

Data tagging exercise primer

Please read this document in fit to screen mode. The plots are of wide aspect ratio and need the full space for readability.

Problem statement:

The task at hand is to identify whether the quality of a signal is good, bad or medium? The signal in question is Ballistocardiogram (BCG) signal.

BCG signal recorded from a person carries information about their heartbeats and their breathing cycles.

You will have 20 BCG signal examples to tag in this exercise. Each example will involve looking at raw data, heart filtered data and breathing filtered data to comment on the quality of the signal. Each example will definitely have data for a 'primary' sheet. Additionally there may or may not be data from a 'secondary' sheet.

Please read this document carefully to understand how to identify a good quality signal.

When you are ready, double click on the index.html file to load the viewer (you will need a web browser like Chrome for this). It will show you one example at a time. You can use the dropdown buttons to capture your tag about the data quality, and click on 'Next' to view the next example. When you are done with all 20 examples, you may click 'Submit'. This will generate a csv file that you can share with us for assessment.

Definitions of dropdown fields in the viewer.

Is vital present: If you see any **vital signs for a minimum of 10 seconds** (breathing or heartbeat or both) in any of the sheets (primary or secondary or both) then select Yes, else if you think that the signal has no human data then select No.

Data quality: Mark good, medium or bad based on the overall quality of the whole signal (breathing or heartbeat from all available sheets).

Primary sheet HR quality: How is the heart signal quality present in the primary sheet (Good/Bad/Medium)?

Primary sheet RR quality: How is the breathing signal quality present in the primary sheet (Good/Bad/Medium)?

Secondary sheet HR quality: If the plot has no secondary sheet data, mark **NA**. Else mark how is the heart signal quality present in the secondary sheet (Good/Bad/Medium)?

Secondary sheet RR quality: If the plot has no secondary sheet data, mark **NA**. Else mark how is the breathing signal quality present in the secondary sheet (Good/Bad/Medium)?

Description of plots

Interactive HTML Plot: These are interactive graphs that can be opened in any web browser. They have built-in functions to zoom, pan, reset axes, and so on. These are positioned at the top right of each plot.

Plot Duration: Each plot represents the data gathered over 30 seconds, referred to as one epoch. The X-axis represents the time in seconds, starting from zero.

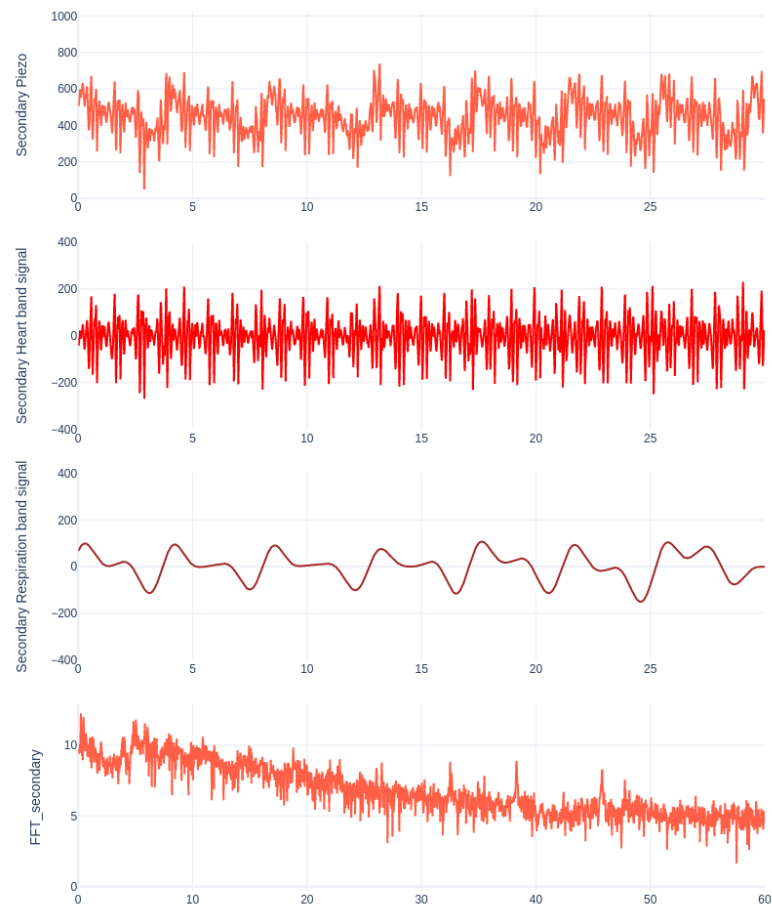
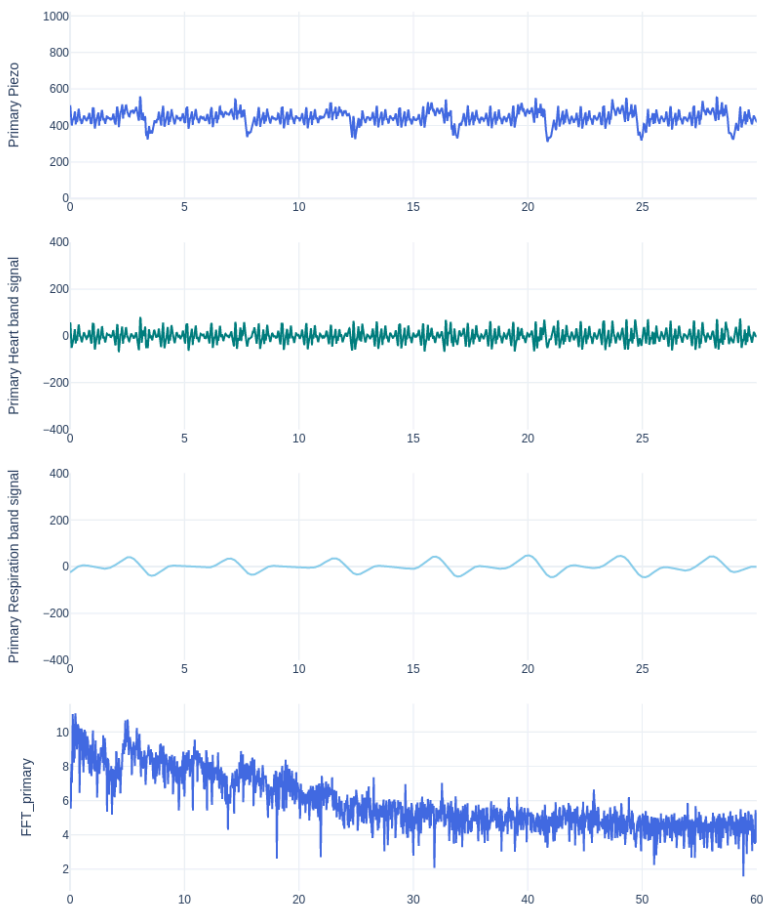
Data Panels: The plot is divided into panels - a left panel for data from the primary sensor sheet, and a right panel for data from the secondary sensor sheet. Devices with only one sensor sheet won't have a right panel.

Signal Processing: Piezo signal seen in the first row of the html is the raw BCG signal. This signal is processed to extract the corresponding heart band signal seen in the second row and the respiration (breathing) band signal seen in the third row.

FFT Plot: You may ignore the FFT plot for this exercise.

Title and File Name: The plot title and file name include the device ID and timestamp. This information helps to trace back to the original data file if needed since this is unique.

2119a4d6-4271-42d8-954e-9849cc6166ba 2023-07-07 20:23:30 Epoch_4



How to interpret RAW BCG data panel (Piezo signal).

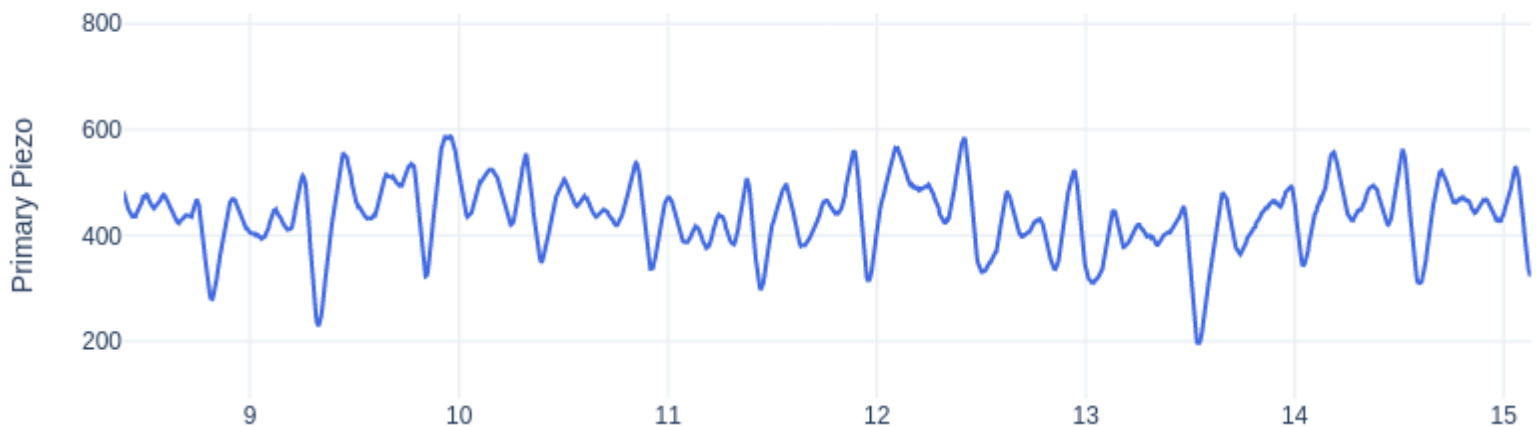
Raw Data and Signal Range: The raw data collected by the sensor typically ranges from 0 to 1023, usually centered around 450.

The signal features distinct, repeating peaks that correspond to heartbeats. There is also a slow, regular oscillation (up and down shift) representing breathing patterns.

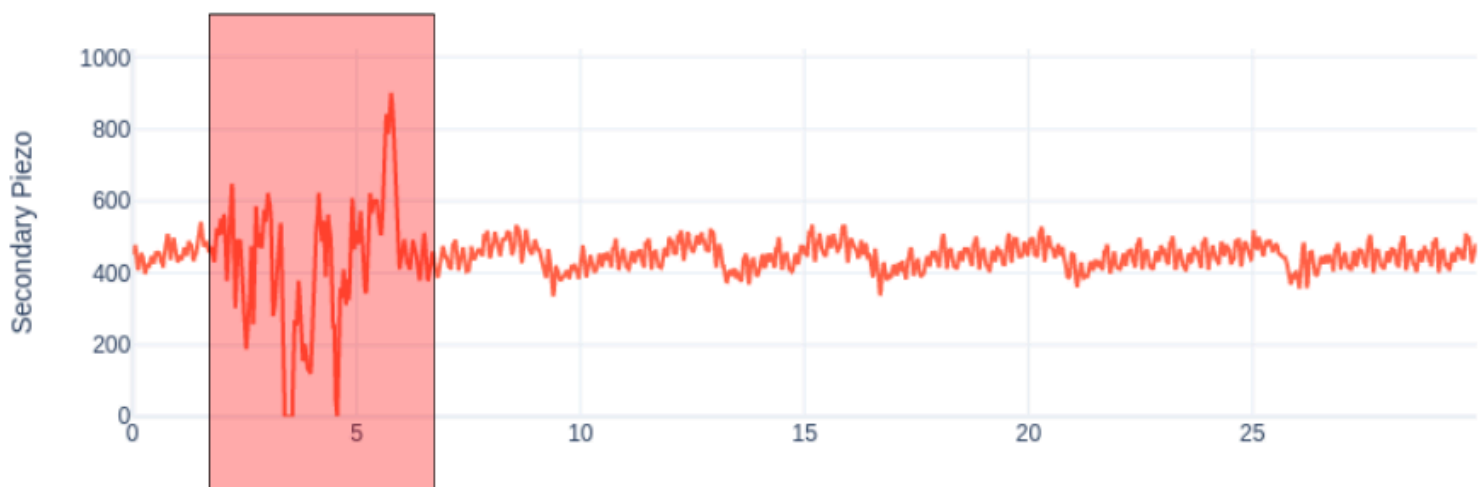
Movement Indicators: Portions of the raw data that show high, erratic signals usually represent movement. Some movement is expected in the data epochs, and the system is designed to handle these movements effectively, as long as there are at least 5-second long segments without movement.

Abnormal Spikes: Users are advised to look out for abnormal spikes in the raw data panel. These spikes may become less noticeable after filtering, making it more difficult to distinguish them from regular heart or breathing signals.

Zoomed in view below of the piezo signal showing repeating heartbeat peaks (good data)



Piezo signal below with small movement present (still good data as rest of the signal is good)

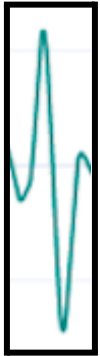


How to interpret Heart band signal

The peaks, representing heart beats, should be distributed at regular intervals. However, their shape can significantly vary based on factors like the type of bed or mattress, sensor position, and the orientation of the subject. For example in the signal below there are 8 heartbeats.



Such that each heartbeat roughly looks like the following snippet.



How to interpret Breathing band signal

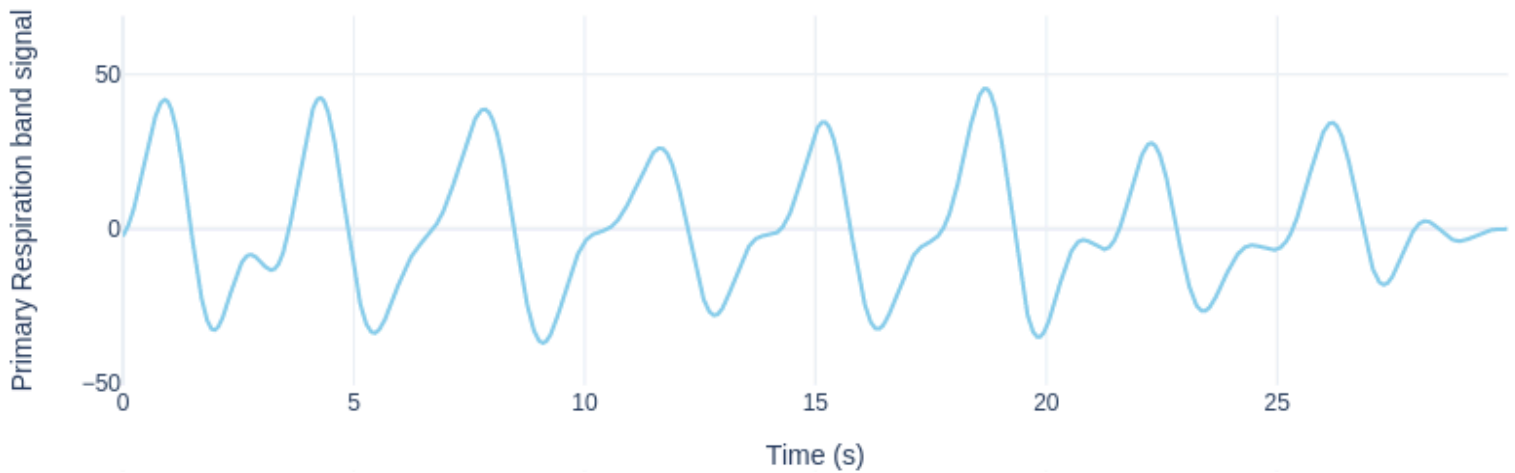
The breathing signal should be centered around zero.

Signal Shape: The shape of the breathing signal can vary. It might look like a smooth sine wave, or it could have sharp, saw-tooth-like peaks, or even secondary peaks. These variations depend on factors like the individual's breathing effort.

Repeating Unit: Regardless of the shape of the signal, you should look for the largest repeating pattern. This pattern typically represents the breathing cycle.

Visualization: The breathing signal is best visualized over a larger time window, typically between 15 to 30 seconds. This time frame allows for the clear observation of breathing patterns.

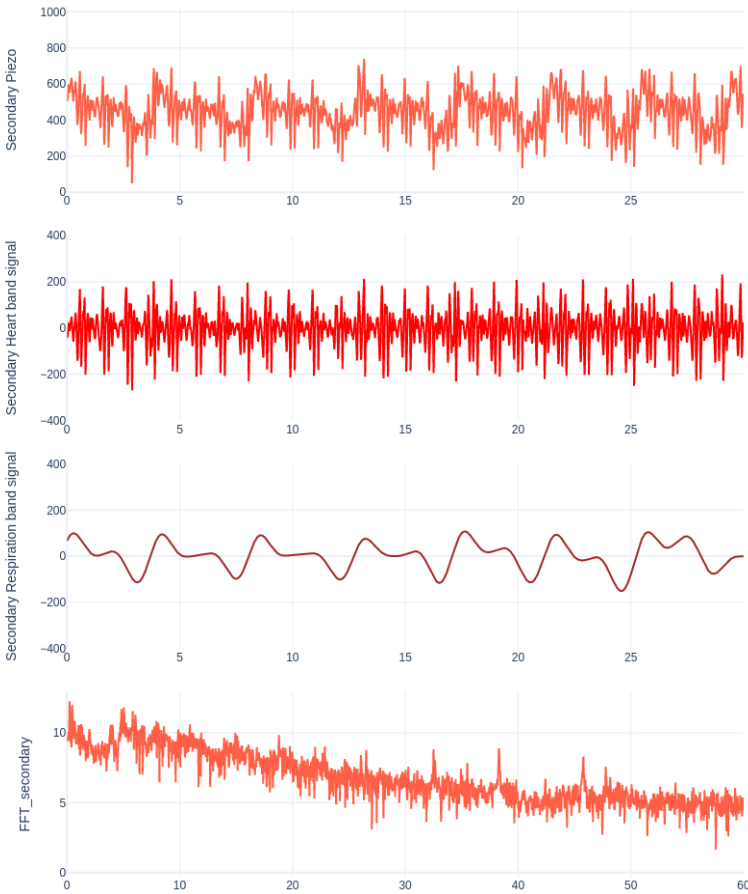
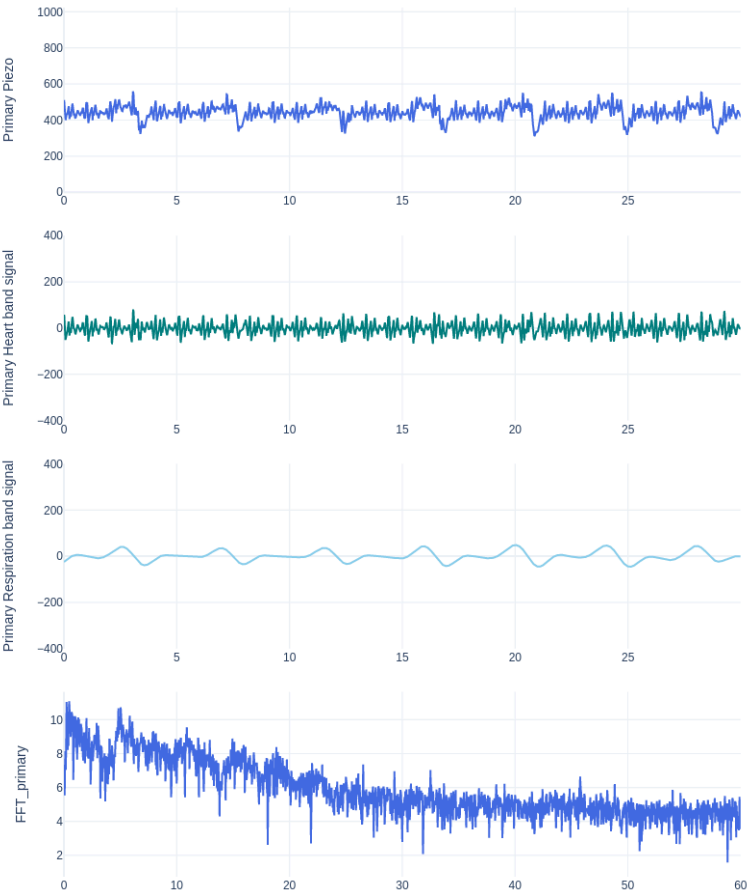
Zooming In: If the signal appears to be a flat line, you might need to zoom in on the Y-axis to see it properly.



Sample signals

Good signal quality with no movement.

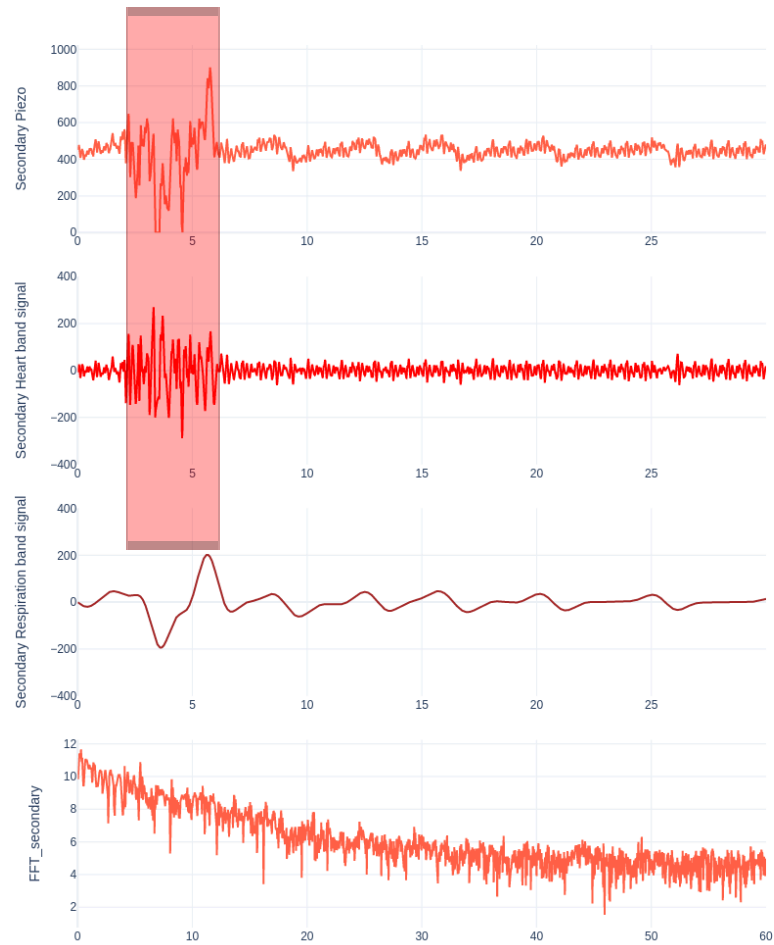
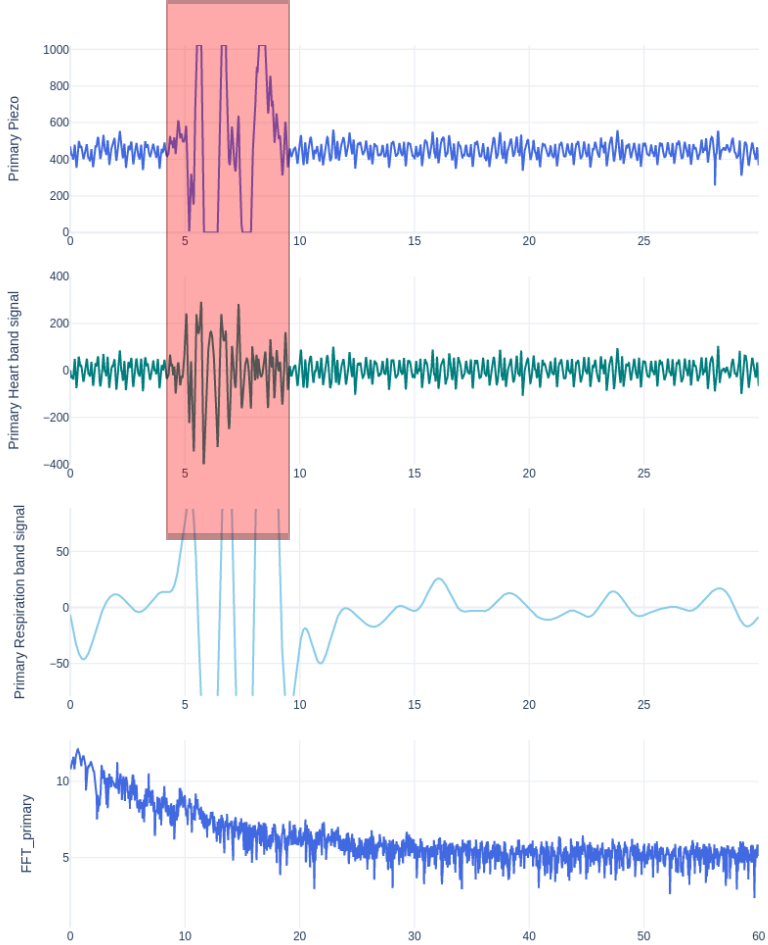
2119a4d6-4271-42d8-954e-9849cc6166ba 2023-07-07 20:23:30 Epoch_4



Good signal quality with some movement present.

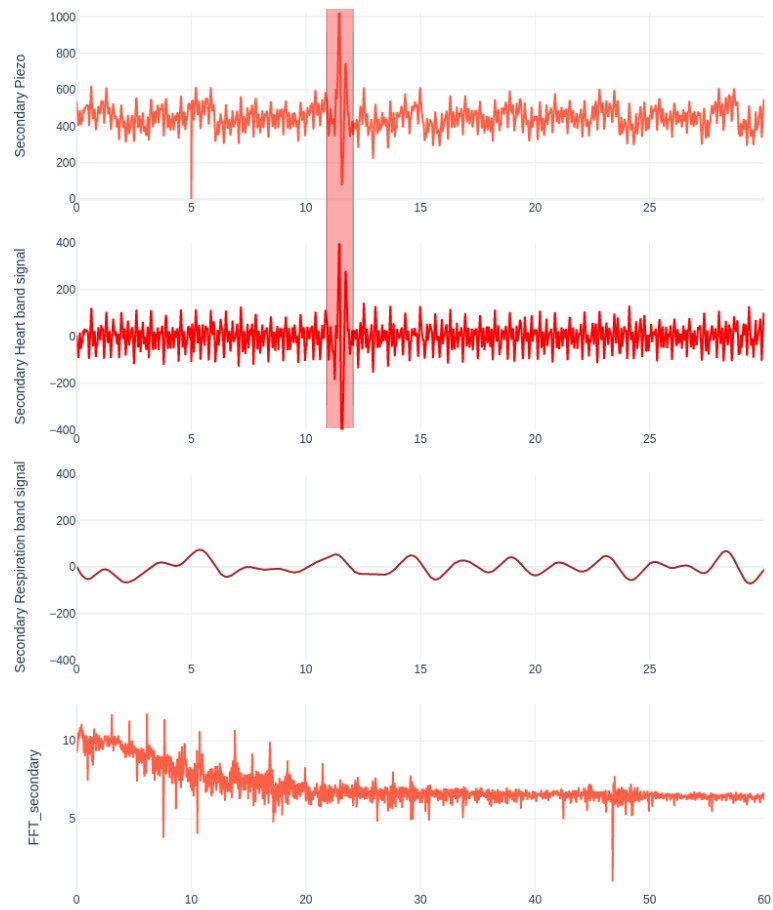
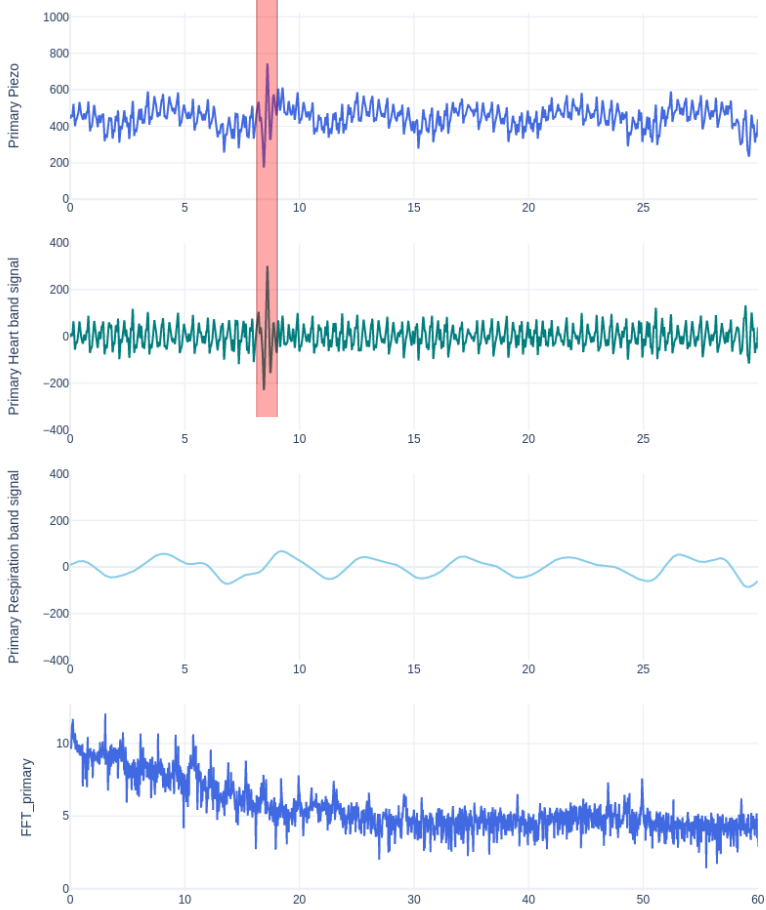
Although respiration information quality is not great, repeating heartbeats are visible well

388da747-ac5d-47fe-b6f6-b7554c17f823 2023-05-10 16:34:00 Epoch_1



Good signal quality with little movement present.

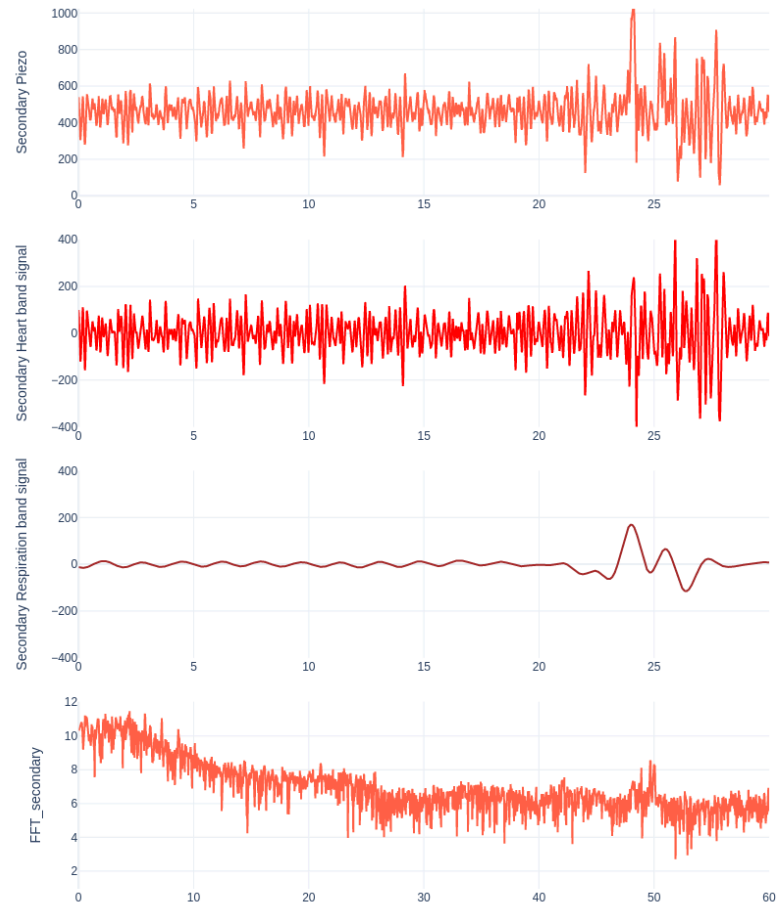
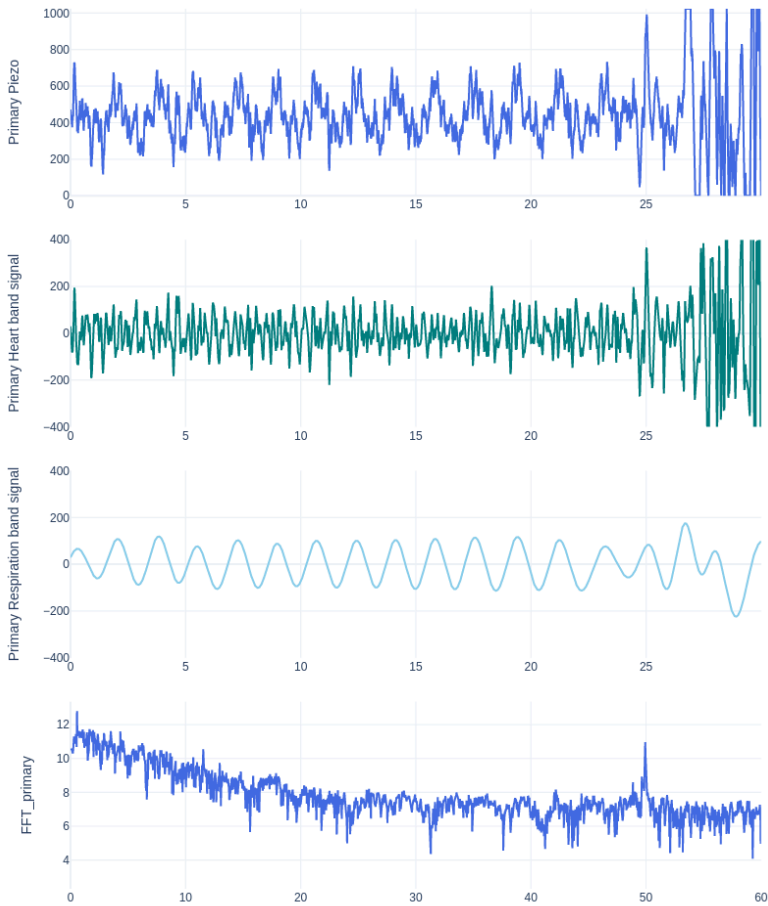
8568ee8d-253b-4c07-bc94-8778d09b73b9 2023-07-11 18:22:00 Epoch_1



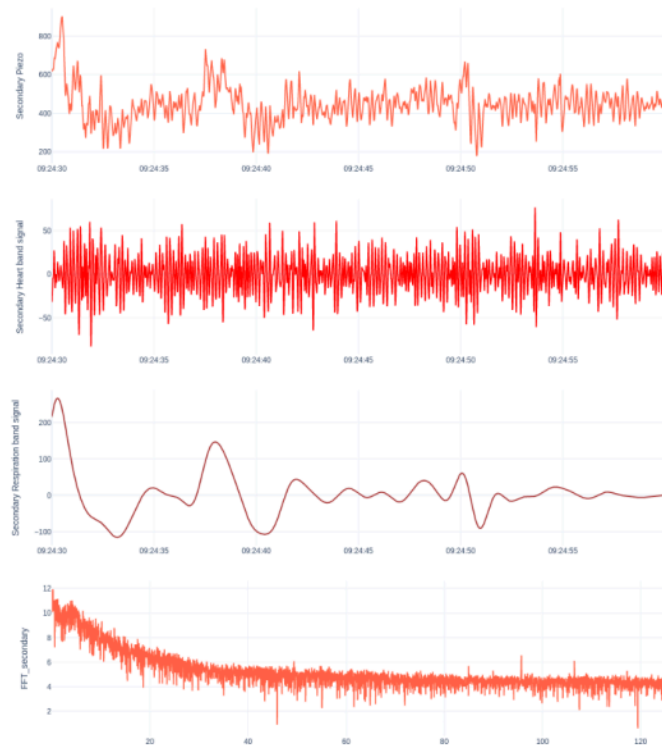
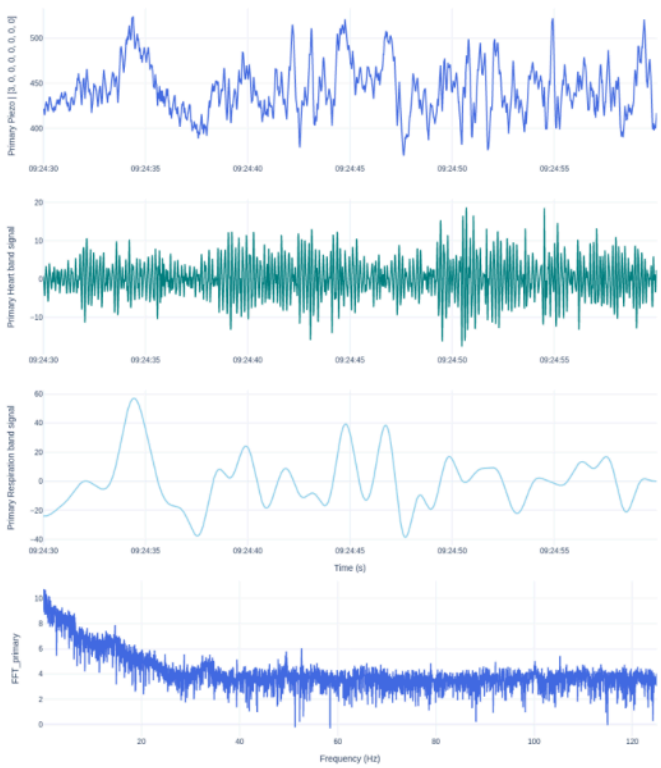
Medium Quality signals, Heavy breathing

Because of heavy breathing, the respiration signal is prominent, and detection of heart peaks becomes difficult.

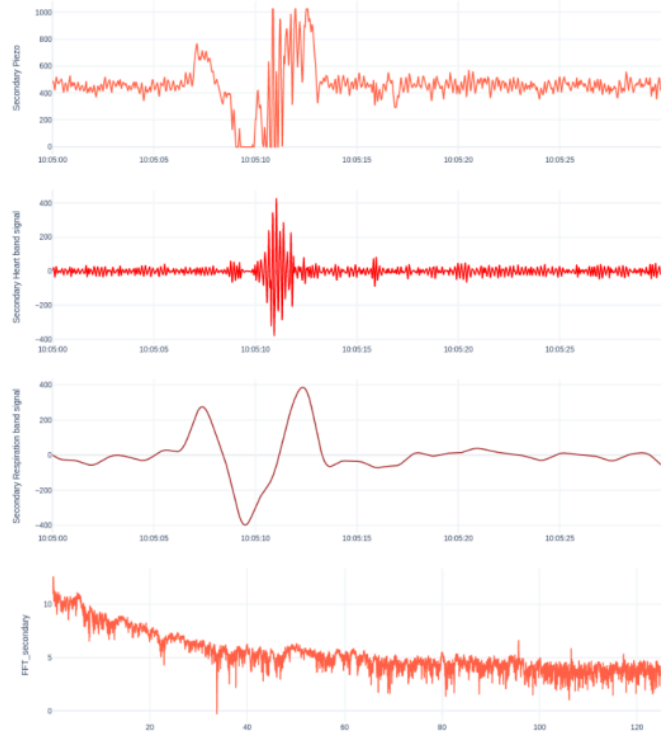
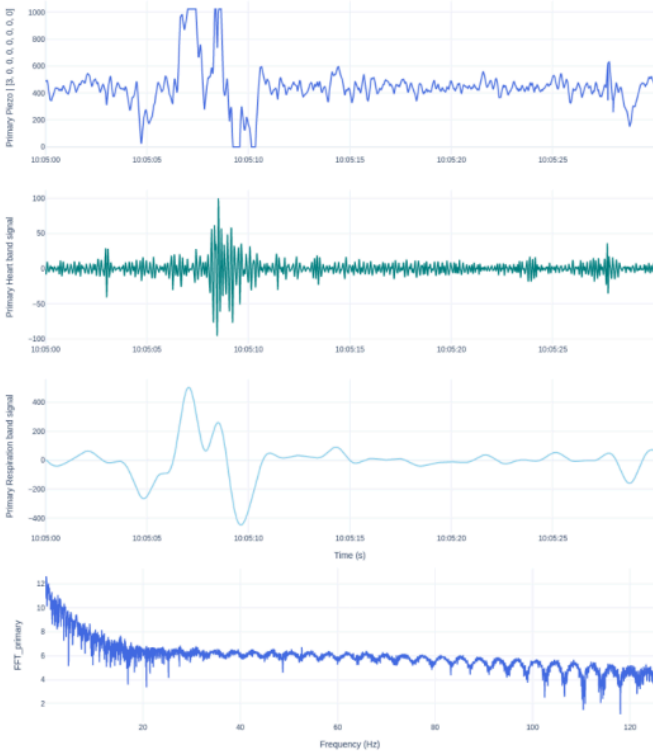
c1fca1d4-6614-4f44-9cbe-4c7c7755737f 2023-04-21 06:45:30 Epoch_2



Bad Quality signals



Bad Quality signals



Thank you and Good Luck 😊