Mind the Gap: Benchmarking Multimodal Datasets for Context-Aware Exoskeleton Control

Abstract

Adaptive exoskeleton control requires datasets that support intent recognition from multimodal, context-rich input. Yet most open locomotion datasets vary in sensing modalities, annotations, and scope, limiting their use for context-aware control research.

This paper introduces a benchmarking framework evaluating the suitability of open motion-capture and wearable datasets for multimodal intent recognition in lower-limb exoskeletons. Based on user-centered task identification, ten essential control functions guided dataset screening and alignment. Four datasets were analyzed through a unified preprocessing, labeling, and classification pipeline. Results indicate that current datasets enable accurate gait detection but lack coverage of interrupt-driven and transitional actions required for adaptive control. The findings emphasize the need for future multimodal datasets with contextual labeling, synchronized sensor streams, and richer task diversity to advance personalized, intent-aware assistive robotics.