A Novel Integration of Bodily-Kinesthetic Intelligence (BKI) and Feature Mining Methodology: Applications in Fall Risk Assessments

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Abstract: Gait and balance disorders pose significant risks of injury and negatively impact quality of life. Precise coordination and control of body movement are crucial for bodily-kinesthetic intelligence (BKI). In this work, we propose a fall risk feature mining method (FRFMM) that utilizes foot pressure sensor data and is based on a nonparametric walking model (NPWM). Our approach generates time-spatial features, including raw features, balance features, ratio features, and gait energy expenditure features. We employ three sorted metrics—correlation coefficient in features (CCF), Bayes factor (BF), and self-information index (SII)—to refine body schema awareness and body image knowledge. This refinement aims to enhance goal-oriented BKI and reduce fall risk. We introduce three threshold rules based on the sorted metrics, enabling the selection of three discriminative fall risk features (the support base of the center and two novel ratio features) from 64

generated features derived from plantar pressure sensors. Our framework integrates BKI and FRFMM across four levels: physical observation, feature extraction, decision-making, and multimodal data analysis. Experimental results using a fall risk dataset demonstrate that the FRFMM improves fall risk prediction accuracy by 10% compared to FRFMM with any single metric. In addition, it outperforms well-known feature selection methods, achieving an accuracy improvement of 7%–34%. Comparisons with clinical methods further highlight the effectiveness of our approach for analyzing and assessing fall risk.

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