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# IDENTIFYING AND VISUALIZING 'INDEPENDENT COMPONENTS IN ARTIFACT-FREE SINGLE-TRIAL EVENT-RELATED POTENTIALS.

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Event-related potentials (ERPs), the portions of EEG signals that are both time- and phase-locked to some experimental events, are usually averaged to increase their signal/noise ratio relative to non-phase locked EEG activity regardless of the fact that in single stimulus epochs response activity may vary widely in both time course and scalp distribution. This study proposes a new visualization method (ERP-image) for investigating the latencies and amplitudes variability of event-evoked responses in spontaneous EEG by sorting single-trial ERP epochs in order of a relevant performance measure (e.g. reaction time) and plotting the potentials in a 2-D space. This method makes visible the single-trial contributions to averaged ERPs and can clearly display relationships between phase, amplitude and timing of ERP components and performance. This study applies a new linear decomposition method, Independent Component Analysis (ICA), to single-trial ERPs recorded at multiple scalp electrodes to derive spatial filters that decompose complex EEG data into a sum of temporally independent and spatially fixed components. We have explored applications of ERP-image and ICA decomposition to single-trial ERPs in a visual selective attention task involving, (1) removing eye and muscle artifacts that interfere with EEG analysis, while preserving the underlying brain activity in the EEG; (2) extracting event-related responses from spontaneous EEG; (3) identifying spatially-overlapping patterns of coherent activity rather than focusing on single scalp channels or channel pairs as in all current analysis methods; (4) separating oscillatory EEG activity into several components with distinct frequency contents.

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