

## Multichannel evoked potentials: new analysis methods and clinical applications

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### Summary

To assess the added value of multichannel evoked potential recordings to the neurological diagnostic process, somatosensory evoked potentials were recorded in 50 healthy subjects and patients with movement disorders. Advanced signal processing techniques were applied to obtain SEP measures that employ all information available in multichannel recordings and have optimal sensitivity.

### Introduction

Although EEG is one of the oldest neuroimaging techniques, with clinical applications since the 1940s, the invention of CT and later (f)MRI and MEG, caused EEG to disappear into the background. However, with the miniaturization of amplifiers, the development of MR-compatible amplifiers and of multichannel EEG, the latter with upto 256 recording sites, interest in EEG has risen again, especially since EEG has supreme temporal resolution, is cheap, patient-friendly, versatile and can be used at the bed-side. Despite these advantages, studies that have investigated the clinical use of multichannel EEG have mostly been limited to group comparisons and typically do not provide estimates of sensitivity and specificity when multichannel EEG is used as a diagnostic tool.

Theoretically, the sensitivity of multichannel EEG to detect abnormalities in brain functioning should be much higher than for conventional recordings, simply because brain activity is measured at many more sites. This project investigates this hypothesis: does measuring more indeed imply knowing more and does this increased knowledge contribute to solving clinical neurological problems?

### Methodology

The ongoing EEG provides information about global brain functioning. However, to study the specific brain response to sensory stimulation, the EEG must be processed to make these particular changes in electrical brain activity, which normally 'drown' in the background EEG, visible. Evoked potentials allow to study the brain response to sensory stimulation in detail. Evoked potentials are clinically used to study the functioning of peripheral and central sensory processing pathways.

In this project, we have focused on multichannel somatosensory evoked potentials (SEPs) because of their relevance for assessment of somatosensory processing as part of the neurological work-up. We have first developed new analysis methods that take advantage of the increased information available in multichannel SEPs and

subsequently applied these methods in patients with neurodegenerative disorders to assess their differential diagnostic value. New analysis methods, that were developed to better estimate SEP amplitude and interhemispheric symmetry, were tested on data collected in 50 healthy subjects, ranging in age from 20 to 70 years.

## Main results

A reduced coefficient of variation was obtained with the 128-channel method due to higher SEP amplitudes compared to the conventional method, both for median and tibial nerve SEPs. This indicates that indeed the 128-channel method can measure SEP amplitude more accurately and should therefore be more sensitive to physiological and pathological changes. Additionally, median SEP waveform interhemispheric symmetry was quantified using a statistical measure; the intraclass correlation coefficient. This measure was found to be high in the majority of healthy subjects and therefore has the potential to detect unilateral abnormalities in cortical sensory processing.

## Future prospects

The new multichannel SEP measures are currently applied in groups of patients with Parkinsonian movement disorders to investigate their differential diagnostic value in an early stage of the disease. Furthermore, other multichannel evoked and event-related potentials (visual EPs, motor-related cortical potentials, cognitive ERPs) are and will be investigated for their added value to differential diagnosis, prognosis and follow-up in neurology.

## Publications

W.J.G. van de Wassenberg, J.H. van der Hoeven, K.L. Leenders, N.M. Maurits  
Multichannel recording of median nerve SEP. *Neurophysiol Clin.*  
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W.J.G. van de Wassenberg, J.H. van der Hoeven, K.L. Leenders, N.M. Maurits  
Quantifying symmetry of somatosensory evoked potentials with the intraclass correlation coefficient.  
*J. Clin. Neurophysiol.*, 25(3):139-46, 2008.

W.J.G. van de Wassenberg, W.J. Kruizinga, J.H. van der Hoeven, K.L. Leenders, N.M. Maurits  
Multichannel recording of tibial nerve SEP. *Neurophysiol. Clinique*, 38(5):277-88, 2008.

W.J.G. van de Wassenberg, J.H. van der Hoeven, K.L. Leenders, N.M. Maurits  
128-channel somatosensory evoked potentials in the differential diagnosis of parkinsonian disorders.  
In press, *Parkinsonism and Related Disorders*.