In The Name of God

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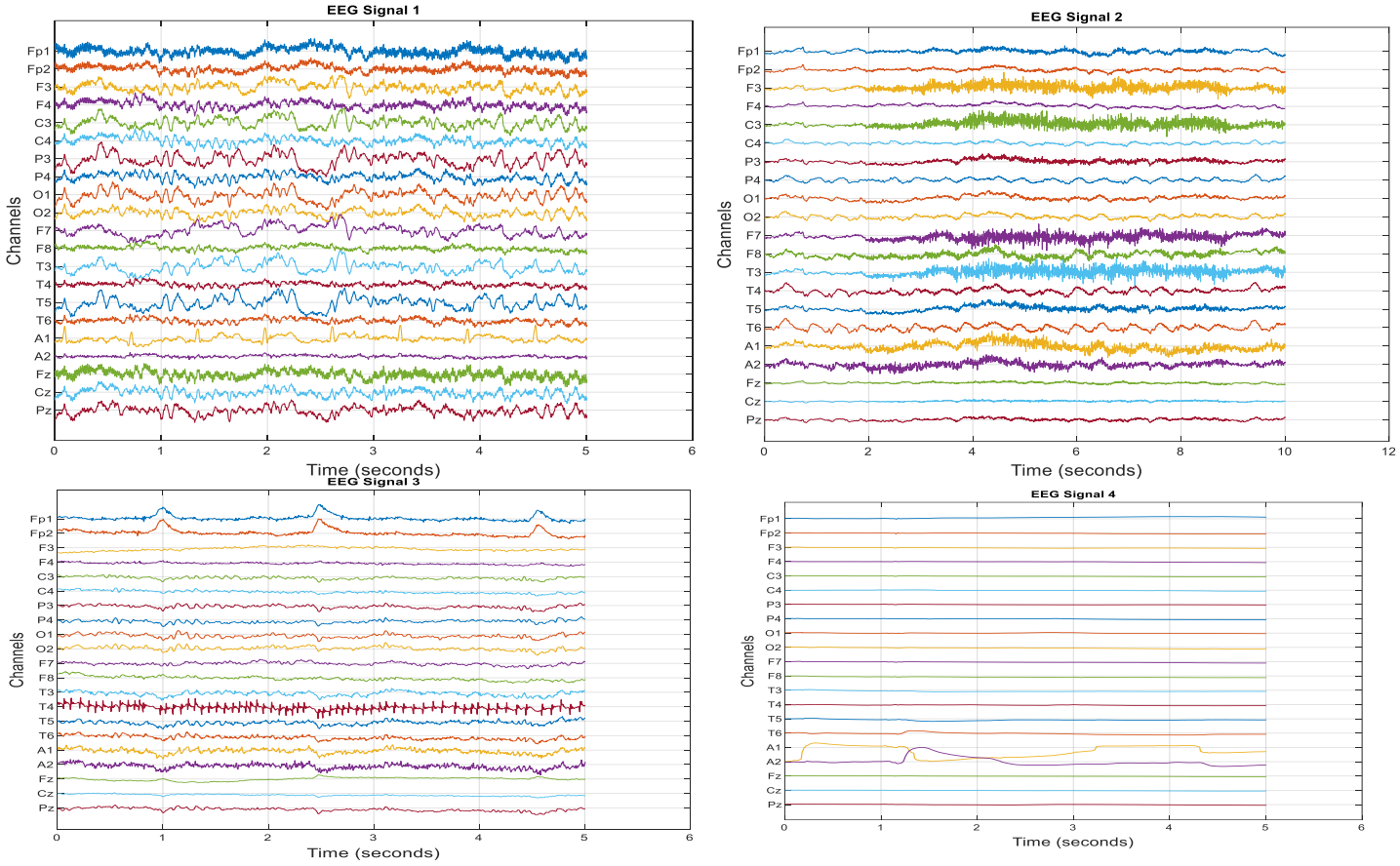
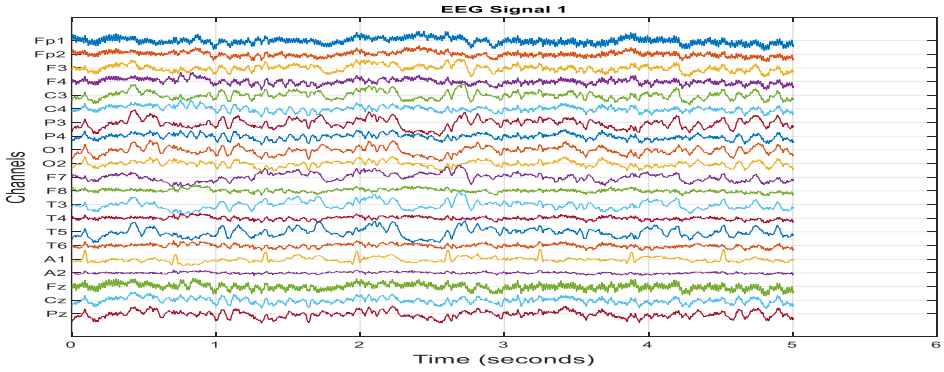
Question3:

a) First, plot all Data.

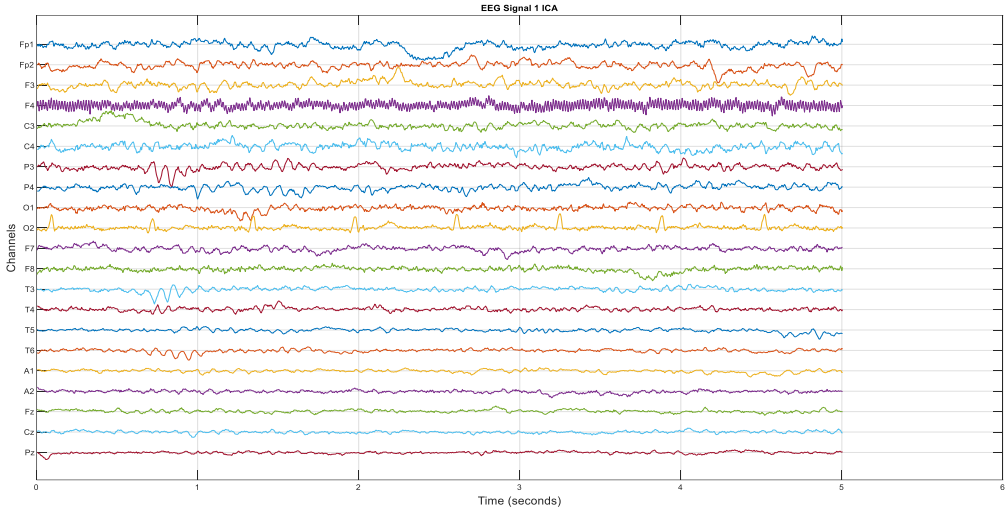


For EEG signal 1:

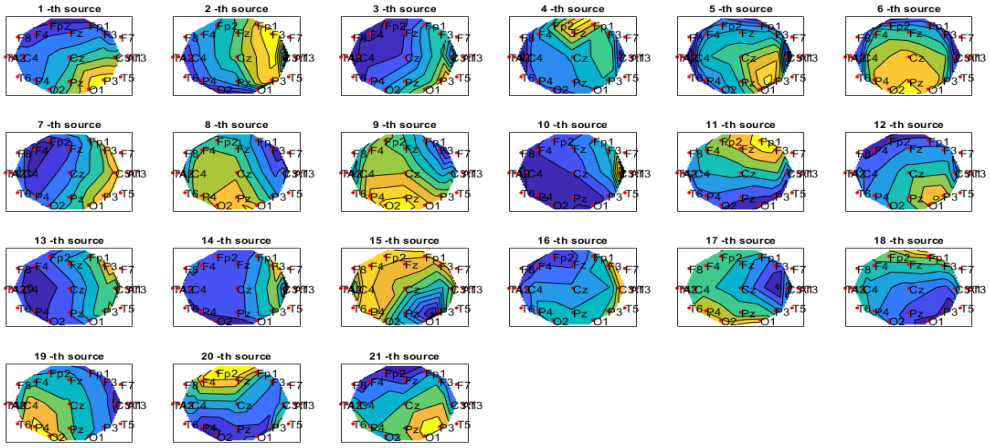
b) Based on the below figure, I think we have Electricity & EOG artifacts.

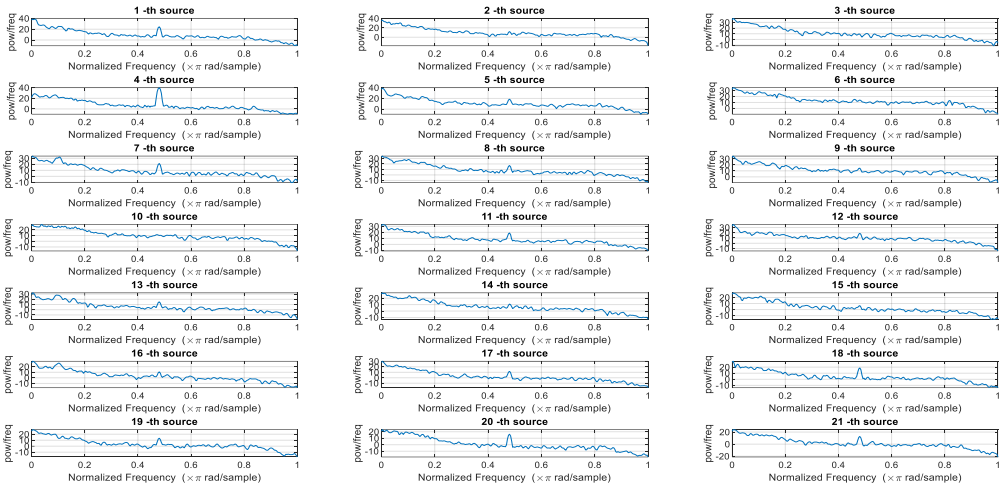


c) After we apply ICA, we have:



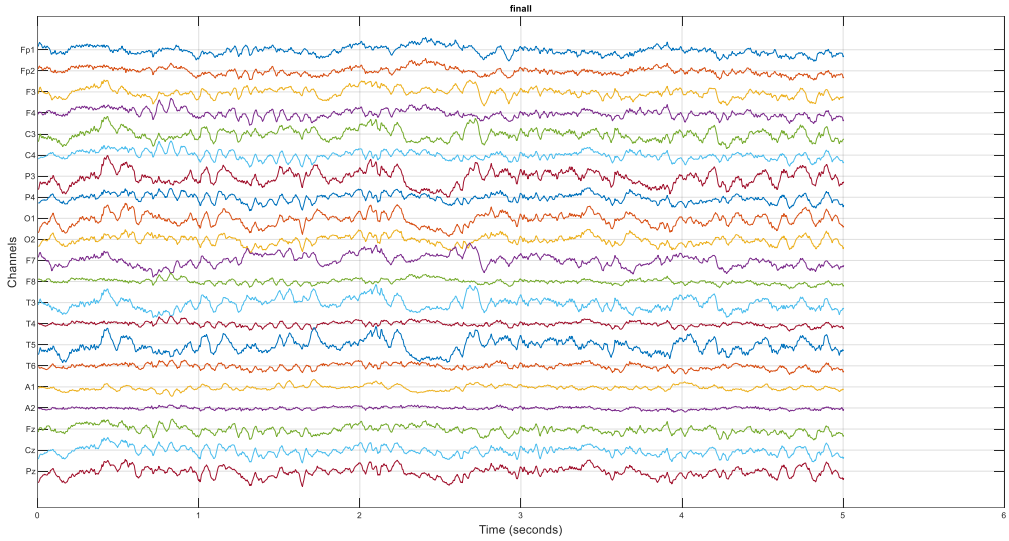
d) And we can plot the power frequency of signals and Spatial information, too:





Based on the above figures, we figure out channel 4 is Electricity (look at the fourth frequency figure) and channel 10 is ECG(look at the location of the 10-th source). So, we can remove that from our sources.

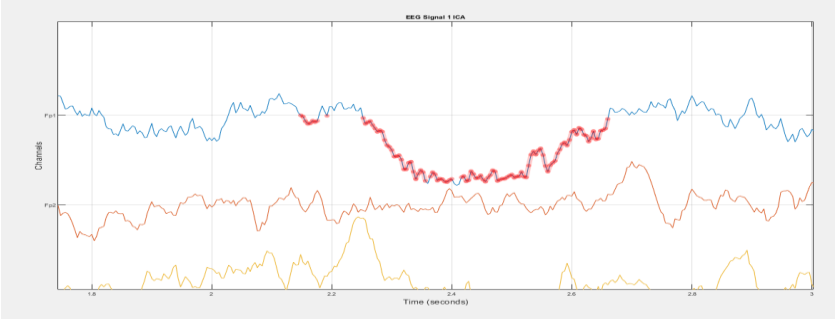
e) If we remove channels 4 & 10 from our sources, we give this result for X denoised:



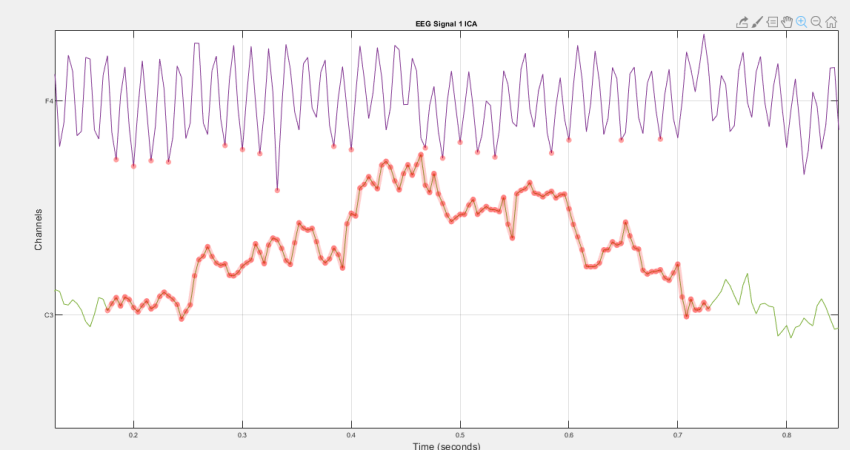
As we see, the result isn't good enough, So we need to remove more sources.

I think we can remove these channels:

Channel 1: because the below pulse can occur when the movement of the electrode:

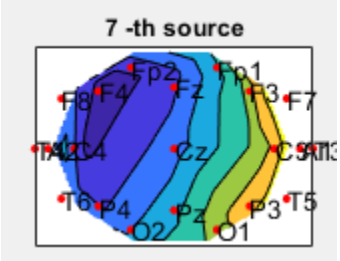


Channel 5: the same reason to channel 1:

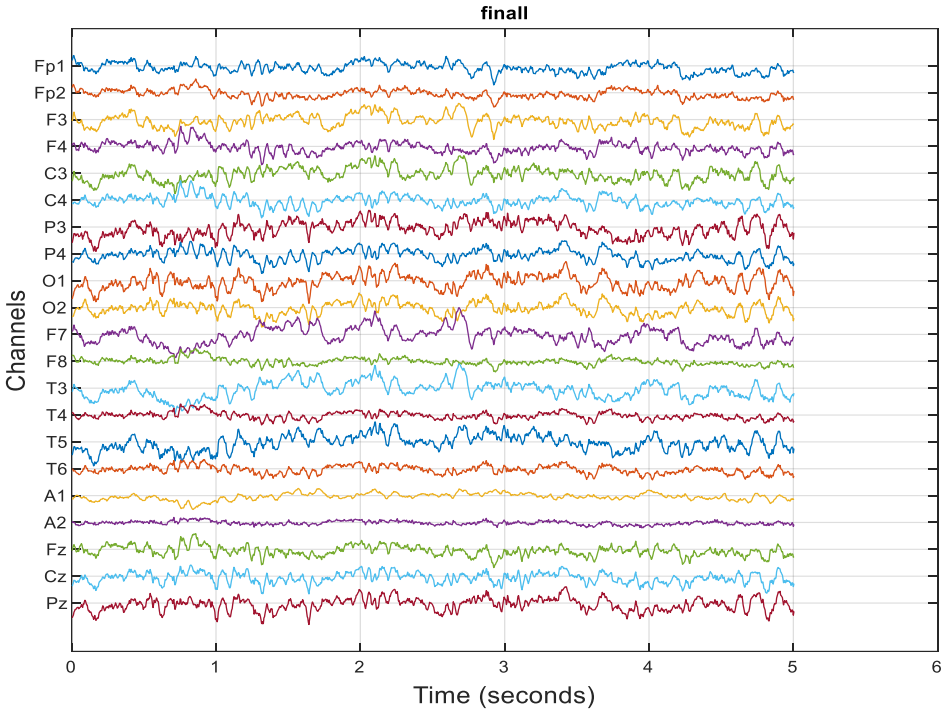


And both channels are located close together.

Channel 7: based on the below figures, it is better to remove it:



After removing these sources, have the below result:

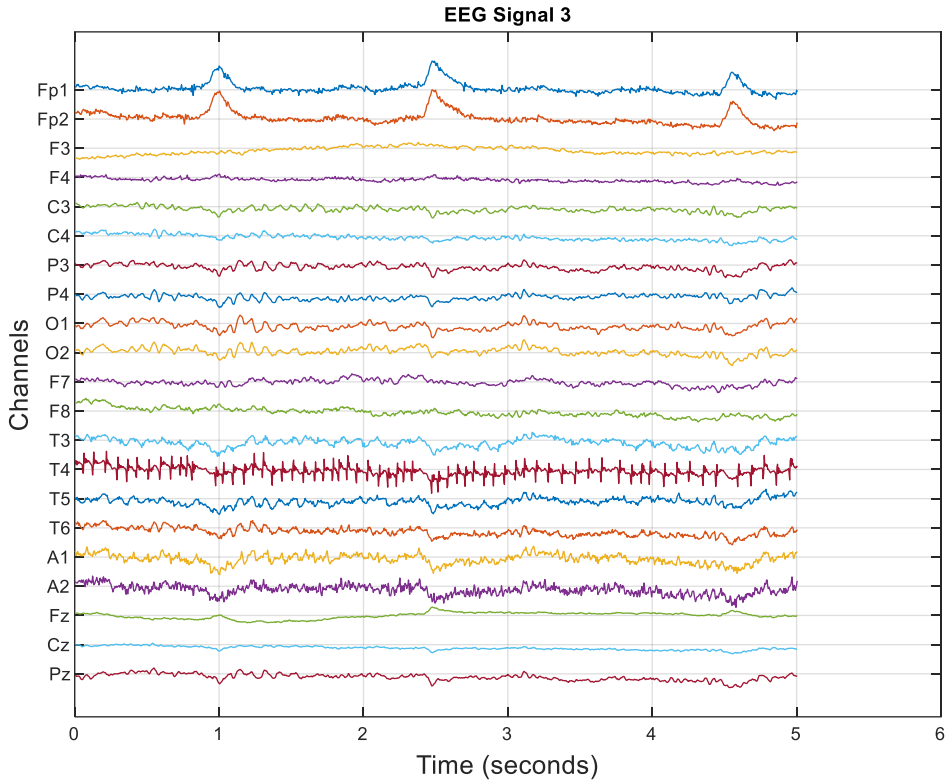


As we see, the result is better than the previous.

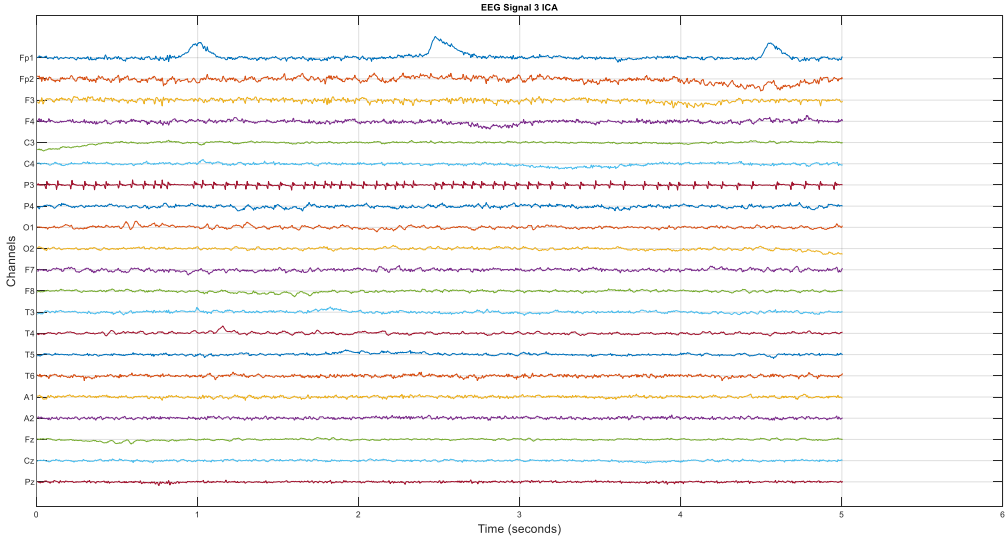
So, with the ICA, we can remove some of the noise and artifacts and get a good result.

For EEG signal 3:

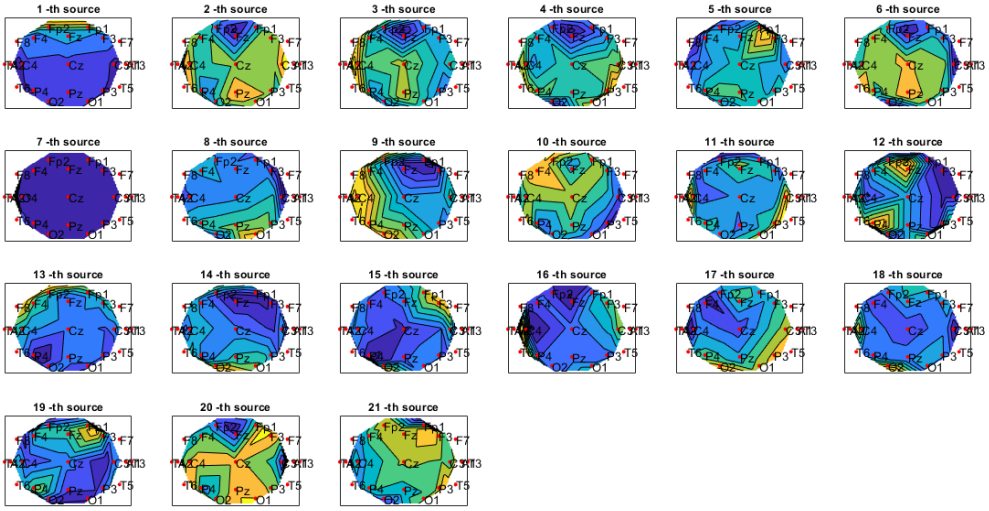
a) Based on the below figure, I think we have eye movements & EMG artifacts.

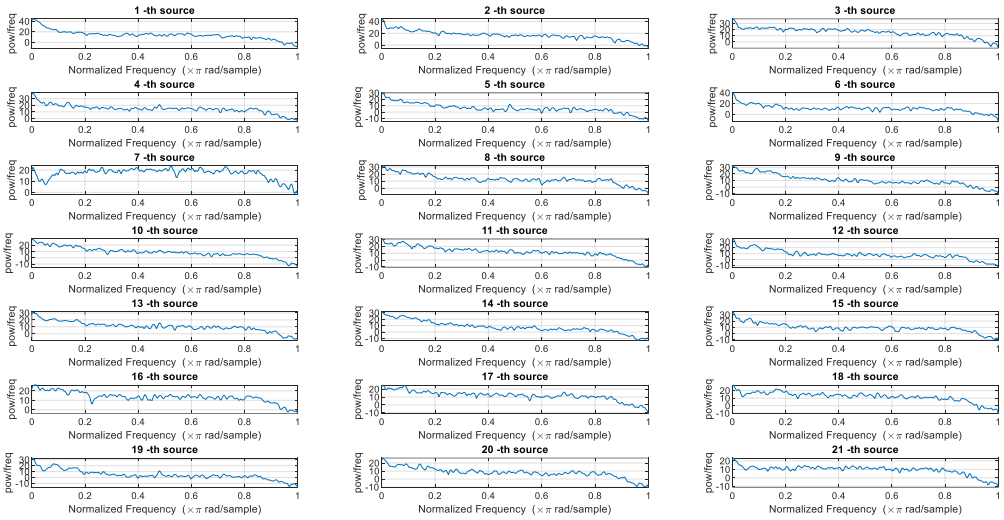


b) After we apply ICA, we have:



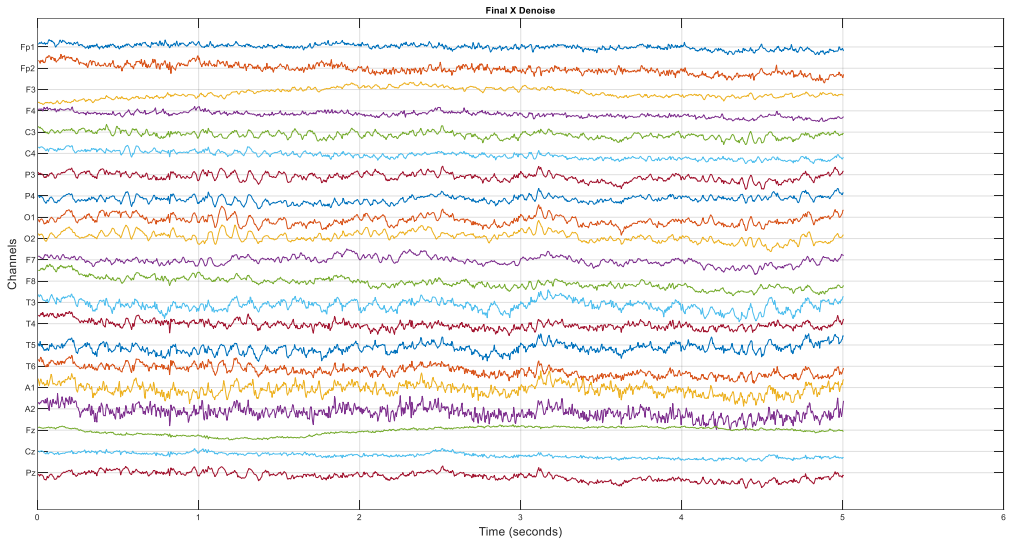
c) And we can plot the power frequency of signals and Spatial information, too:





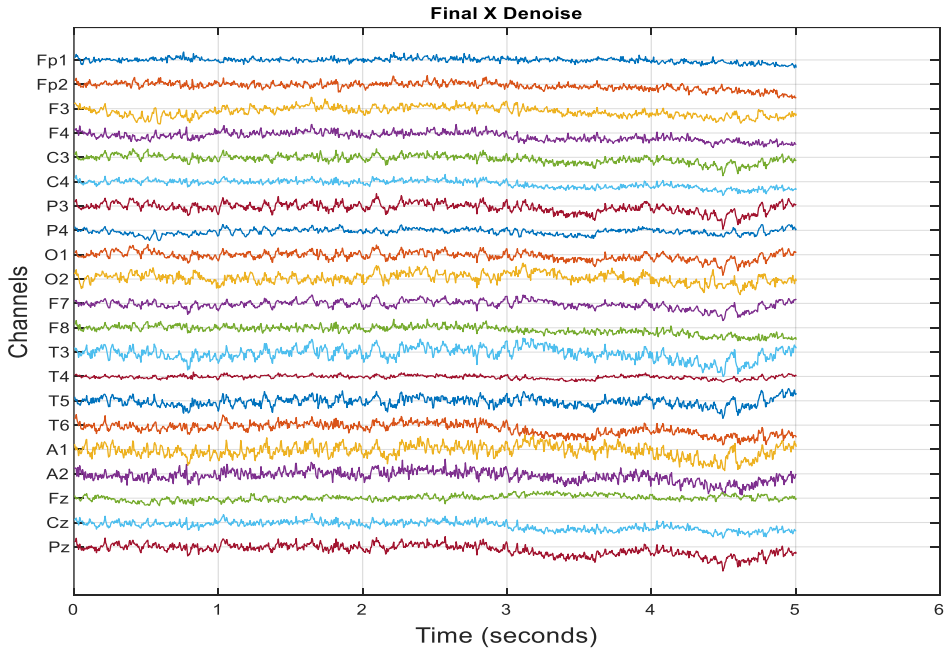
Based on the above figures, we figure out channel 1 is eye movements (look at the time plot and location of 1-th source), and channel 7 is EMG(look at the site of the 7-th source and pwelch too). So, we can remove that from our sources.

d) If we remove channels 1 & 7 from our sources, we give this result for X denoised:



As we see, the result isn't good enough, So we need to remove more sources.

In this case, I remove a few sources to reach the following result:



As we see, the result is better than the previous.

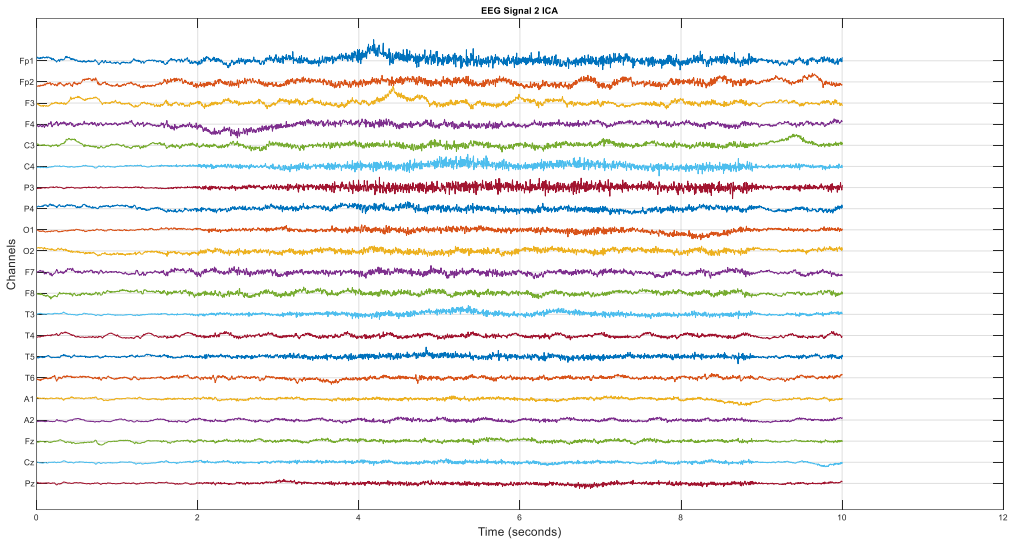
In this case, we keep the following sources:

2,6,10,17,18,19,20,21

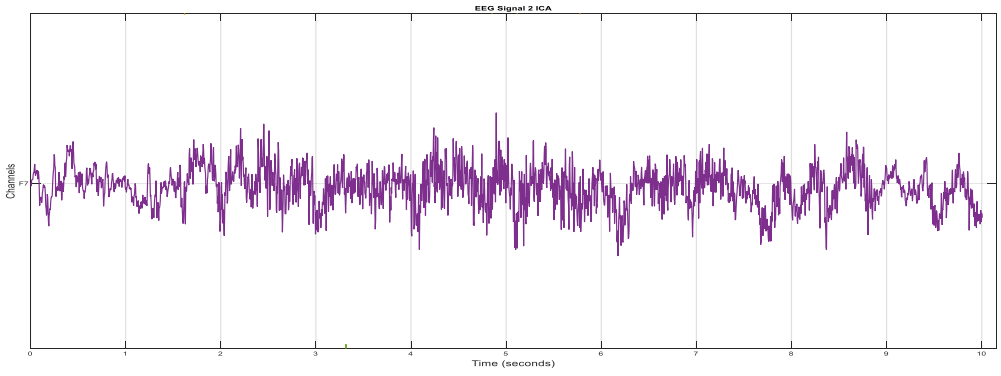
So, with the ICA, we can remove some of the noise and artifacts and get a good result.

For EEG signal 2:

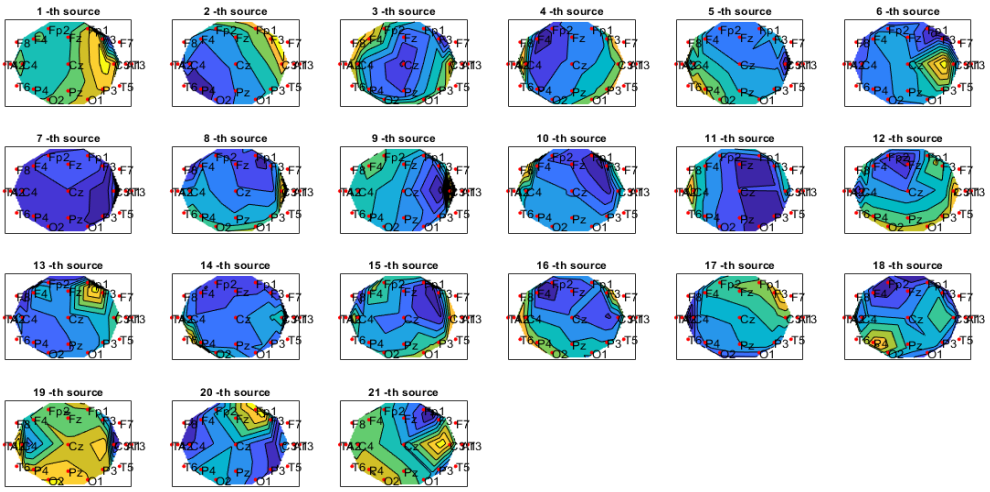
In this case, I think we have a lot of EMG artifacts sources.



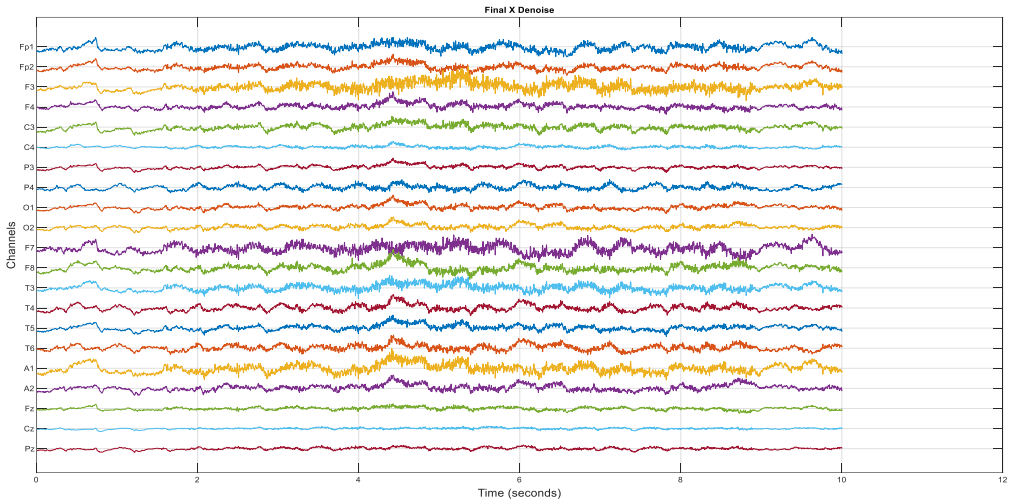
A few sources are EEG signals that are combined with EMG artifacts. Like this:



As we see in the figure below, most of the sources are located near the ear and contain a large period of high freq so that they can be EMG.



After removing lots of sources, we get this result:



It is a good result, but as we see, the EMG artifacts remain on some channels.

So, the ICA method is suitable and can remove some artifacts and noise.