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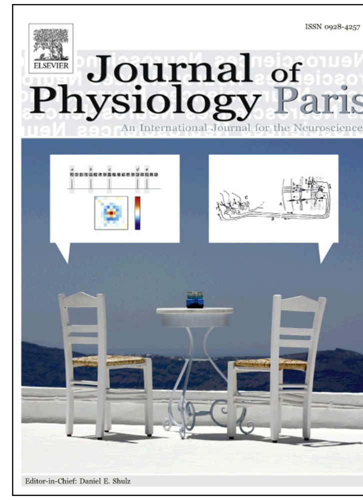

Original Research Paper

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Retrospectively supervised click decoder calibration for self-calibrating point-and-click brain-computer interfaces

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Abstract

Brain-computer interfaces (BCIs) aim to restore independence to people with severe motor disabilities by allowing control of a cursor on a computer screen or other effectors with neural activity. However, physiological and/or recording-related nonstationarities in neural signals can limit long-term decoding stability, and it would be tedious for users to pause use of the BCI whenever neural control degrades to perform decoder recalibration routines. We recently demonstrated that a kinematic decoder (i.e. a decoder that controls cursor movement) can be recalibrated using data acquired during practical point-and-click control of the BCI by retrospectively inferring users' intended movement directions based on their subsequent selections. Here, we extend these methods to allow the *click* decoder to also be recalibrated using data acquired during practical BCI use. We retrospectively labeled neural data patterns as corresponding to "click" during all time bins in which the click log-likelihood (decoded using linear discriminant analysis, or LDA) had been above the click threshold that was used during real-time neural control. We labeled as "non-click" those periods that the kinematic decoder's retrospective target inference (RTI) heuristics determined to be consistent with intended cursor movement. Once these neural activity patterns were labeled, the click decoder was calibrated using standard supervised classifier training methods. Combined with real-time bias correction and baseline firing rate tracking, this set of "retrospectively labeled" decoder calibration methods enabled a BrainGate participant with amyotrophic lateral sclerosis (T9) to type freely across 11 research sessions spanning 29 days, maintaining high-performance neural control over cursor movement and click without needing to interrupt virtual keyboard use for explicit calibration tasks. By eliminating the need for tedious calibration tasks with prescribed targets and pre-specified click times, this approach advances the potential clinical utility of intracortical BCIs for individuals with severe motor disability.