BM5080
Brain Computing Interfaces

Dipole, topography and re-referencing

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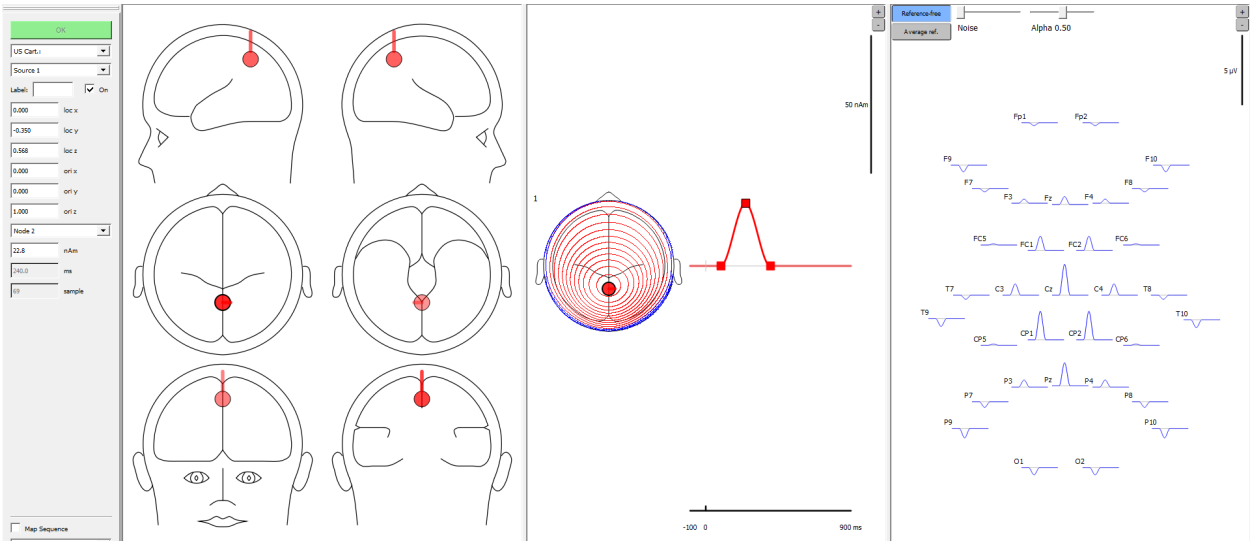
BM20BTECH11015

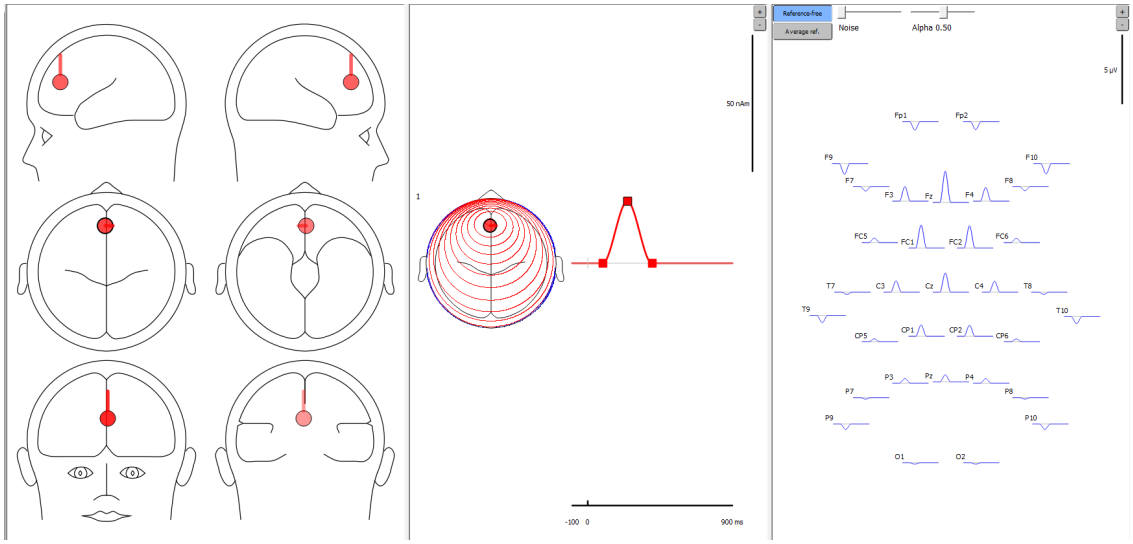
1. Simulate a source in S1 – post-central gyrus

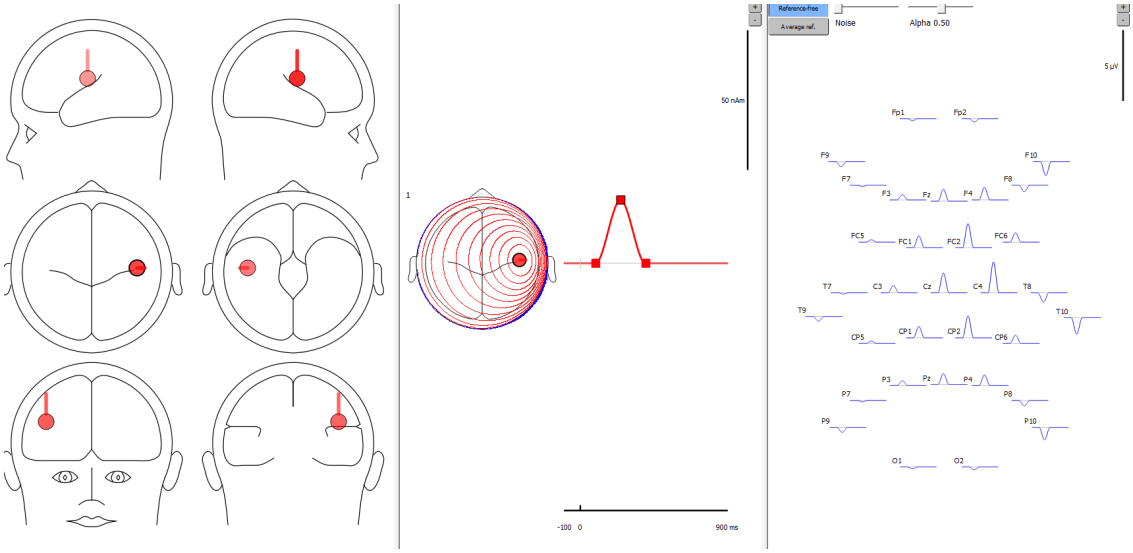
    How does the topographical plot look like? Where is the maximal activation and why?

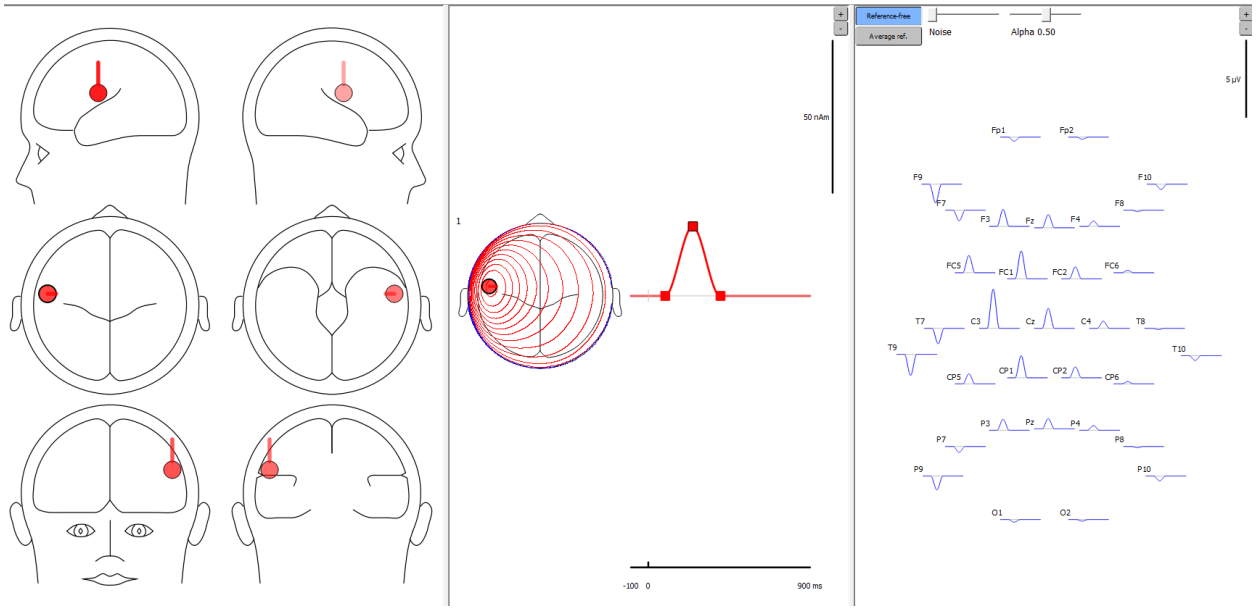


Here the picture in the 3rd column is the topographical plot. It is maximum at Cz when the dipole is placed near the post central gyrus because the dipole is closest at Cz. Additionally we also see that the isopotential rings are densely packed in the occipital lobe and are more sparse near the frontal lobe.

Move the dipole around to understand how topoplot changes with the dipole


Reference-free
Average ref.
Noise
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
Fp1
Fp2
F9
F7
F3
Fz
F4
F8
F10
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2


Reference-free
Average ref.
Noise
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
Fp1
Fp2
F9
F7
F3
Fz
F4
F8
F10
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2

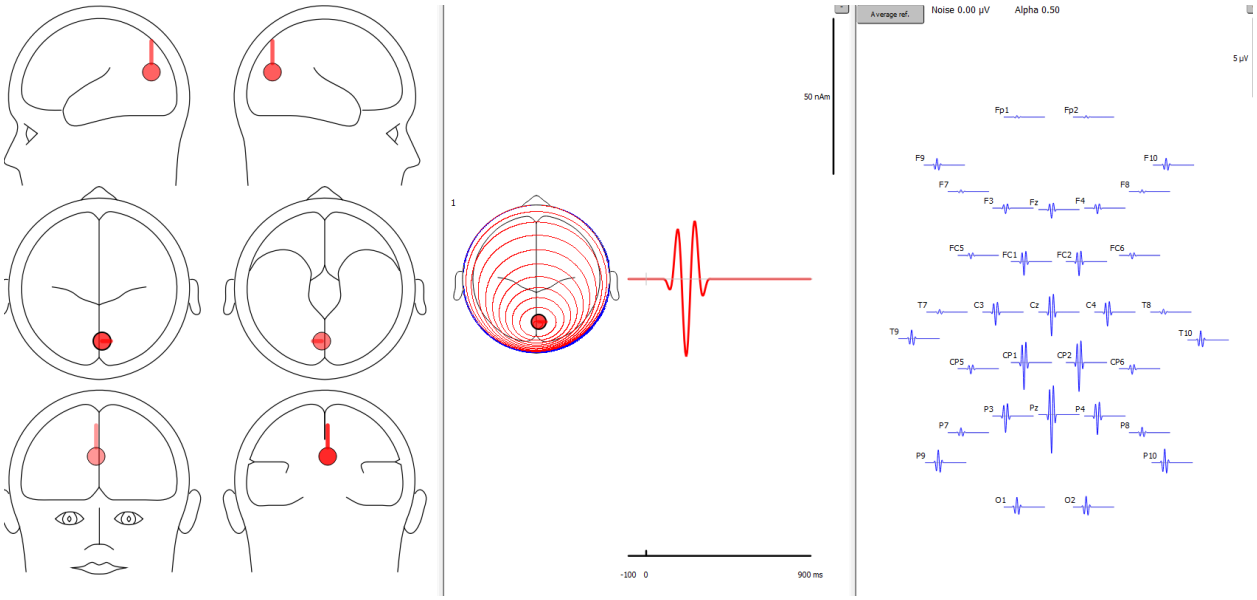


From the above 3 plots we can conclude that when we move the dipole around, the isopotential rings shift and are more densely packed near the dipole and sparse on the opposite side of the dipole. The maximum activation is at the point to which the dipole is nearest.

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

Yes. We can consider the pyramidal neurons to be a single electric vector and the sum of all such vectors will give a single vector.

2. Simulate an oscillating sinusoidal source (8-12 Hz) in the visual cortex
    a. How does the topographical plot look like? Where is the maximal activation and why?

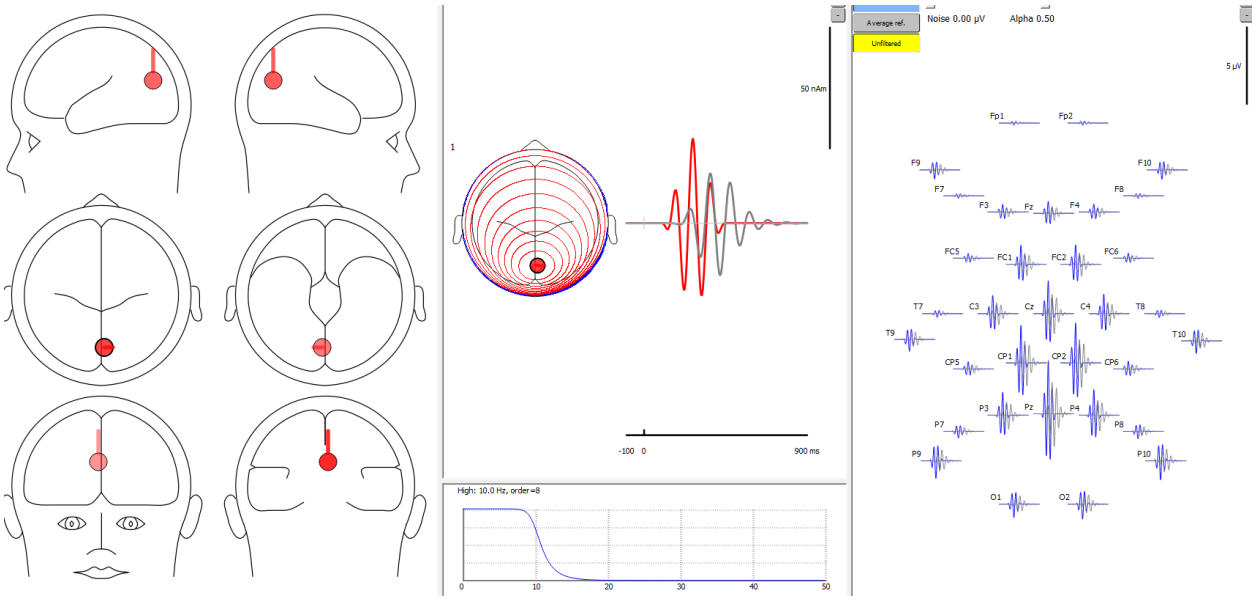


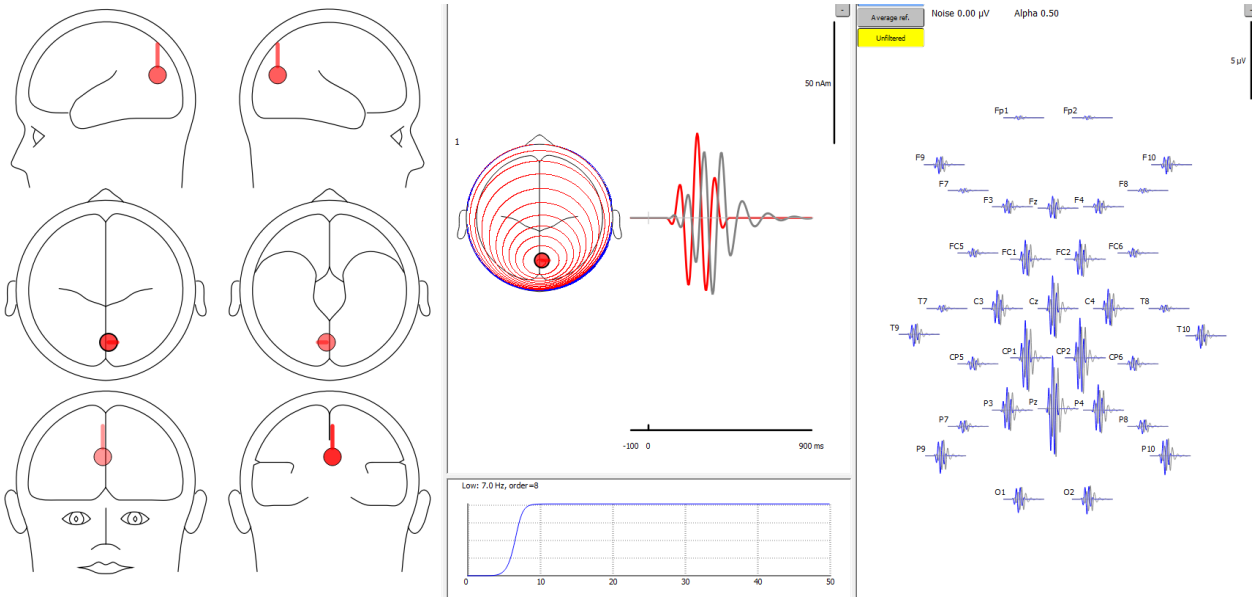
When a sinus impulse of frequency 10Hz and amplitude 25nAm is given, this is how the topographical plot looks like. The maximum activation is seen at Pz because it is near the dipole.

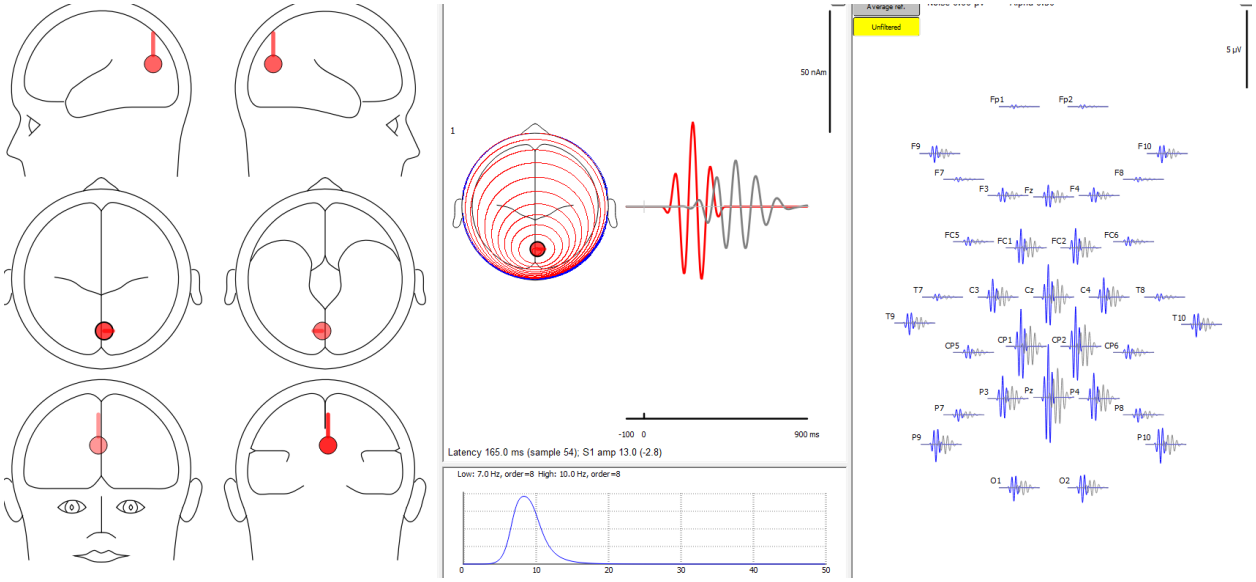
3. Effect of filtering on evoked potential

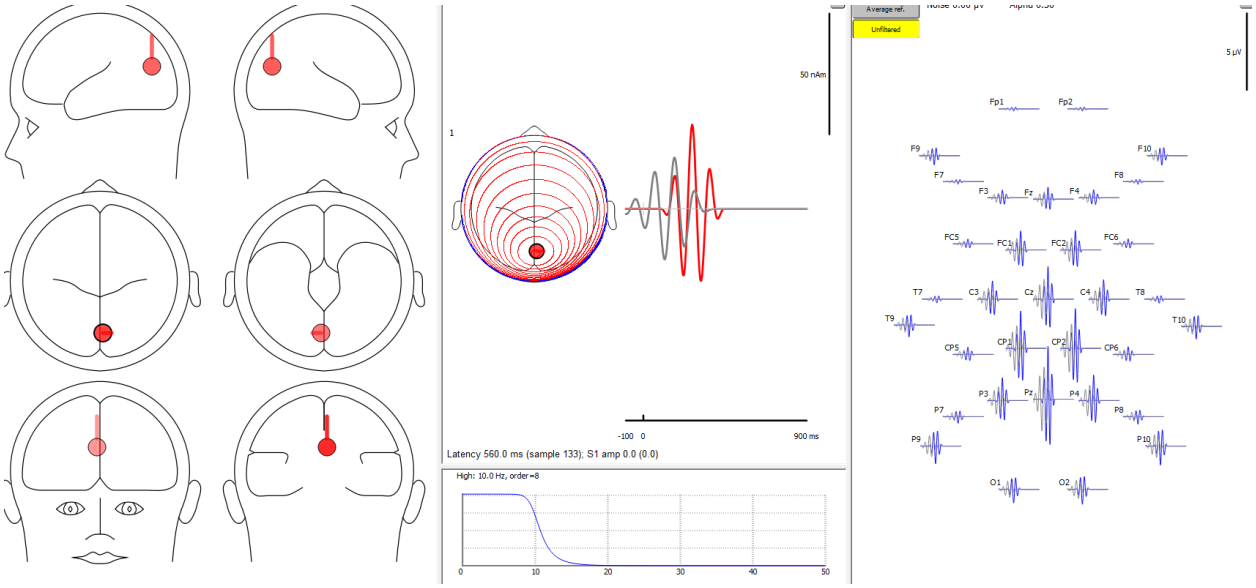
a. Low-pass, high-pass

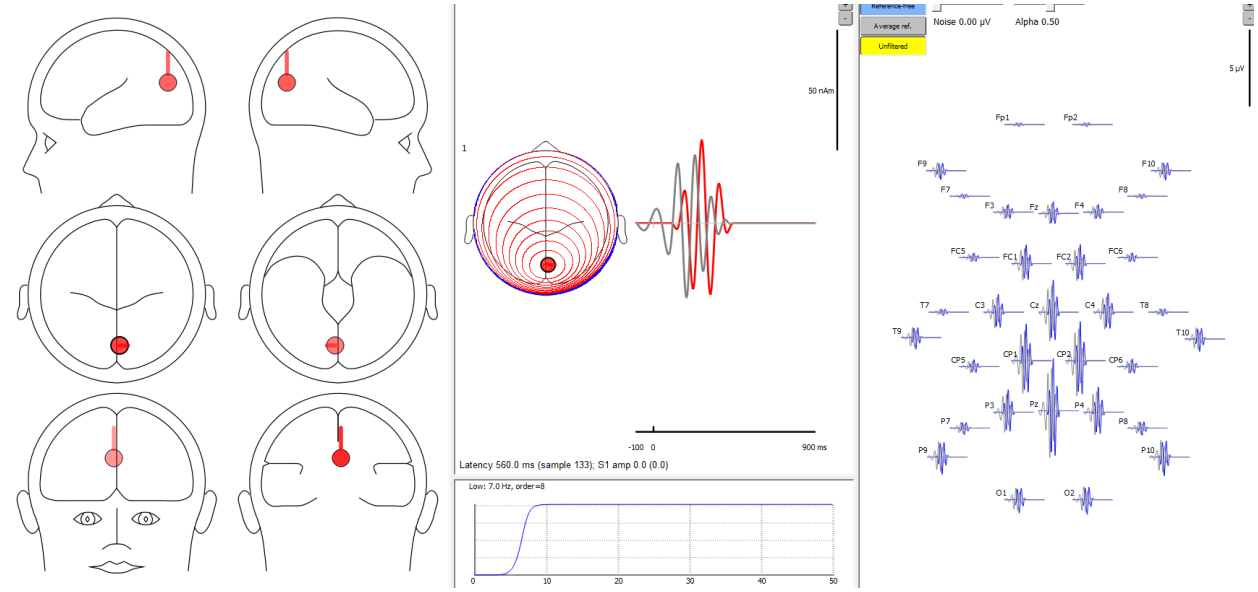
b. Forward, reverse, zero-phase filtering

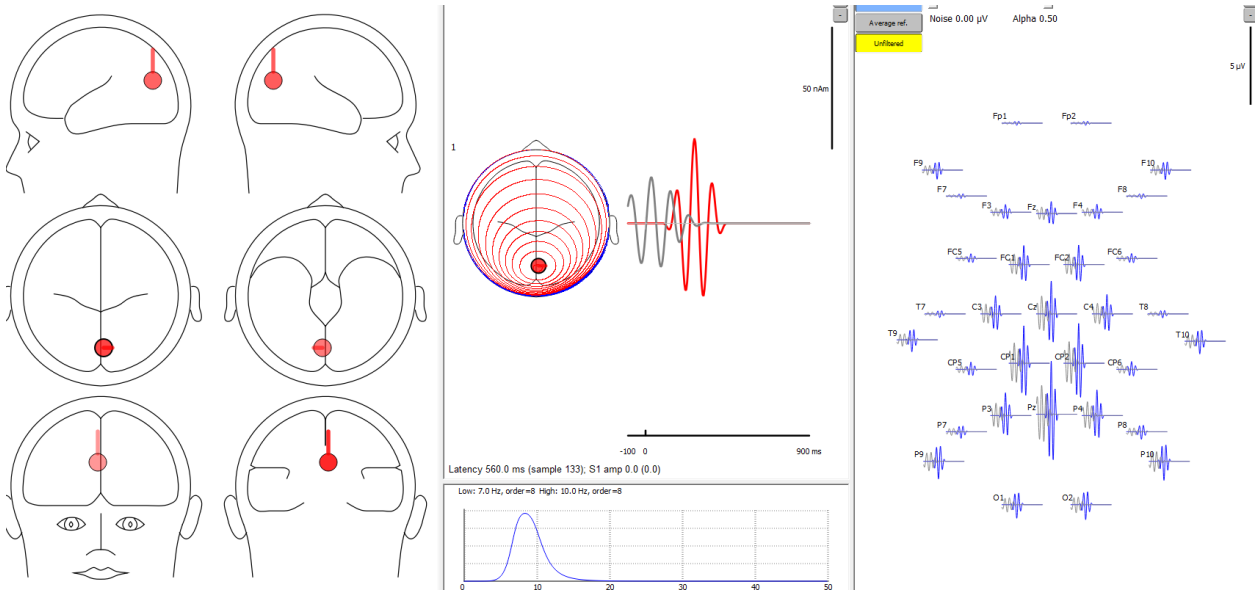

Average ref.
Unfiltered
Noise 0.00 µV
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
High: 10.0 Hz, order=8
Fp1
Fp2
F9
F10
F7
F8
F3
Fz
F4
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2

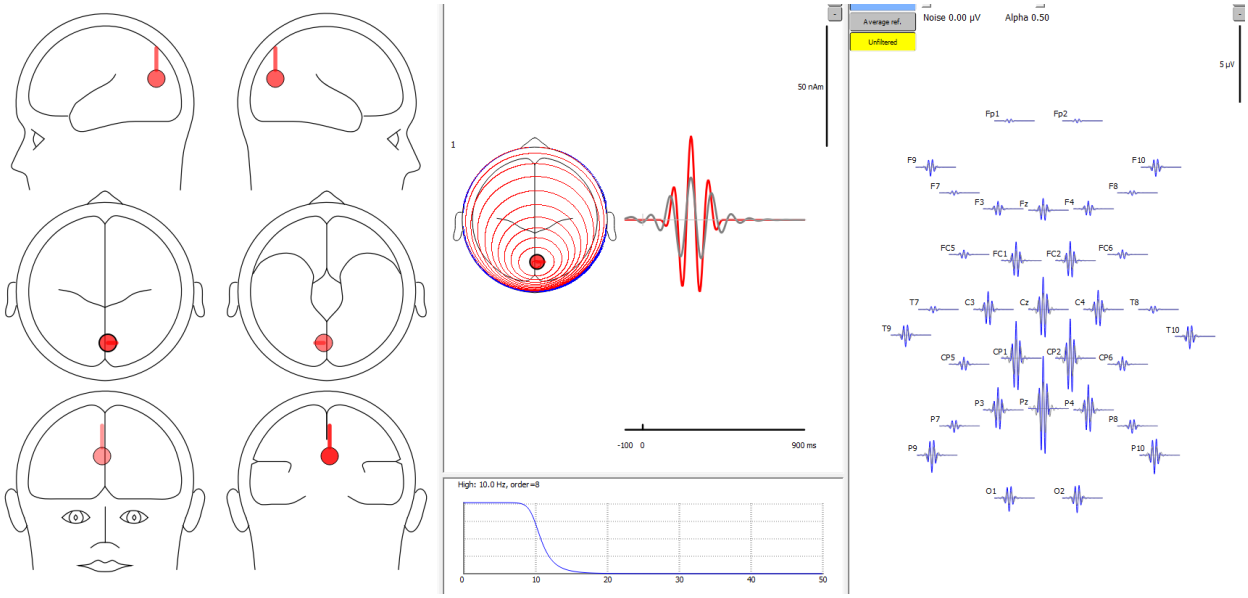

Average ref.
Unfiltered
Noise 0.00 µV
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
Low: 7.0 Hz, order=8
Fp1
Fp2
F9
F10
F7
F8
F3
Fz
F4
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2

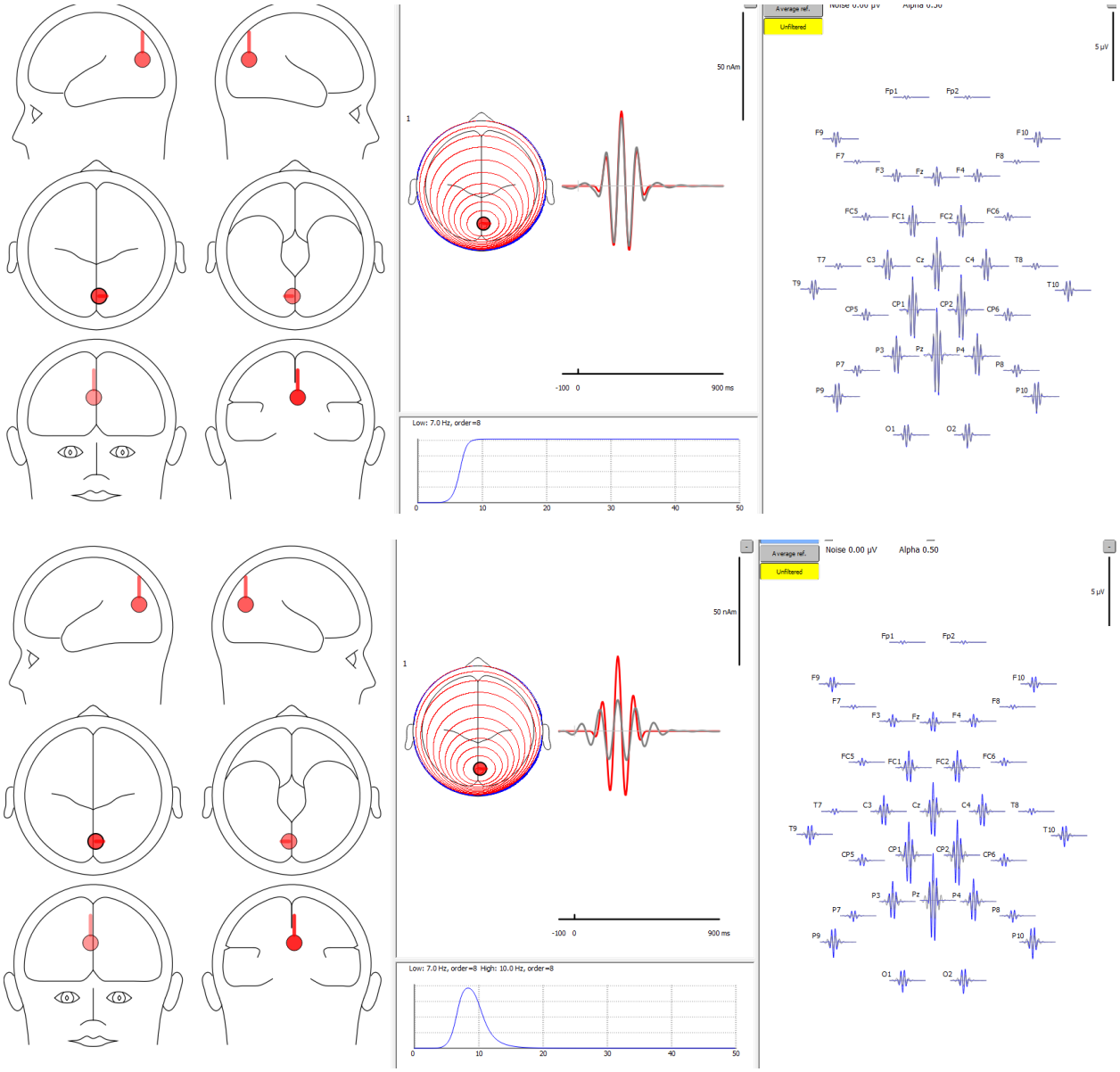

Average ref.
Unfiltered
50 nAm
5 µV
1
Fp1
Fp2
F9
F10
F7
F8
F3
Fz
F4
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2
-100 0
900 ms
Latency 165.0 ms (sample 54); S1 amp 13.0 (-2.8)
Low: 7.0 Hz, order=8 High: 10.0 Hz, order=8
0
10
20
30
40
50


Average ref.
Unfiltered
50 nAm
5 µV
1
Fp1
Fp2
F9
F10
F7
F8
F3
Fz
F4
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2
-100 0
900 ms
Latency 560.0 ms (sample 133); S1 amp 0.0 (0.0)
High: 10.0 Hz, order=8
0
10
20
30
40
50


Average ref.
Unfiltered
Noise 0.00 µV
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
Latency 560.0 ms (sample 133); S1 amp 0.0 (0.0)
Low: 7.0 Hz, order=8
0 10 20 30 40 50
Fp1 Fp2
F9 F7 F3 Fz F4 F8 F10
FC5 FC1 FC2 FC6
T7 C3 Cz C4 T8 T9 T10
CP5 CP1 CP2 CP6
P7 P3 Pz P4 P8 P9 P10
O1 O2


Average ref.
Unfiltered
Noise 0.00 µV
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
Latency 560.0 ms (sample 133); S1 amp 0.0 (0.0)
Low: 7.0 Hz, order=8 High: 10.0 Hz, order=8
0 10 20 30 40 50
Fp1 Fp2
F9 F7 F3 Fz F4 F8 F10
FC5 FC1 FC2 FC6
T7 C3 Cz C4 T8 T9 T10
CP5 CP1 CP2 CP6
P7 P3 Pz P4 P8 P9 P10
O1 O2


Average ref.
Unfiltered
Noise 0.00 µV
Alpha 0.50
50 nAm
5 µV
1
-100 0
900 ms
High: 10.0 Hz, order=8
0
10
20
30
40
50
Fp1
Fp2
F9
F10
F7
F8
F3
Fz
F4
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
T9
T10
CP5
CP1
CP2
CP6
P3
Pz
P4
P7
P8
P9
P10
O1
O2



In the above graphs we can see the lowpass, highpass and bandpass filters for forward, reverse and zero phase filtering. We can infer from the plots above that zero phase filtering doesnt introduce any time latency and preserves the topographical plots while forward and reverse filtering introduce some kind of latency and cause some distortions.