Sampling rate in TMS-EEG coregistration: Any benefits over 5000 Hz?

Agnese Zazio[1], Guido Barchiesi[1], Marta Bortoletto[1]

[1] Neurophysiology Lab, IRCCS Isituto Centro S. Giovanni di Dio Fatebenefratelli, Brescia, Italy

Background and Aim

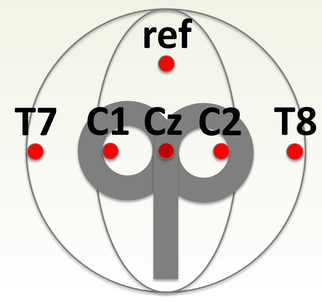
Concurrent transcranial magnetic stimulation and electroencephalography (**TMS-EEG**) is a highly promising technique in neuroscience research, which combines the opportunity of directly activating a target brain area – by means of TMS – and to record the spread of neural activation with an excellent temporal resolution – via EEG (i.e., **effective connectivity** [1]).

Although important advances in off-line analysis have been made in recent years [2], the **TMS-induced artifact** still represents a major challenge in TMS-EEG recordings [3]. It is known that increasing sampling rate (SR) can reduce the duration of the TMS artifact because it allows to increase the low-pass anti-aliasing filter [4]. Importantly, new EEG devices allow recordings at very high SR.

Does SR > 5000 Hz reduce TMS artifact duration?

Methods

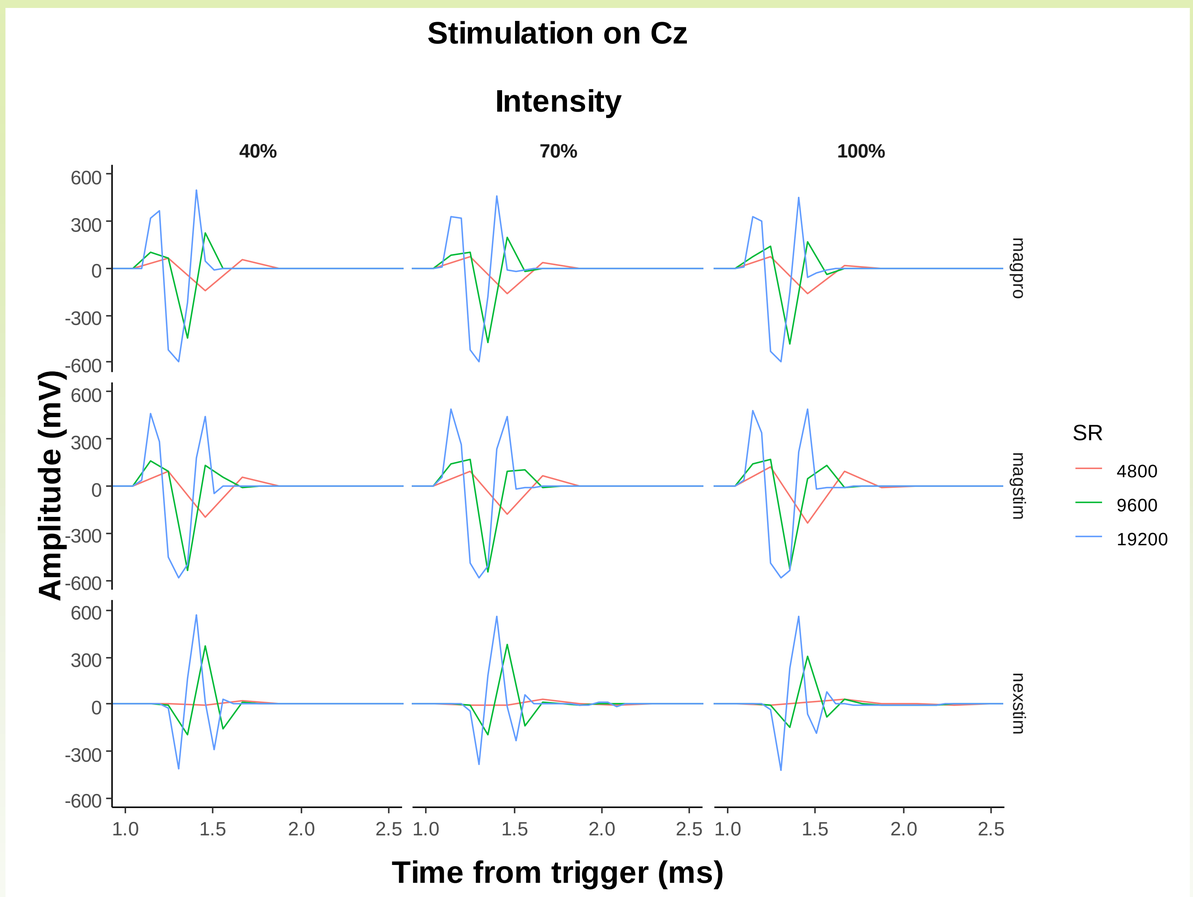
- Phantom head model (melon)
- 5-channel EEG montage (g.HIamp)
- Manipulated variables:
  - SR (4800 Hz, 9600 Hz, 19200 Hz)
  - TMS intensity (40%, 70%, and 100% of maximal stimulator output)
  - stimulator model (Super Rapid, Magpro and Nexstim)
- 40 TMS pulses per condition

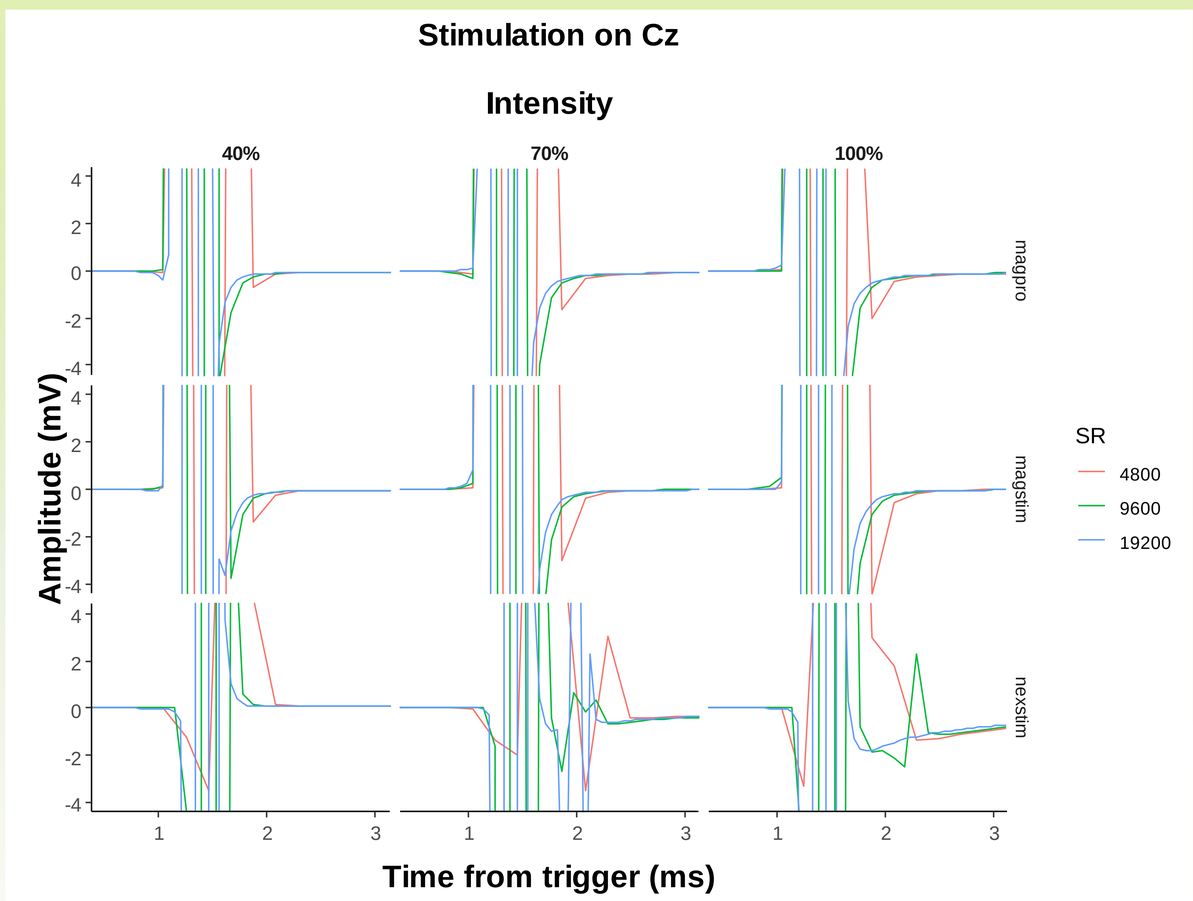


Offline analysis steps

- Epoching (based on trigger)
- Baseline correction

Results





Preliminary analyses show a progressive reduction of TMS artifact duration as a function of SR to less than 2 ms, independent of stimulator type and TMS intensity.

Conclusions

Preliminary results suggest that, together with appropriate off-line analysis pipelines, using SR above 5000 Hz may be beneficial in TMS-EEG recordings, allowing the investigation of the earliest TMS-evoked potential components within 5 ms, which could reflect the neural response of the stimulated area beneath the TMS coil. Future investigations may reveal whether the same results can be obtained with other recording systems.

References

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agnese.zazio@cognitiveneuroscience.it