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SmartNRI: algorithm and mathematical basis

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Background: Modern cochlear implants support objective measurements such as Neural Response Imaging (NRI) to complement behavioural measures. However, the overlap of stimulus artefact and noise with neural response sometimes makes it difficult to determine whether a neural component is present.

Aims: To validate a new algorithm developed: to automatically determine if a neural response is present and to more reliably obtain the thresholds.

Methods: It is assumed that any NRI measurement consists of: neural response, noise, residual artefact. A principle component analysis approach is taken to reduce the noise. The artefact can be accurately represented by a parametric model. Any de-noised NRI recording can be compared to the artefact model. If a significant difference is observed, the NRI measurement is said to contain a neural response. A specific metric is defined, the “Strength of Response” (SOR), to quantify how far a measurement deviates from the artefact model. A trace is assumed to contain a neural response if its SOR exceeds a criterion value. The method was validated by comparing the auto-detection to clinicians’ assessment. The detection principle was incorporated into an automated algorithm for NRI threshold estimation.

Results: The algorithm mathematical basis will be presented. The criterion value was determined by measuring the SOR for 410 measurements obtained below psychophysical threshold (assumed to contain only artefact and noise). The SOR was always below 27. The reliability of using this value as a criterion was confirmed by another set of recordings classified as “responses” or “no responses” by five clinicians. Using the criterion value resulted in a 100% correct classification of the measurements labelled as “responses”. Only one false positive was found.

Conclusions: This new system removes the subjective element from the interpretation of NRI and provides a faster, wholly objective system likely to be of great benefit to clinicians.