Mitigation of DC Transients and Stimulus Artifacts for Adaptive Deep Brain Stimulation Evaluated by Temporal Localization Analysis

Tzi-Chi Liu, Neurology, CGMH-Linkou

Abstract. Adaptive deep brain stimulation (aDBS) delivers individualized therapy based on symptom-related biomarkers, offering the potential to enhance the efficacy of conventional DBS and reduce power consumption. However, technical challenges, particularly signal contamination caused by stimulation, hinder its widespread clinical adoption. Various front-end and back-end approaches have been proposed to mitigate these artifacts, but none provide a generalizable solution that supports flexible aDBS algorithm design. Among existing methods, Shrinkage and Manifold-based Artifact Removal using Template Adaptation (SMARTA) effectively suppresses stimulus artifacts with limited distortion of local field potentials (LFPs), yet its high computational cost limits real-time applicability. In this study, we propose SMARTA+, an enhanced version of SMARTA, designed to address two major sources of contamination, stimulus artifacts and DC transient artifacts, while significantly reducing computational load. The performance of SMARTA+ was evaluated using semi-real aDBS signals synthesized from recordings of PD patients and compared against SMARTA and other established artifact removal methods. Results demonstrate that SMARTA+ effectively suppresses stimulus-induced artifacts, mitigates DC transients, and preserves the integrity of the underlying LFPs. The reduced computation time and algorithmic flexibility of SMARTA+ represent a substantial step toward real-time aDBS applications, with potential utility across a range of neurological disorders.