Research using Deep Learning to estimate 3D hand pose from wearable sensor data.

Hoang Danh Tuyen

Abstract: This study investigates the application of deep learning for estimating 3D hand pose using data from wearable sensors. While vision-based methods are prevalent, they suffer from occlusion and lighting limitations. Wearable inertial measurement units (IMUs) offer a robust alternative, yet accurately mapping their signals to complex hand kinematics remains challenging. We propose a novel deep neural network architecture designed to process multi-channel time-series data from a minimal set of wrist and finger-mounted sensors. The model leverages convolutional and recurrent layers to extract spatial-temporal features, directly regressing the 3D joint angles of the hand. We evaluate our approach on a dataset of synchronized IMU and motion-capture data, demonstrating that the network can reconstruct natural hand gestures with high fidelity. The results indicate that deep learning can effectively bridge the gap between noisy sensor readings and precise 3D pose estimation, enabling practical applications in virtual reality, human-computer interaction, and rehabilitation monitoring without the constraints of external cameras.

Keywords: Deep Learning, 3D hand pose estimation, wearable sensors, human-computer interaction