EEG - signals, topography, re-referencing

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1 Simulate a source in S1 – post-central gyrus.

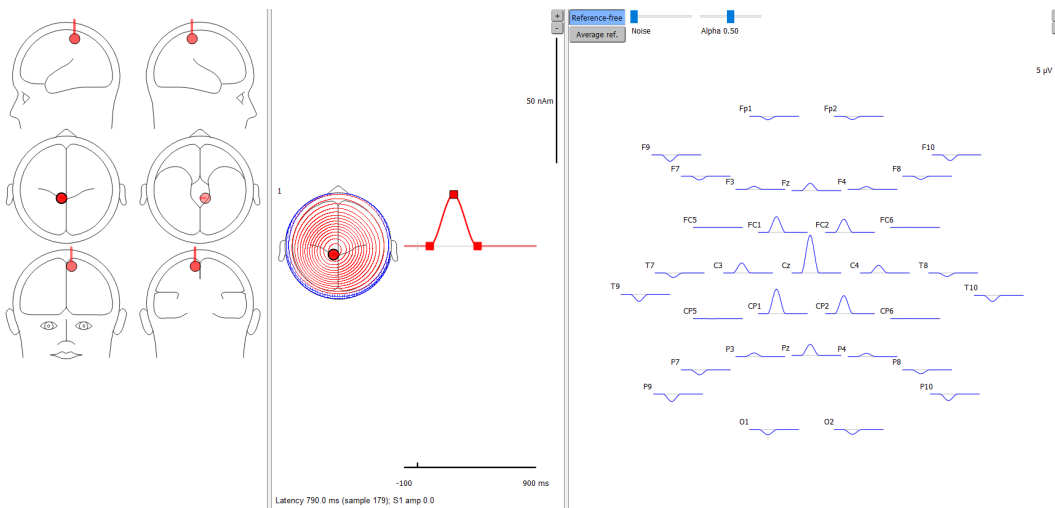### 1.1 How does the topographical plot look like? Where is the maximal activation and why?

Figure 1: Source in S1 – post-central gyrus

Topographical Plot is shown above in above figure which is generated using two colours red and blue, red is indicating '+' side of the dipole and blue is indicating '-' side of the dipole or source.

Maximal activity is observed in the central, centro-parietal and frontal-central because source location is in the the position of S1 as shown above in fig. 1.

1.2 Move the dipole around to understand how topo-plot changes with the dipole
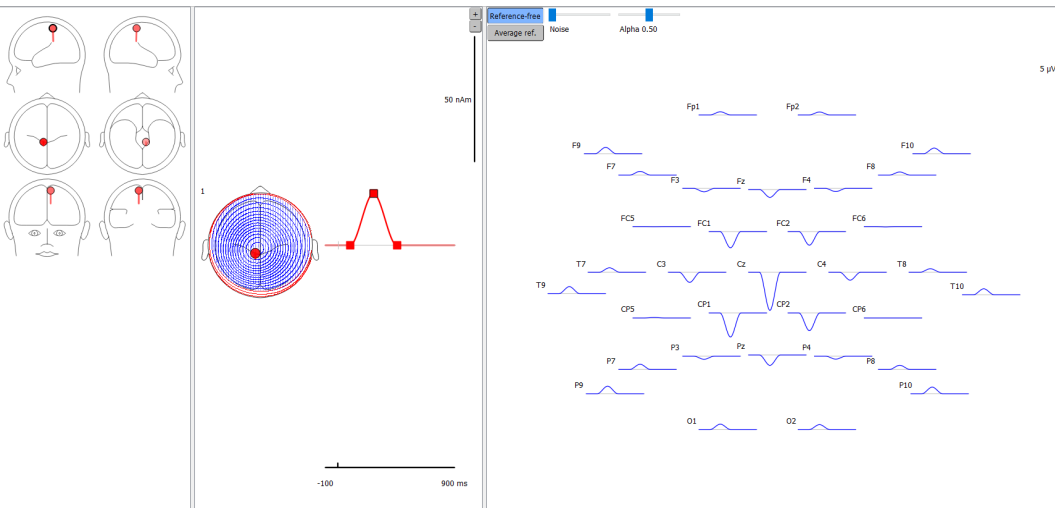

Figure 2: Source in S1 – post-central gyrus

As we can observe from the above results when the direction of the dipole is rotated by 180 degree then the blue and red contour lines are also interchanged, basically these contour lines are indication of the direction of the dipole.

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1.3 Can you reduce the topo-plot to a simple electric vector in each case?
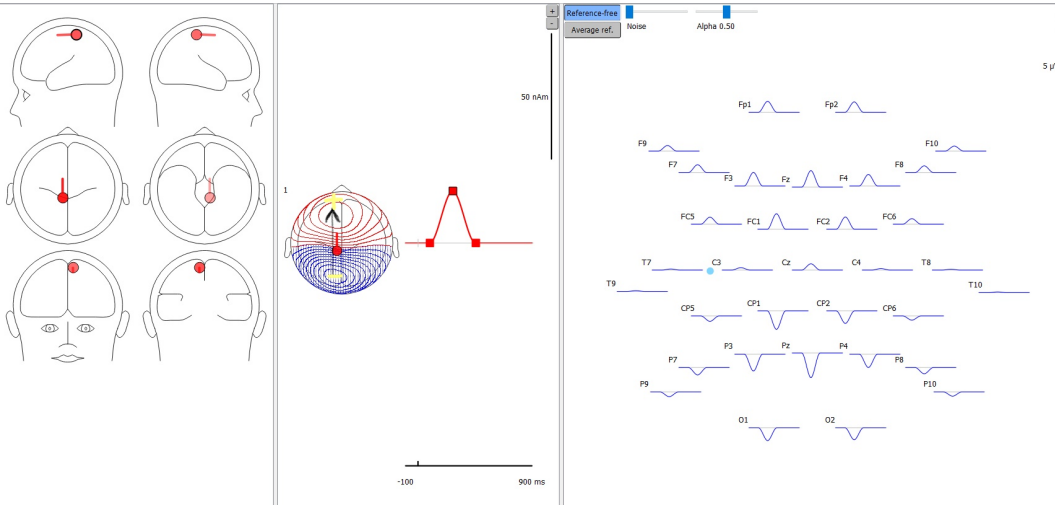

Figure 3: Source in S1 – post-central gyrus

No, we can not reduce all the topo-plots to the simple electric vector because topo-plots are plotting a 3-D activity of space as an example fig. 1, but in some cases we can do it as shown in fig. 3

2 Simulate an oscillating sinusoidal source (8-12 Hz) in the visual cortex

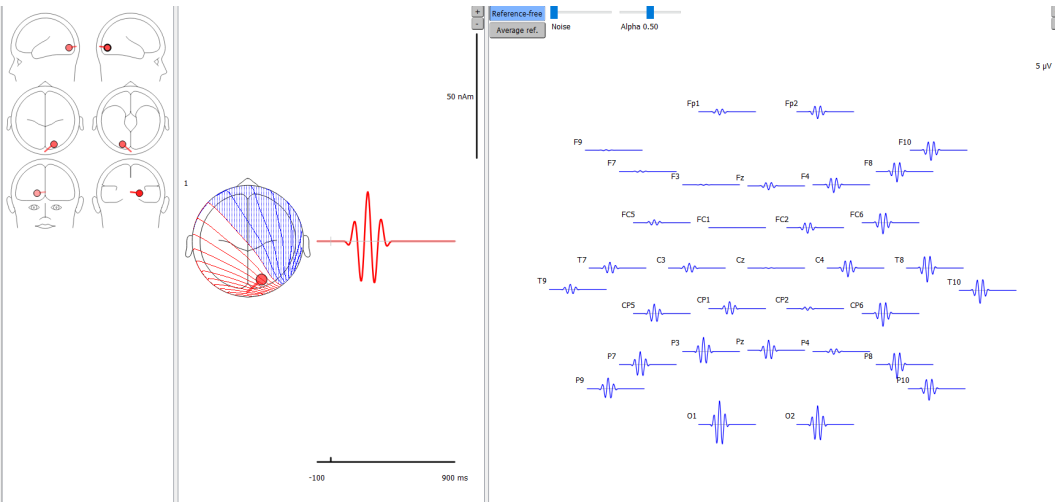## 2.1 How does the topographical plot look like? Where is the maximal activation and why?

Figure 4: Source in visual cortex

A source of sine wave with frequency of 10 Hz is placed in visual cortex with directed to downwards and it's topo-plots is indicating same information. The maximal activity is observed in the occipital lobe electrodes because visual cortex is in occipital lobe of brain.

3 Effect of filtering on evoked potential

3.1 Low-pass, high-pass

Two sources are placed in the Occipital lobe of the brain both the sources are sine wave and frequency of 10 Hz. we are putting a low pass filter with cut-off frequency of 12Hz and High pass filter with the cut-off frquency of the 8Hz as shown in above figure response it works as band pass filter with order 8.
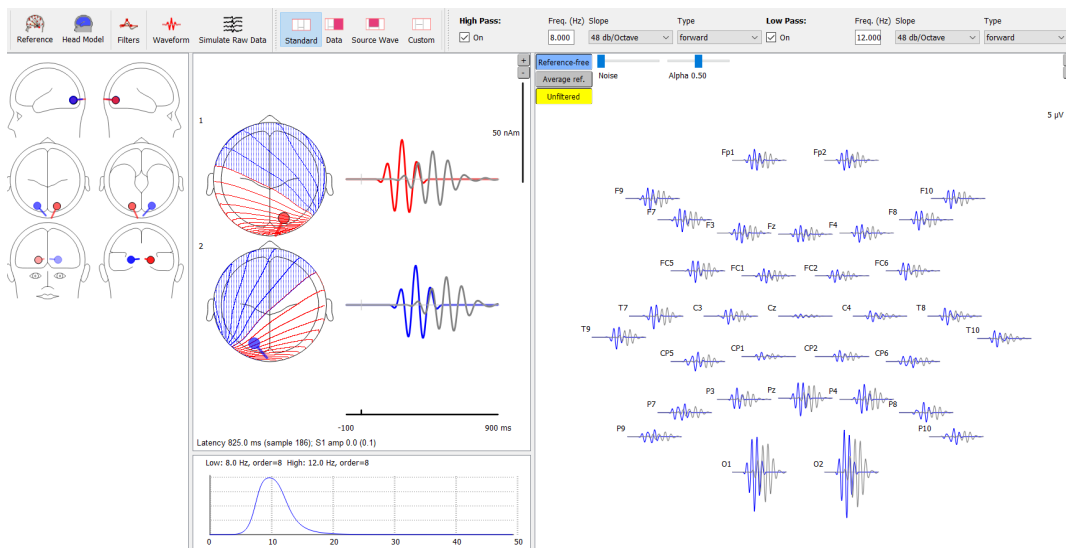
Figure 5: Sources in visual cortex
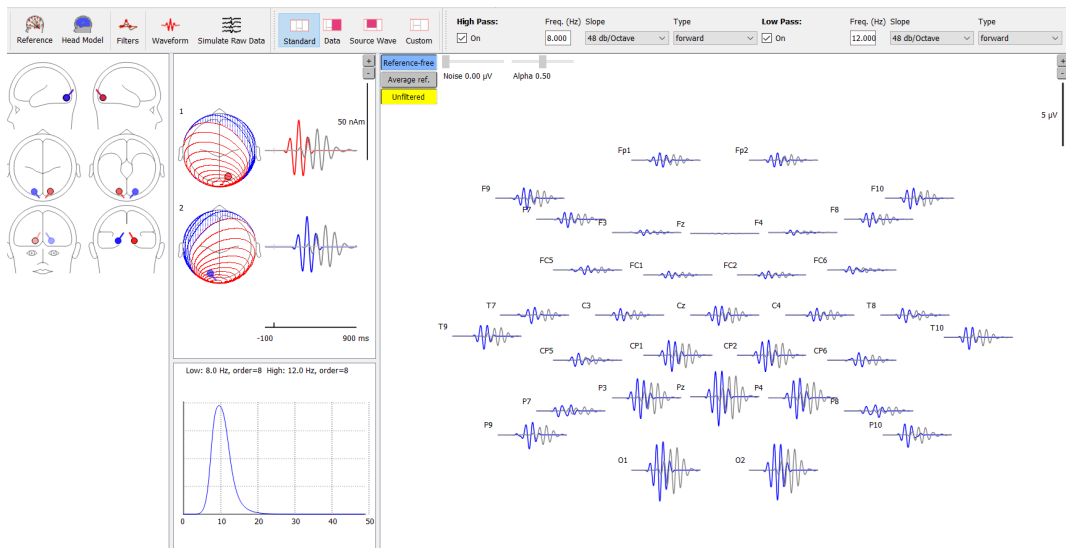
3.2 Forward, reverse, zero-phase filtering

Figure 6: Forward Filter

- Forward filter : Response is delayed
- reverse Filter : response is Advanced
- Zero Phase Filter : NO lead-lag in response

4 Effect of re-referencing topo-plot changes with different references
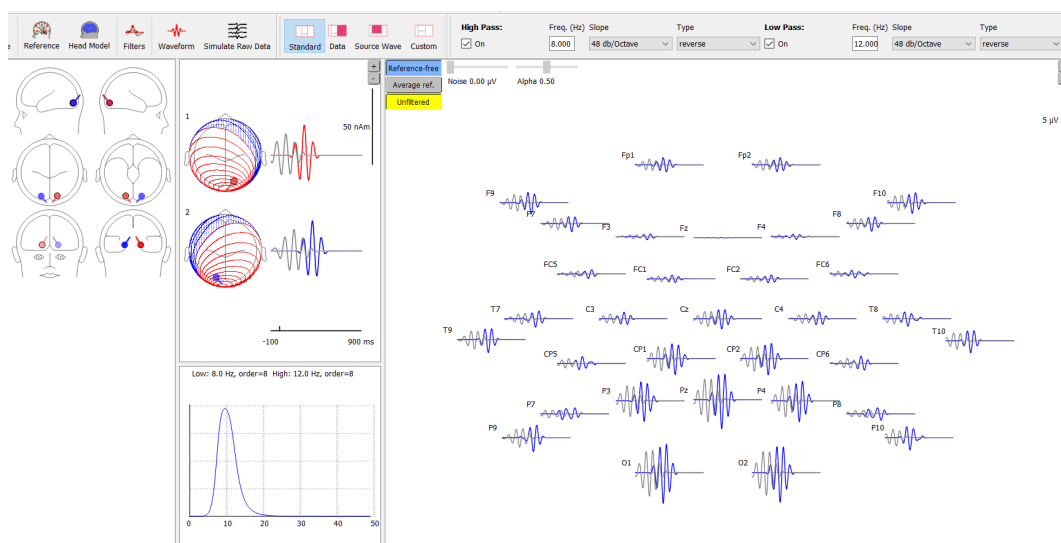
4.1 Common average

4.2 Linked mastoid reference
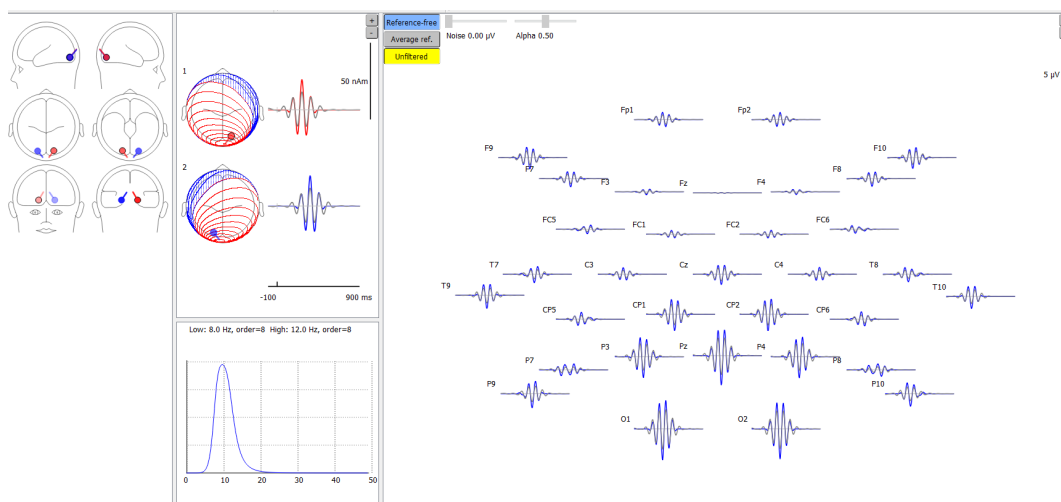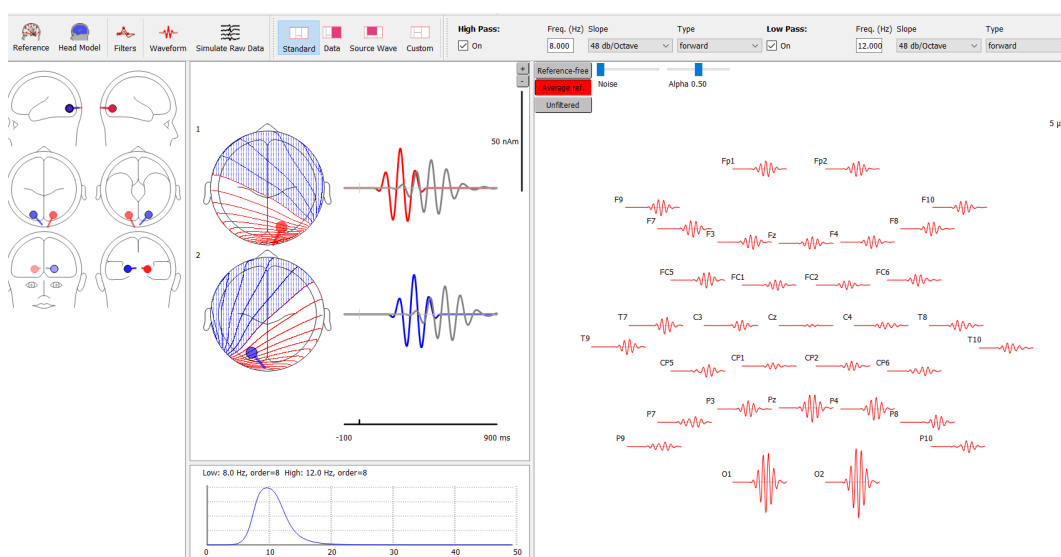
Figure 7: Reverse Filter

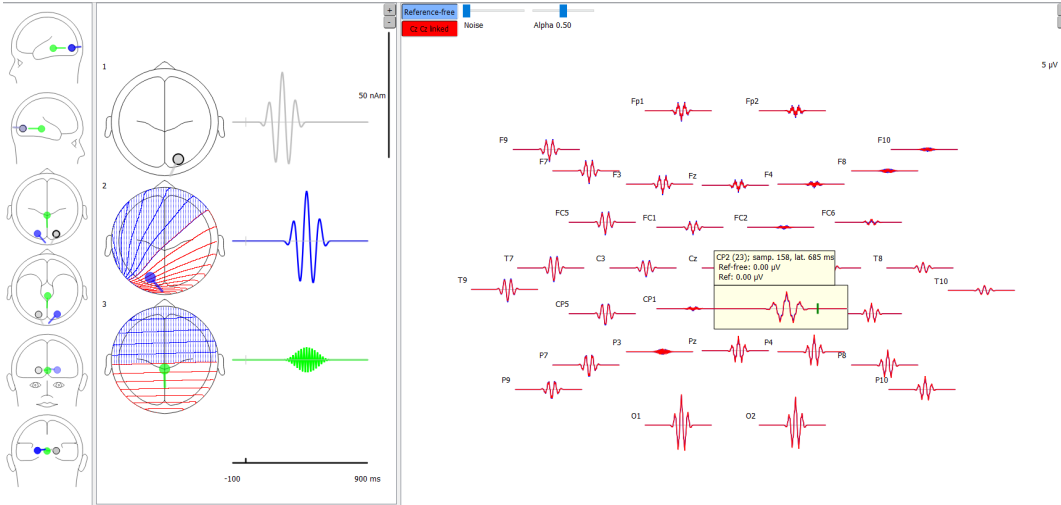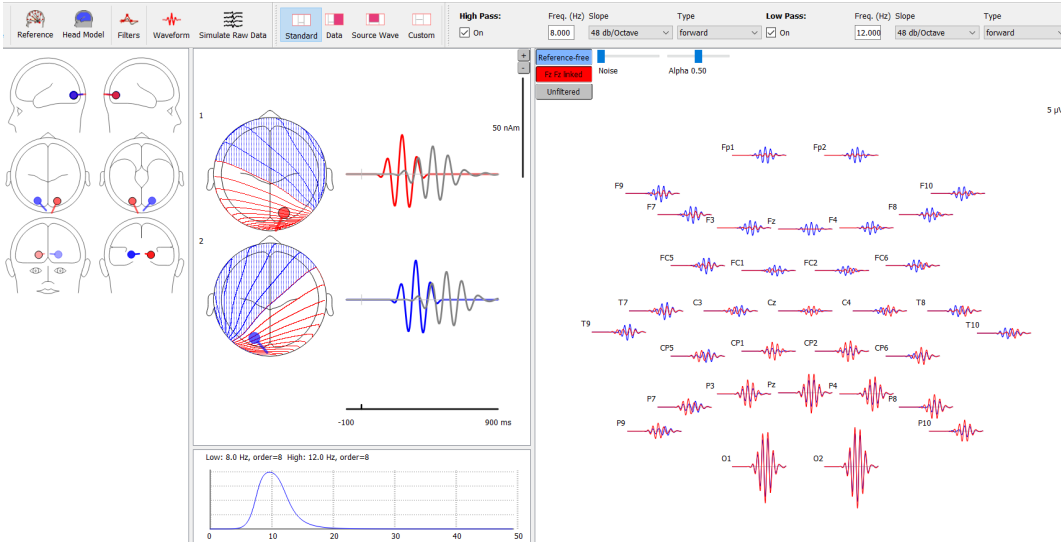Figure 8: Zero filter

Figure 9: Common average

Figure 10: Cz

Figure 11: Fz

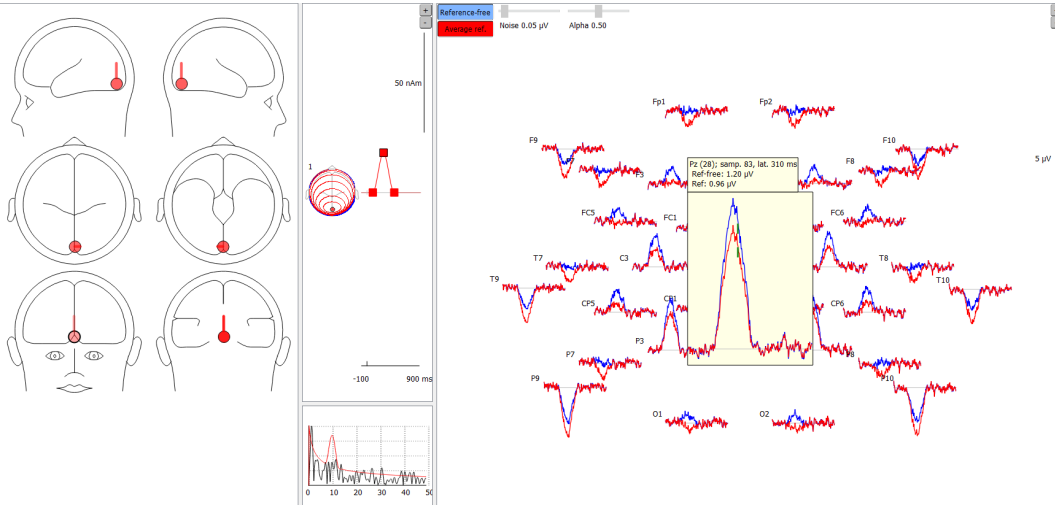# 5 Effect of noise on re-reference techniques

5.1 Add noise

Figure 12: Noise and re-reference

5.2 Which of the re-referencing technique handles noise best?

Average reference is the best technique to handle noise among linked (Fz, Fc) and referencing after comparison for the above source for different source and different purpose different referencing may work better.