Brain Signal Analysis

Advances in Neuroelectric and Neuromagnetic Methods

edited by Todd C. Handy

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Preface

With the rise of functional magnetic resonance imaging in the 1990s, it was not uncommon to hear the opinion that cognitive electrophysiology was now doomed to obsolescence. In looking back now, however, it seems that if anything, the advent of fMRI actually *stimulated* growth in ERPs/EEG and MEG, as they have proved to be complimentary methods to fMRI rather than redundant ones. As a consequence, not only have these measures been taken up by ever greater numbers of researchers, but the tools and techniques of data acquisition and analysis have been evolving at an accelerating pace. The advances being made in this latter regard have been considerable, and thus, only a few years on since editing a volume on the basics of ERP methodology, it seemed that a new book was warranted to capture and disseminate these broader developments in cognitive electrophysiology.

In introducing the book's material, perhaps what the contributions here highlight best is the increasing overlap in EEG and MEG analytic techniques. For example, chapters by Kiebel et al. and Ward and Doesburg concern dynamic causal modeling of evoked responses (chapter 6) and phase synchrony analysis (chapter 7) respectively, both of which are equally applicable to EEG or MEG data. Likewise the beamformer approach to source localization was originally applied to MEG data as discussed by Herdman and Cheyne (chapter 5), yet it has now also been developed for use with EEG signals as well, as detailed by Green and McDonald (chapter 4).

The book begins with a set of chapters speaking to new advances being made in ERP/EEG-related analyses. Among these are Lalor and colleagues' presentation of a novel visual-evoked potential based on reverse correlation methods designed to surmount inherent limitations of the classic visual-evoked potential (chapter 1), Murray and colleagues' new approach to topographic mapping using reference-independent spatial information in high-density electrode montages (chapter 2), and Grave de Peralta Mendez and colleagues' novel method for estimating local field potentials via a newly developed solution for the neuroelectromagnetic inverse problem (chapter 3).

Following chapters 4 through 7 on interrelated EEG/MEG techniques, the book concludes with a pair of chapters that speak to the latest thinking on design aspects of EEG/MEG studies: Talsma and van Harmelen discuss how the signal-to-noise ratio of event-related data can be optimized via experimental design considerations (chapter 8), while Handy and colleagues present the latest statistical developments for maximizing power and accuracy when analyzing event-related data via repeated-measures ANOVAs (chapter 9).

That the book has come to fruition is due chiefly to the chapter authors, and I warmly thank each for accepting my email solicitation out of the blue and agreeing to put together a contribution. Of course, the book would also not be possible without the MIT Press, and I am indebted to Barbara Murphy, Susan Buckley, and Robert Prior for their time and patience as the volume has moved from concept to reality. Finally, on a more personal note, I owe my own background in cognitive electrophysiology to the fine guidance and training of George R. Mangun. To Ron, thanks for a strong foundation in this ever-evolving field.