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Regression of Hand Kinematics from Surface Electromyography Data Using an Long Short-Term Memory-Transformer Model

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Abstract : Surface electromyography (sEMG) offers important insights into muscle activation and has applications in fields including rehabilitation and human-computer interaction. The purpose of this work is to predict the degree of activation of two joints in the index finger using an LSTM-Transformer architecture trained on sEMG data from the Ninapro DB8 dataset. We apply advanced preprocessing techniques, such as multi-band filtering and customizable rectification methods, to enhance the encoding of sEMG data into features that are beneficial for regression tasks. The processed data is converted into spike patterns and simulated using Leaky Integrate-and-Fire (LIF) neuron models, allowing for neuromorphic-inspired processing. Our findings demonstrate that adjusting filtering parameters and neuron dynamics and employing the LSTM-Transformer model improves joint angle prediction performance. This study contributes to the ongoing development of deep learning frameworks for sEMG analysis, which could lead to improvements in motor control systems.

Keywords : surface electromyography, LSTM-transformer, spiking neural networks, hand kinematics, leaky integrate-and-fire neuron, band-pass filtering, muscle activity decoding
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