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Deconvolution of Overlapping Responses and Frequency Domain-based Artifact Rejection Methods Using Randomized Stimulation

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Background: Most of the techniques that allow the recording of overlapping auditory evoked potentials (AEPs) use different methods of deconvolution. The stimulation sequences of these techniques are composed of a stimulation pattern that is repeated periodically. This stimulation pattern must accomplish several frequency-domain constraints in order to achieve deconvolution efficiently, which makes the choice of the stimulation pattern a difficult task. On the other hand, the randomized stimulation and averaging (RSA) technique allows the recording of AEPs at high stimulation rates using stimulation sequences that only require the accomplishment of a minimum jitter, which facilitates the stimulation sequences generation. However, RSA proceeds by averaging the auditory responses in the time-domain, thus no deconvolution is achieved.

Aims: The present study describes a deconvolution approach for randomized stimulation sequences and artifact rejection techniques to be applied in the frequency domain.
Methods: This work describes the underlying principles and the mathematical procedure of the deconvolution approach for randomized stimulation and specific artifact rejection techniques for the frequency domain. The performance of the described methodologies is evaluated by analyzing auditory brainstem responses (ABRs) recorded from 5 normal hearing adults using randomized stimulation sequences with mean stimulation rates of 44, 54, 69, 80, 118, 154, and 222 Hz.

Results: The morphology, the features of the most important components of the deconvolved ABRs, and the waveform shift as a function of stimulation rate are in accordance with previous literature. In addition, the use of artifact rejection techniques in the frequency domain improves significantly the quality of the responses.

Conclusion and significance: The deconvolution approach for randomized stimulation introduced in this study seems to be an efficient tool for obtaining reliable ABRs. This methodology allows the deconvolution of overlapping ABRs with stimulation sequences whose only constraint is a minimum jitter.