# *Source analysis of auditory steady-state responses based on independent components*

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**Abstract**

Several electrophysiological studies have investigated neural generators of auditory steady-state responses (ASSRs). The low signal-to-noise ratio (SNR) of these auditory evoked responses as well as the activity of deep sources complicate ASSR source analysis. Most of the prior ASSR localization studies, whether they used dipole source analysis or distributed source analysis, averaged the recorded ASSR across subjects to achieve a higher SNR. Consequently, they have a bias toward return the largest source of the ASSR instead of all sources (large as well as small ones). Another limitation of prior ASSR studies, particularly MEG studies, concerns the difficulty of detecting deep and also radially oriented sources. The aim of the current study is the spatio-temporal reconstruction of ASSR sources with no prior assumptions about their number and location.

In order to reconstruct ASSR sources, we applied independent component analysis (adaptive mixture ICA) with subsequent equivalent dipole modeling to single-subject EEG data (young adults, 20-30 years of age). These data were based on white noise stimuli, amplitude modulated at 4, 20, 40, or 80 Hz. The independent components that exhibited a significant ASSR were clustered among all participants by means of a probabilistic clustering method based on a Gaussian mixture model.

Our results suggest that a widely distributed network of ASSR sources, located in cortical as well as subcortical regions, is active in response to different stimuli. For the four modulation frequencies, the identified dipole clusters were located in the similar locations around the left and right auditory cortex and the brainstem. The phase and SNR of the reconstructed sources were consistent with the ASSR literature. In conclusion, the present study shows that the ICA source analysis approach successfully deals with both low SNRs and deep sources.

**Keywords:** EEG, auditory steady-state response, independent component analysis, auditory pathway, source localization.