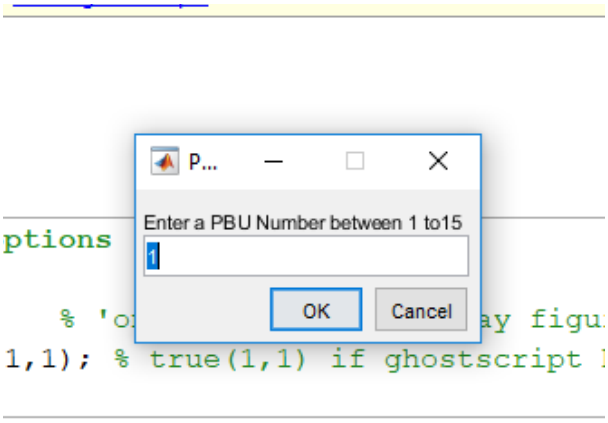
Task 2: Single Sample Threshold Selection

Run ‘single_sample_threshold_selection.m’ ,

Prompt to select data folder. Here we select WELL_D_PBU.



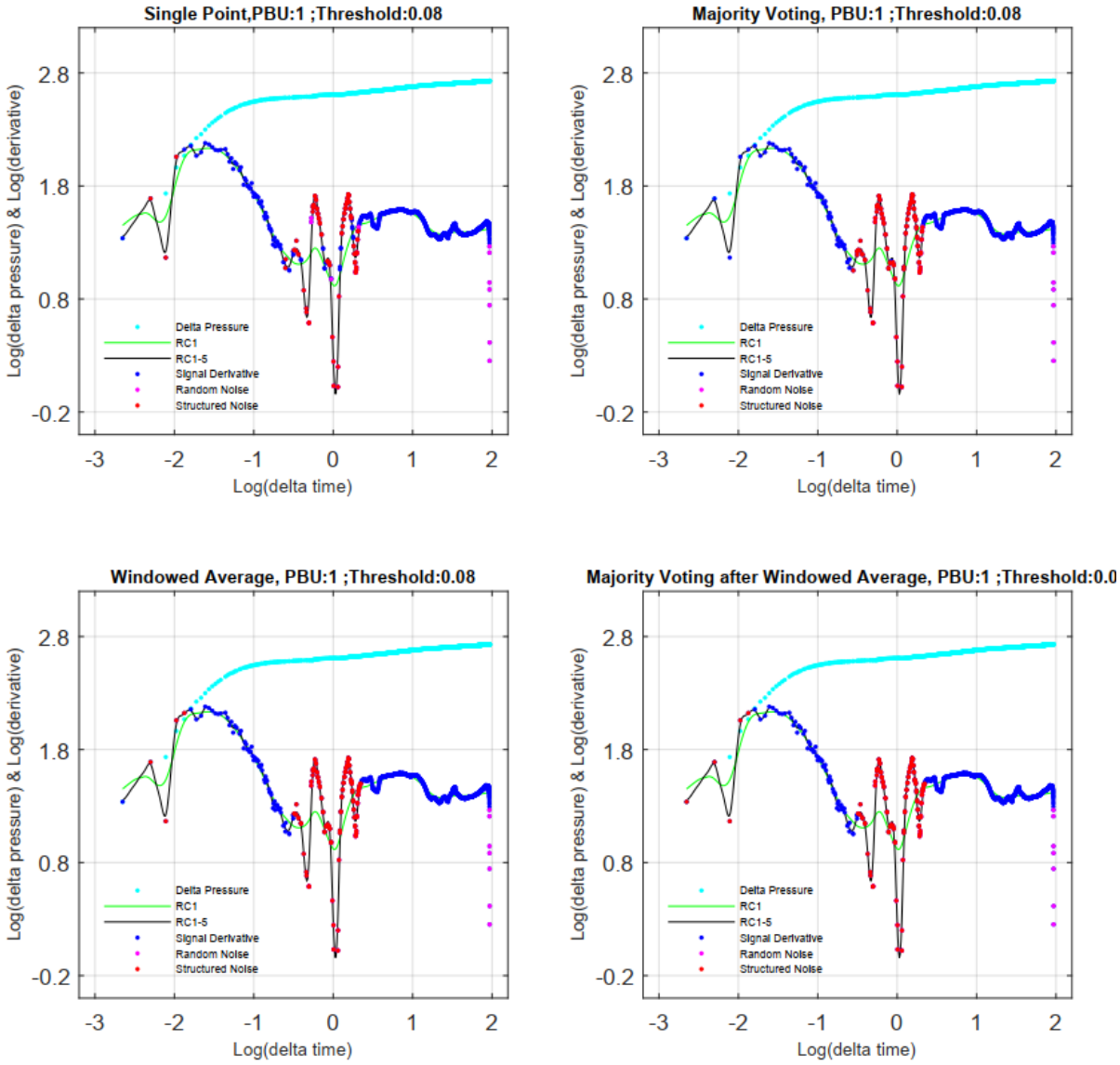
Prompt to enter a PBU Number:



After entering a PBU number the program continues. After the program has finished running, go into the WELL_D_PBU_RESULT folder inside the RESULT folder. There are now pdfs for threshold selection process.

WELL_D_PBU_PLOT_14	8/30/2018 3:04 PM	Foxit Reader PDF ...	84 KB
WELL_D_PBU_PLOT_15	8/30/2018 3:04 PM	Foxit Reader PDF ...	26 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.1	8/30/2018 3:08 PM	Foxit Reader PDF ...	253 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.03	8/30/2018 3:08 PM	Foxit Reader PDF ...	287 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.04	8/30/2018 3:08 PM	Foxit Reader PDF ...	272 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.05	8/30/2018 3:08 PM	Foxit Reader PDF ...	262 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.06	8/30/2018 3:08 PM	Foxit Reader PDF ...	256 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.07	8/30/2018 3:08 PM	Foxit Reader PDF ...	254 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.08	8/30/2018 3:08 PM	Foxit Reader PDF ...	254 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.09	8/30/2018 3:08 PM	Foxit Reader PDF ...	253 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.11	8/30/2018 3:08 PM	Foxit Reader PDF ...	252 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.12	8/30/2018 3:08 PM	Foxit Reader PDF ...	252 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.13	8/30/2018 3:08 PM	Foxit Reader PDF ...	251 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.14	8/30/2018 3:08 PM	Foxit Reader PDF ...	251 KB
WELL_D_PBU_THRESHOLD_SELECTION_PBU_1_T_0.15	8/30/2018 3:08 PM	Foxit Reader PDF ...	250 KB

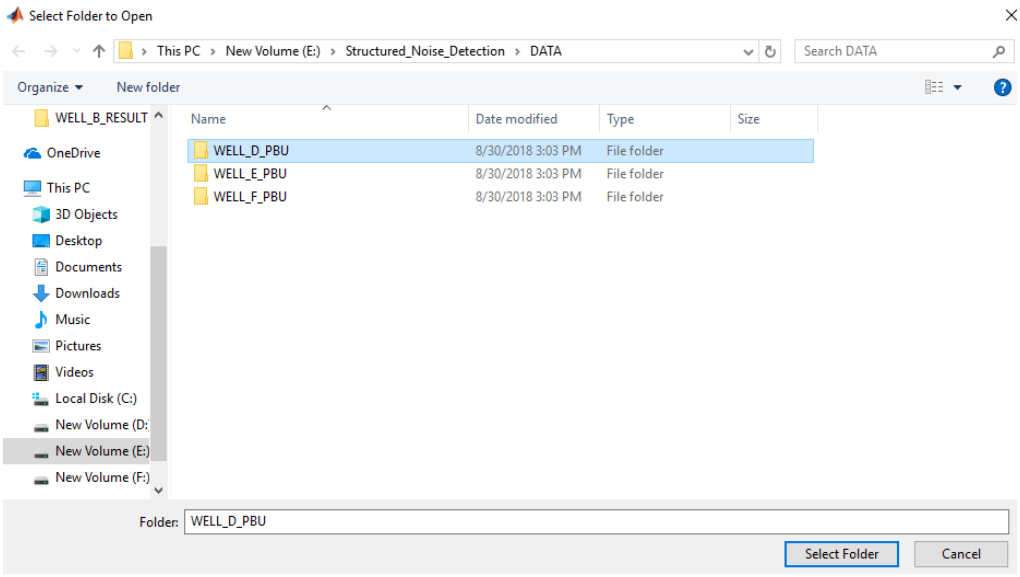
A sample figure inside a pdf



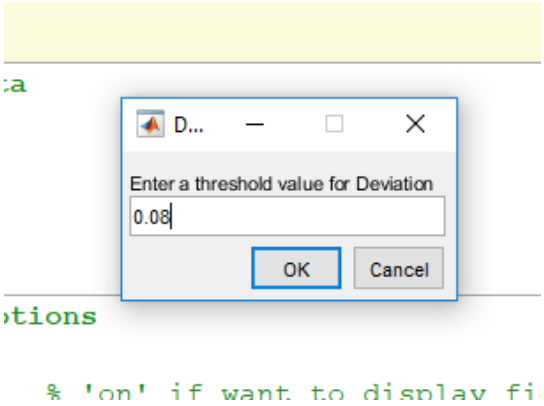
Task 3: Automatic Noise Detection

Run ‘automatic_noise_detection.m’

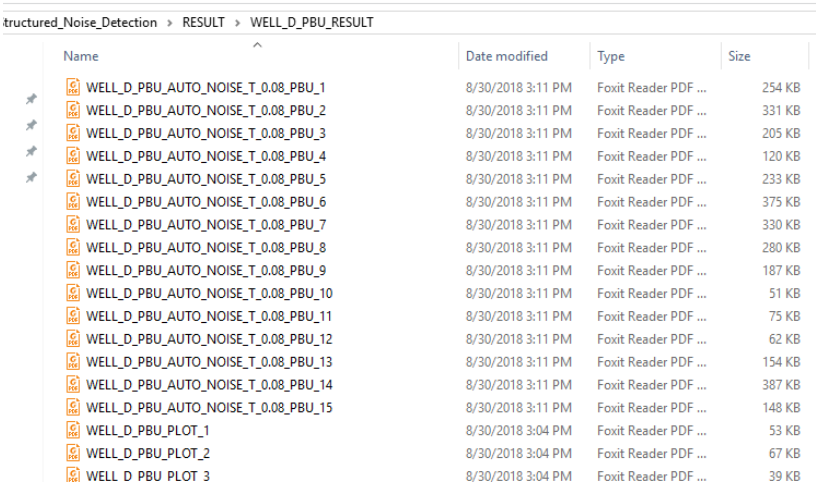
Select Well PBU data folder when the select folder prompts come. Here, again we select WELL_D_PBU.



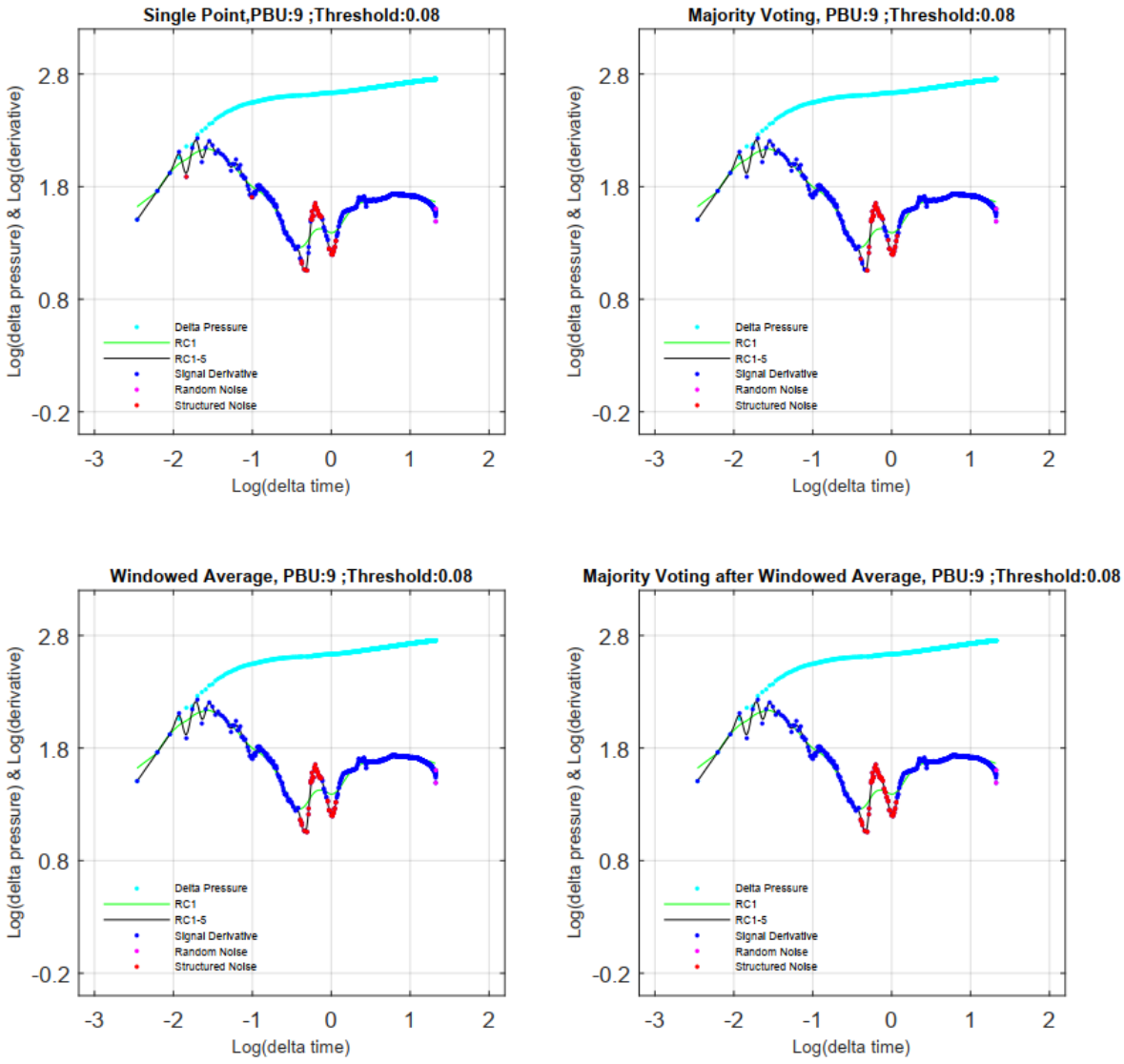
Prompt for Threshold value; as we have empirically observed from task 2 that 0.08 works best, we will enter 0.08 as threshold value.



After we have entered the threshold value, the program continues. When ‘Finished’ is displayed in the command line we go to the WELL_D_PBU_RESULT folder. There are now pdfs for each of the PBU for Automatic noise detection.



A sample pdf figure:



References:

Please refer to the following files for more information:

1. Developers Guide (And the code documentation files mentioned in the developers guide)
2. Technical Report
3. UNM_URC_Project_Presentation.pptx

End