

NeuralMetricsWeb — EEG Analysis Methods

A concise guide for the Methods section of a manuscript

This is a condensed, paper-style draft of the NeuralMetricsWeb Python pipeline, for adaptation into a manuscript. Shaded items marked **[TO BE COMPLETED BY THE AUTHOR]** are study-specific; confirm the numerical parameters against the software version used (record the version/commit). Superscript numbers refer to the numbered reference list.

Data collection and montage. **[TO BE COMPLETED BY THE AUTHOR: recording device and model, number of recordings/subjects, anaesthetic technique, sampling rate (Hz), and the ethics-approval and informed-consent statement]** Perioperative frontal EEG was recorded from a standard frontal montage. The Masimo SedLine sensor approximates positions Fp1, Fp2, F7 and F8 of the international 10–20 system, referenced to an electrode ≈ 1 cm posterior to Fpz, with electrode impedances kept low (typically < 5 k Ω).⁶ (The Medtronic BIS sensor is a four-electrode frontal strip placed across the forehead, referenced within the sensor.) Recordings were exported as European Data Format files (EDF/EDF+)^{1,2} for SedLine, or as the vendor raw export with its 1-Hz trend (.spa) and event-log (.e_a) sidecars for BIS Vista, and analysed entirely on the local device.

Preprocessing. EEG was analysed in Python (NumPy, SciPy; Python Software Foundation, USA), executed in the browser via Pyodide. Multi-file sessions were assembled on the recording clock and sensor-off segments removed; a single frontal channel was then processed with the scipy.signal package: a 60-Hz infinite-impulse-response notch filter and a zero-phase, 4th-order Butterworth band-pass (0.5–40 Hz; upper edge clamped below Nyquist for low sampling rates). Quality control rejected 4-s windows that were flat (standard deviation < 0.5 μ V), saturated, stuck, or exceeded 150 μ V, and isolated device impedance checks were treated as indeterminate; overall signal composition was summarised as the clipping (eCR), flat-line (eFR) and true-EEG (eTR) ratios.^{8–10}

Spectral analysis. Power spectra and spectrograms were computed by Welch's method³ using 4-s Hann-tapered windows with 50 % overlap (0.25-Hz resolution), averaged across quality-control-valid windows. EEG power is displayed as a function of time using a color-scaled spectrogram (density spectral array, DSA); power is expressed in decibels, defined as 10 times the base-10 logarithm of the squared amplitude of a given frequency component, which compresses the orders-of-magnitude differences in power across frequencies onto a single scale.^{4–6} Absolute band power (μ V²) and relative band power (% of total 0.5–30 Hz power) were computed for delta (0.5–4 Hz), theta (4–8 Hz), alpha (8–12 Hz) and beta (12–30 Hz), together with the spectral edge frequency (SEF95).^{4,5}

Burst suppression and composite index. Suppression was detected on the filtered signal by a line-length-and-amplitude criterion (centred line length ≤ 40 μ V over a 0.2807-s window and amplitude ≤ 5 μ V, with a minimum 1-s episode)^{4,7}; saturated, stuck and impedance-check samples were excluded as indeterminate, and the burst-suppression ratio (BSR) is the percentage of determinate EEG in suppression. A processed-EEG composite index was derived from the frontal signal using an open reimplement of the depth-of-anaesthesia algorithm, with the signal resampled to 128 Hz.¹¹ **[TO BE COMPLETED**

References

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