Comparative Analysis of Neural Decoding Algorithms for Brain-Machine Interfaces

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Introduction

Accurate neural decoding of brain dynamics is an open challenge in brain-machine interfaces. While various signal processing, feature extraction, and machine learning classification algorithms have been developed, a systematic comparison of these is lacking. Here we conducted one of the largest comparative studies to evaluate different state-of-the-art algorithms for motor neural decoding to find the optimal combination for brain-machine interfaces.

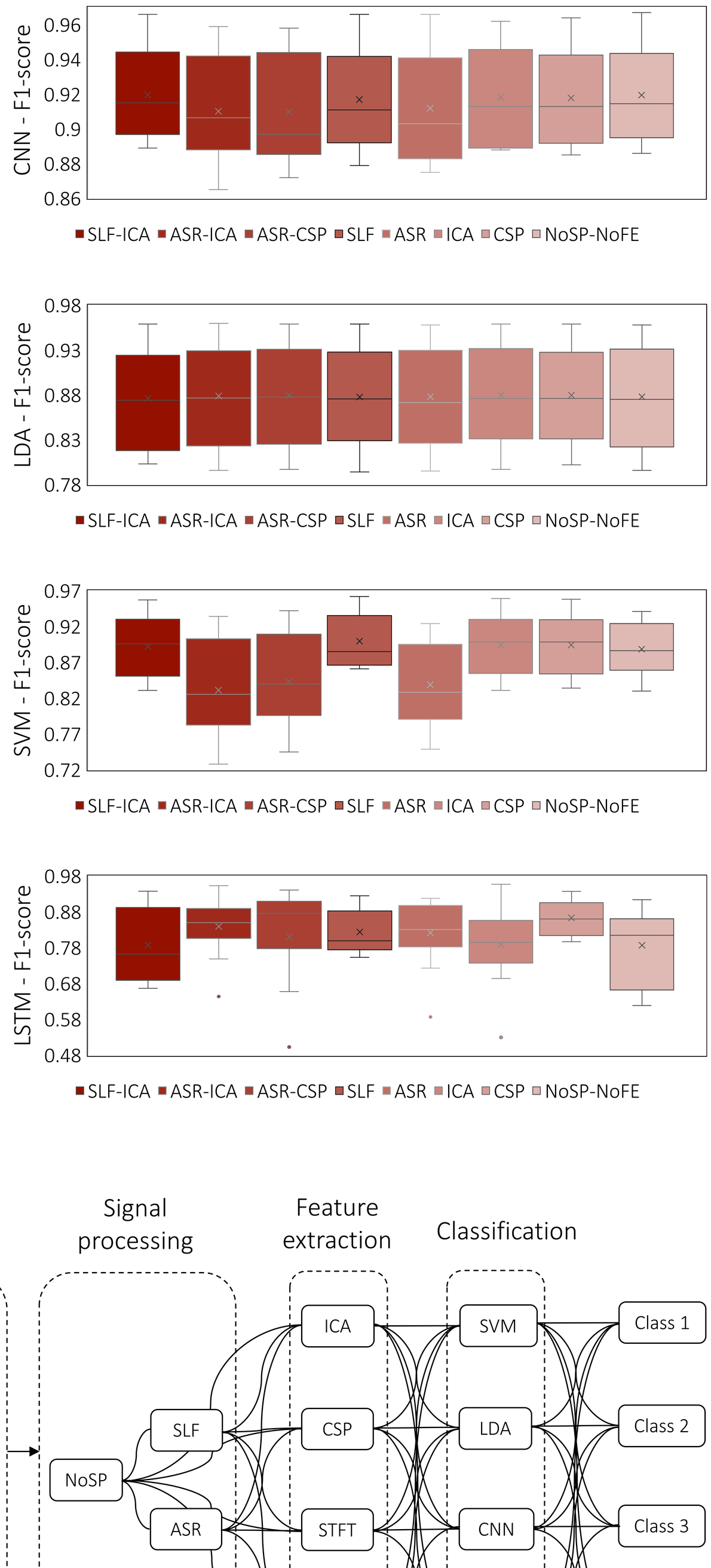


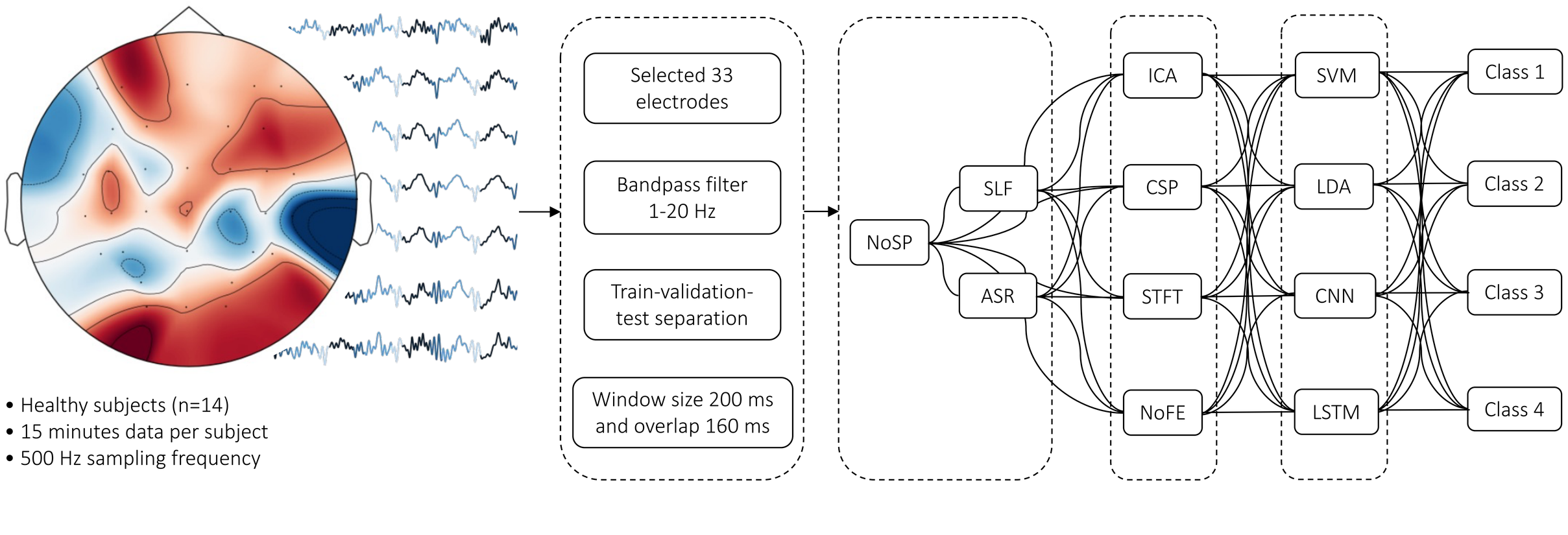


Methods

We studied three signal processing methods (i.e., artifact subspace reconstruction, surface Laplacian filtering, and data normalization), four feature extractors (i.e., common spatial patterns, independent component analysis, short-time Fourier transform, and no feature extraction), and four machine learning classifiers (i.e., support vector machine, linear discriminant analysis, convolutional neural networks, and long short-term memory networks). Using a large-scale EEG dataset, we optimized every algorithmic combination for individual subjects, resulting in 672 experiments, and evaluated performance based on classification accuracy.

Results





- Healthy subjects (n=14)
- 15 minutes data per subject
- 500 Hz sampling frequency