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Brain Computer Interface

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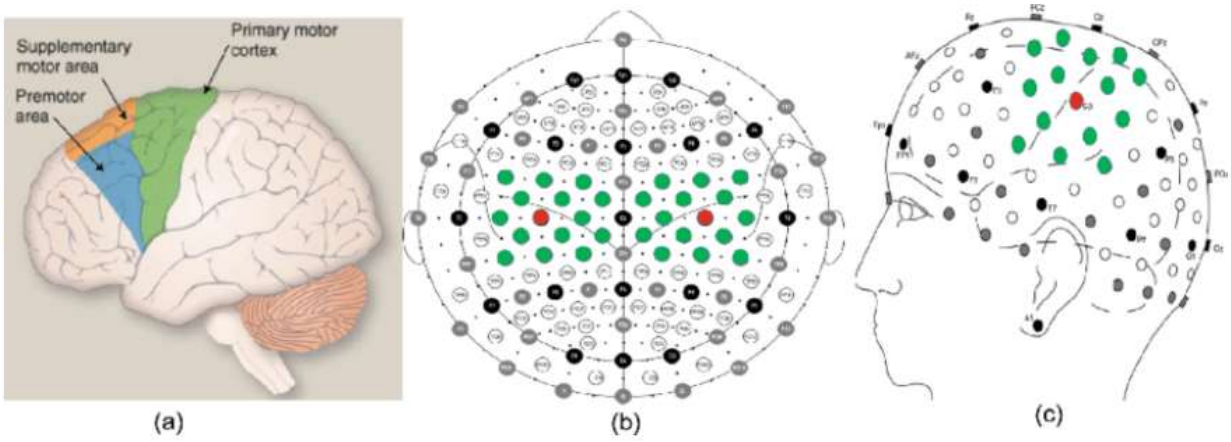
Content

1. Data:

1.1. Select channels

Areas around the frontal and central are most related to the motion, especially the premotor cortex which is responsible for the imaginary motion, since brain signals about motion are not produced once you move, instead when we imagine or think about the action.



(a) Motor cortex of the brain (b) Standard 10 ± 20 system of electrode placement for 128 channel EEG system. The electrodes in green and red colour are selected for processing (c) The anterior view of the scalp and the selected channels. (Color figure online)

Publication: *https://www.researchgate.net/publication/321394237_Classification_of_Motor_Im*

However, ignoring both pure central and frontal parts is somehow a risk.

Suggestions:

1. We can transform channels, that we think they may have an impact on the classification, to the frequency domain, then choose most of them that produce frequency within the hand movement band frequency.

2. Make use of the topological features in locating electrodes using mathematical concepts or applying GNNs where electrodes are nodes and have weighted edges where the weights represent distances.

3. Apply band pass filtering on the chosen channels.

1.2. Outliers

Outliers Detection → Assuming data is not normally distributed, I have applied the "Median" method and IQR for detecting the outliers.
Dealing → Removed them.

Suggestions:

1. You can replace them with other values whether from trial or time or channel levels, (column or row based), whether considering the class or just being concern about the feature level.

1.3. Other preprocessing

1.3.1. Average on the time dimension is done, although it has its drawbacks, as we now deal each trail as it was defined only on one time point, it means temporal precision have been lost.

Suggestion:

1. Classify across time.
2. Apply time**x**time classification.

1.3.2. Trail time length is 8 seconds. The actual event is conducted within 4 seconds, and the others are non-crucial phases. **Suggestion:** Make use of those phases and apply baseline correction to remove noise.

1.3.3.

2. Classification

Suggestions:

Try different model's architectures, include skip residual network.

2.1. Time domain

1. Apply band pass filtering using the defined hand movement range and then return to the time domain to be more focused on the movement's frequencies.
2. Learn a kernel that is able to attenuated the nonpivotal frequencies in the signal.

2.2. Frequency domain

Apply Fourier transform and then using the magnitude as a feature vector, it gave a better result than applying in time domain.

Suggestions:

1. Apply band pass filtering using the defined hand movement range.