Automated Artifact Injection

This term is less common in current scientific literature. It could potentially refer to a method of introducing controlled disturbances or external signals into the brain modulation devices to study their effects on neural behavior. However, the specifics would depend on the context and the technology involved.

Alarie ME, Provenza NR, Herron JA, Asaad WF. Automated artifact injection into sensing-capable brain modulation devices for neural-behavioral synchronization and the influence of device state. Brain Stimul. 2023 Sep 8:S1935-861X(23)01906-X. doi: 10.1016/j.brs.2023.09.005. Epub ahead of print. PMID: 37690601.

Bidirectional deep brain stimulation (DBS) platforms have enabled a surge in hours of recordings in naturalistic environments, allowing further insight into neurological and psychiatric disease states. However, high-amplitude, high-frequency stimulation generates artifacts that contaminate neural signals and hinder our ability to interpret the data. This is especially true in psychiatric disorders, for which high amplitude stimulation is commonly applied to deep brain structures where the native neural activity is minuscule in comparison.

Alarie et al. characterized artifact sources in recordings from a bidirectional DBS platform, the Medtronic Summit RC + S, with the goal of optimizing recording configurations to improve signal-to-noise ratio (SNR). Data were collected from three subjects in a clinical trial of DBS for obsessive-compulsive disorder. Stimulation was provided bilaterally to the ventral capsule/ventral striatum (VC/VS) using two independent implantable neurostimulators. They first manipulated DBS amplitude within safe limits (2-5.3 mA) to characterize the impact of stimulation artifacts on neural recordings. We found that high amplitude stimulation produces slew overflow, defined as exceeding the rate of change that the analog-to-digital converter can accurately measure. Overflow led to expanded spectral distortion of the stimulation artifact, with a six-fold increase in the bandwidth of the 150.6 Hz stimulation artifact from 147-153 to 140-180 Hz. By increasing sense blank values during high amplitude stimulation, we reduced overflow by as much as 30% and improved artifact distortion, reducing the bandwidth from 140-180 Hz artifact to 147-153 Hz. They also identified artifacts that shifted in frequency through modulation of telemetry parameters. We found that telemetry ratio changes led to predictable shifts in the center frequencies of the associated artifacts, allowing us to proactively shift the artifacts outside of our frequency range of interest. Overall, the artifact characterization methods and results described here enable increased data interpretability and unconstrained biomarker exploration using data collected from bidirectional DBS device [1)]

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Alarie ME, Provenza NR, Avendano-Ortega M, McKay SA, Waite AS, Mathura RK, Herron JA, Sheth SA, Borton DA, Goodman WK. Artifact characterization and mitigation techniques during concurrent sensing and stimulation using bidirectional deep brain stimulation platforms. Front Hum Neurosci. 2022 Oct 19;16:1016379. doi: 10.3389/fnhum.2022.1016379. PMID: 36337849; PMCID: PMC9626519.