

## Abstract

Low back pain (LBP) is one of the most frequent causes for limitation in daily activities. Unfortunately, effective treatments to this disease are still yet to be found because of the lack of understanding of the root causes of LBP. In this study, a novel approach to diagnosing and studying LBP using machine learning (ML) techniques is proposed and implemented. ML models are developed to analyze the spinal kinematic information obtained using a multi-segment spine model from 60 different subjects in 4 gait cycles. Coefficient of multiple correlation (CMC) is calculated for each time-varying angle in the multi-segment model, and the three most consistent angles, including the lower-lumbar transverse angle, the lower-thoracic transverse angle, and the upper-thoracic frontal angle, are selected for feature extraction. 10 features are extracted for each angle from one trial, generating 30 features in total for one subject in one gait cycle. 3 ML methods and 1023 sets of features were tested to find the optimal model for LBP diagnosis. A support vector machine (SVM) model using the features time when the maximum angle occurs, time when the minimum angle occurs, and imbalance between left and right gait cycles yields the highest prediction accuracy of 62.3%. Due to the low accuracy, none of the models are recommended for LBP diagnosis, but the features with leading accuracies in different models are recommended to be further studied in future work. Furthermore, principle component analysis (PCA) and linear discriminant analysis using Fukunaga-Koontz transformation (LDA/FKT) are used to find the most correlated features for LBP. While PCA does not yield useful results, LDA/FKT suggests that time when the maximum angle occurs in lower-thoracic transverse angle and 90th percentile frequencies of lower-thoracic transverse angle and upper-thoracic frontal angle have the strongest correlation to LBP in this data set.