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Data Science



Introduction

My name is Sofia. I am interning at Promaxo as a Data Scientist.

I am a rising senior at UC Berkeley, majoring in Data Science.

I like to bake and to travel.



Enhancing the Echo Check App - Promaxo's software tool for visualizing the MRI data

Project 1 - Visualising the MRI noise data from Promaxo's scanners

Project 2 - Detecting abnormalities in the noise lines

Project 1 - Visualising the MRI noise data from Promaxo's scanners

Background:

Originally, there were **2 ways to access noise or signal data**:

1) look at the **Echo plots in the Echo Check App**

2) **scan_data_analytics** python file => generate a noise or signal table for one dataset at a time => manually combine the tables => plot them

Problem:

- each table gives information for one dataset at a time and doesn't visualize it
- scan_data_analytics path is time inefficient
- the Echo plots don't separate noise and signal data, and they represent the data for the range of 2 milliseconds only => not useful for finding long-term trends.

Purpose:

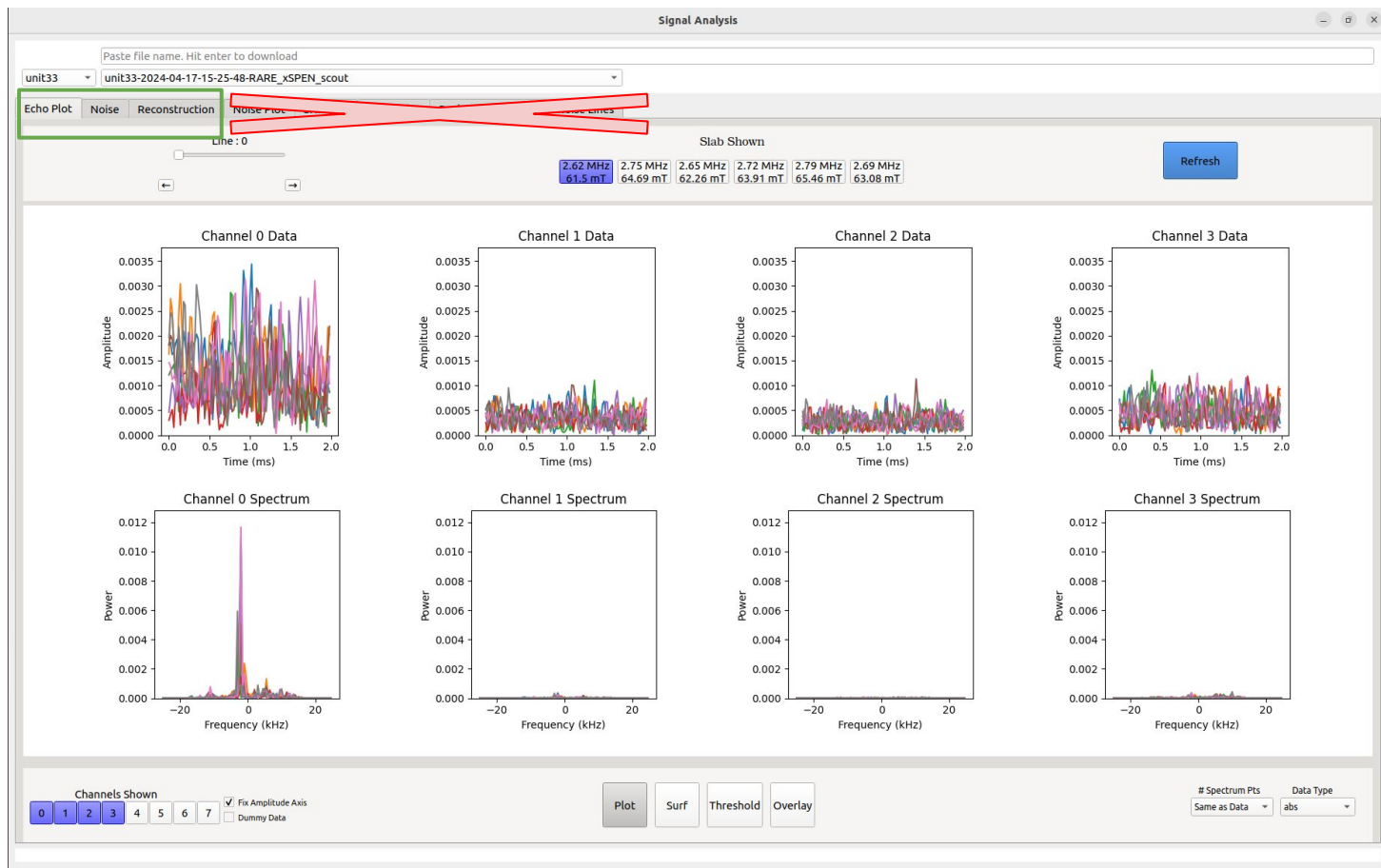
- to visualise trends and better identify the causes of noise over an extended period of time.
- to use employees' time more efficiently.

Solution:

Add 3 new features representing Noise, Signal, and Signal-to Noise Ratio (SNR) data over the period of one day or more.

- use the pre existing functions from the scan_data_analytics python file
- write additional code to process, combine and visualize the necessary datasets

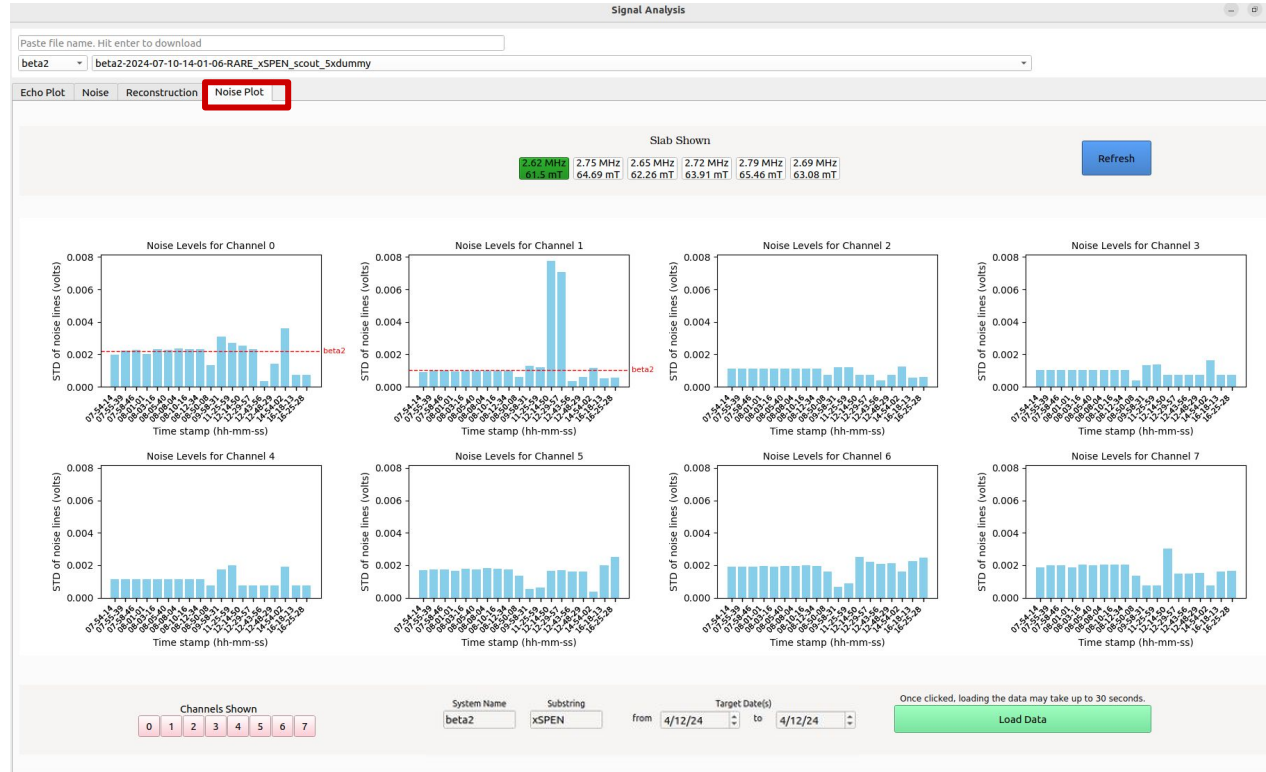
Echo Check App - original version



Feature 1 - Noise Plot tab available

The new tab includes:

- 1) bar plots representing the noise of the MRI system.
- 2) the noise is from Promaxo's pre existing noise calculation methods
- 3) these graphs are compatible with preexisting noise analyses.
- 4) a separate page of plots for every slab.
- 5) a separate plot for every channel.



Feature 2: Signal-to-Noise Ratio Plots



Feature 3: Peak Signal Plots



Project 2 - Detecting abnormalities in the noise lines

Background:

Data from the MRI scanners is not always perfect. Noise can be abnormally high, which directly affects the quality of the images.

Problem:

A lack of automation in the Noise outlier detection is problematic.

Purpose:

- to have a fast and accurate visualization of outliers in the noise lines from the MRI scanners.
- to use employees' time more efficiently.

Solution:

Add 2 new features representing the Table of Outliers in the noise lines as well as the Noise Lines alone (Noise Lines are the raw noise data, before a FFT transformation was performed. The Noise Lines plots are different from the Noise plots.)

Feature 1 - Outlier detection table

unit33

unit33-2024-04-17-15-25-48-RARE_xSPEN_scout

Echo Plot

Noise

Reconstruction

Noise Plot

SNR Plot

Signal Plot

Peak Noise Analysis

Noise Lines

Dataset: 2

Refresh

Detecting Outliers using IQR-based Outlier Detection with Amplitude and Oscillation Thresholds with Threshold 7.672

Current dataset: unit36-2024-01-26-10-18-14-RARE_xSPEN_scout.zip

	Slab 0 2.62 MHz 61.5 mT	Slab 1 2.75 MHz 64.69 mT	Slab 2 2.65 MHz 62.26 mT	Slab 3 2.72 MHz 63.91 mT	Slab 4 2.79 MHz 65.46 mT	Slab 5 2.69 MHz 63.08 mT
Channel 0	none	none	none	none	none	none
Channel 1	none	none	none	none	none	none
Channel 2	none	1	none	none	none	none
Channel 3	none	1	none	none	none	none
Channel 4	none	2	28	none	none	5
Channel 5	none	30	none	none	30	6
Channel 6	30	30	30	3	30	30
Channel 7	none	none	none	none	none	none

#: Total number of outliers among the 30 repetitions of dataset 2

System Name

unit36

Substring

xSPEN

Target Date

1/26/24

Load Outlier Table

Feature 2 - Noise Line Plots



Summary of the Improvements

- considering Promaxo's current focus on maximizing image quality, minimizing noise levels is crucial
- looking at noise levels over a span multiple days can help identify the causes of noise (If system breaks, or if there's a spike, we can know when it happened)
- Having access to the SNR and Signal plots helps us better understand the causes of varying behavior of noise levels
- Echo check app is used by multiple employees, primarily on the imaging and service teams.
- Having access to the Noise, SNR, peak Signal plots, the outlier table, and the Noise Line plots **saves time** and **allows to observe trends**.

Possible Next Steps:

- Implement the code for the echo_check_app into a standalone application

The Process

- The first and fundamental step was to get an understanding of how the MRI data is collected and organized.
- It was important to understand the pre-existing code
- Considering that the Echo Check App is used by the Imaging and the R&D teams, I collected feedback from co-workers from those teams and made respective improvements of the tool.

Any questions and/or suggestions?

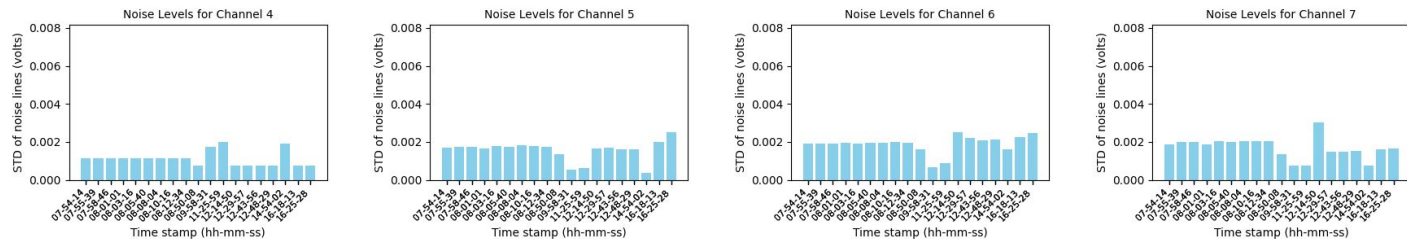
promaxo

Thanks!

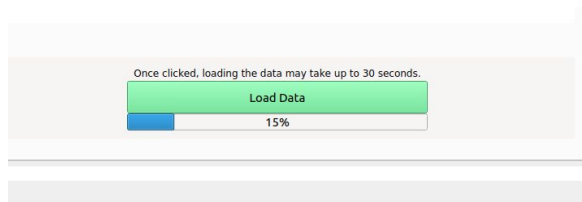


Improvements based on feedback collected from co-workers

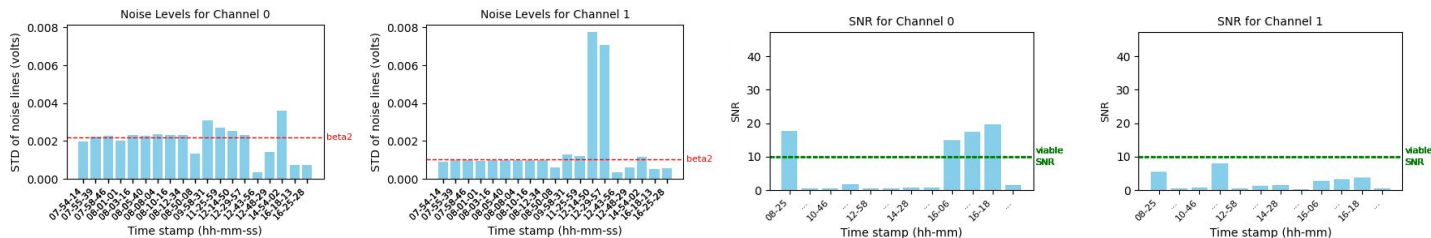
1) set the y axis to the same scale for every plot in a specified slab
=> improved readability



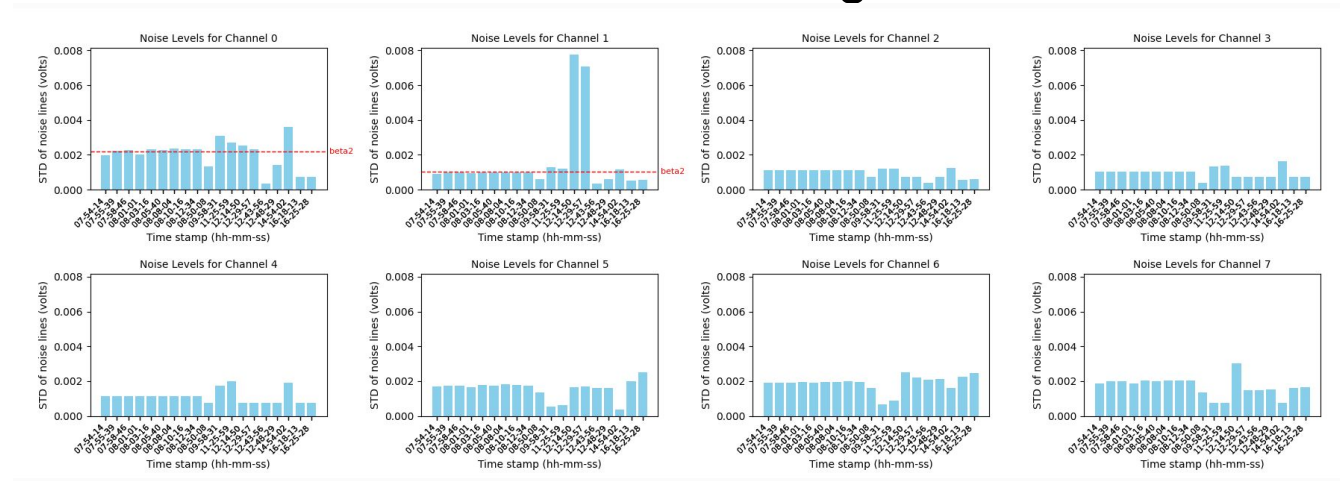
2) added a progress bar for data loading
=> improved tracking & more guidance



3) added an indicator of the average (expected) noise levels for channels 0 and 1
and an indicator of the minimum viable SNR
=> improved usability



Challenge: Collecting Data to find the average noise levels for channels 2 through 7



- there are only 2 channels on the ACR coil
- the ACR coil are usually used on channels 0 and 1
- there is currently not enough data to compute the average noise levels for channels 2 through 7 with the ACR coil
- data collected with the Rx coil might not be useful here

Functionality

1. Input the necessary information to select a specific dataset.

System Name defaults to beta2.

Target Start Date defaults to 04/12/24

Target End Date defaults to the start date

Substring defaults to xSPEN.

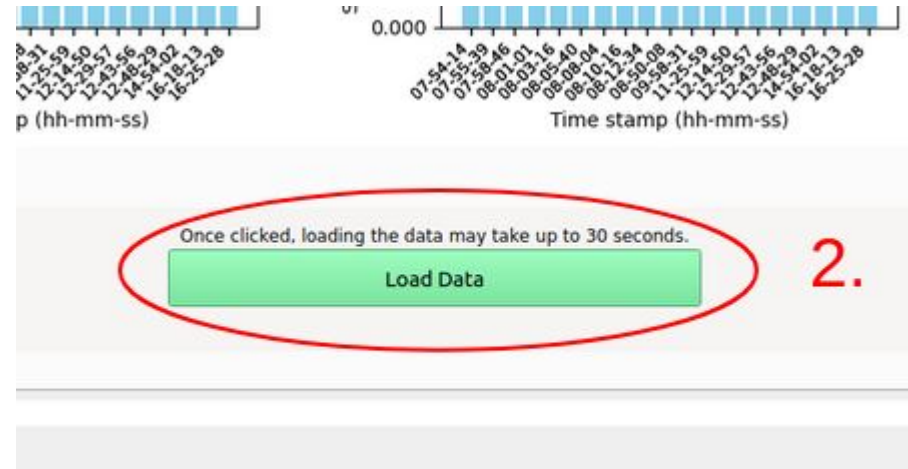
1.

System Name Substring Target Date(s)

beta2 xSPEN from 4/13/24 to 4/13/24

2. Click on the “**Load Data**” button.

Due to the large size of the dataset, it takes around 20 seconds to load the data.



3. The channels highlighted in pink are displayed.

The program defaults to channels 0 through 3 being displayed at first.

To display or hide a channel, click on the button with the respective channel number.

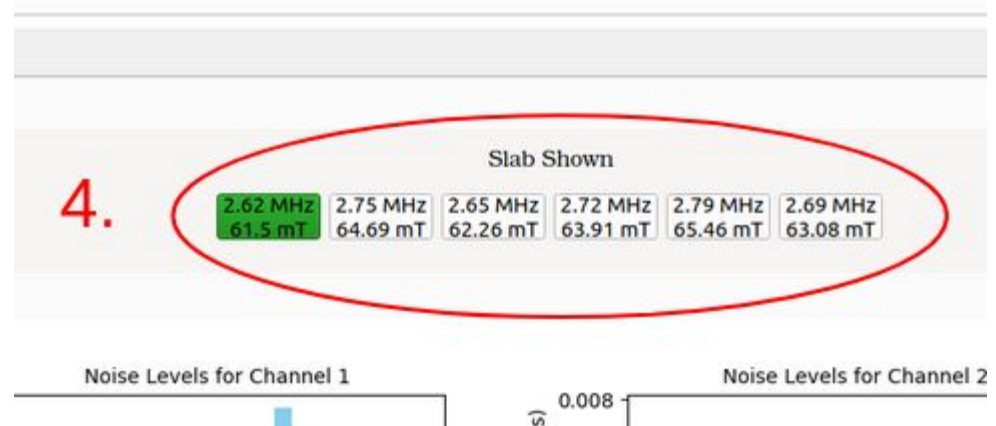


4. The button in green represents the slab that is being displayed.

Only one slab can be displayed at a time.

To switch to a different slab, click a different slab button.

The previous will be automatically unclicked.



5. Click on the “Refresh” button to reset the input boxes to nothing and hide the current plots.

