New avenues for recording auditory evoked potentials

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Abstract. This talk presents recent advances in the field of auditory evoked potentials (AEPs) developed by the 'Signal Processing in Audiology' research team at the University of Granada and the San Cecilio University Hospital in Granada (Spain).

The team has developed a novel AEP recording system mainly based on consumer electronics, which effectively reduces electromagnetic interference from the power network. This alleviates the need for conducting AEP experiments in a shielded booth. The system records both a differential-mode and a common-mode electroencephalogram (EEG) from the active and reference electrodes. The differential-mode EEG records AEPs contaminated by electromagnetic noise, while the common-mode EEG provides an estimate of the noise itself. AEP measures conducted outside traditional laboratory settings, such as a living room or a lecture room, exhibited similar quality to standard measures obtained through conventional protocols. The ability to conduct AEP experiments outside of a laboratory, coupled with the low-cost nature of the system, opens up new possibilities for research and clinical applications.

Additionally, the research team has developed novel signal processing algorithms that are transforming the way AEPs are recorded and processed. One notable algorithm provides latency-dependent filtering and down-sampling of AEPs. The setup of this filter is optimised to achieve a compact representation of all AEPs from the auditory pathway, from cochlea to cortex. This innovative representation of AEPs not only removes the traditional discontinuities between peripherical, middle and central AEPs, but also enables the representation of AEPs with significantly less coefficients. This has important implications for the storage, transmission, and processing of these signals.

Further, the team has developed a method that enables deconvolution of overlapping AEPs. The mathematical formulation of this algorithm in terms of matrix processing, along with the dimensionality reduction provided by the latency-dependent filter and down-sampling mentioned above, enables the simultaneous deconvolution of multiple categories of overlapping AEPs (multi-response deconvolution). Deconvolving AEPs grants researchers increased flexibility in designing AEP experiments. For instance, we used deconvolution to study neural adaptation of AEPs evoked by bursts of clicks and to characterise the neurophysiological response to binaural and multi-level stimuli. Simulations and toolkits programmed in Matlab/Octave are readily available to assist on the implementation and use of these methodologies.

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