Aziz, Wajid; Hussain, Lal; Khan, Ishtiaq Rasool; Alowibdi, Jalal S.; Alkinani, Monagi H.
Machine learning based classification of normal, slow and fast walking by extracting multimodal features from stride interval time series. (English) Zbl 1471.92046

Summary: The gait speed affects the gait patterns (biomechanical and spatiotemporal parameters) of distinct age populations. Classification of normal, slow and fast walking is fundamental for understanding the effects of gait speed on the gait patterns and for proper evaluation of alternations associated with it. In this study, we extracted multimodal features such as time domain and entropy-based complexity measures from stride interval signals of healthy subjects moving with normal, slow and fast speeds. The classification between different gait speeds was performed using machine learning classifiers such as classification and regression tree (CART), support vector machine linear (SVM-L), naïve Bayes, neural network, and ensemble classifiers (random forest (RF), XG boost, averaged neural network (AVNET)). The performance was evaluated in term of accuracy, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), p-value, area under the receiver operating characteristic curve (AUC). To distinguish the slow and normal gait walking, the highest performance was yielded in terms of accuracy (100%), p-value (0.004), and AUC (1.00) using RF, XGB-L followed by XGB-Tree with accuracy (88%), p-value (0.04) and AUC (1.00). To classify the fast and normal walking, the highest performance was obtained with accuracy (88%), p-value (0.04) using XGB-L, XGB-Tree and AVNET. The highest AUC (0.94) was obtained using NB. To discriminate the fast and slow gait walking, the highest performance was obtained using SVM-R, NNET, RF, AVNET with accuracy (88%), p-value (0.04) and AUC (0.94) using RF and AUC (0.96) using XGB-L.

MSC:
92C10 Biomechanics
68T05 Learning and adaptive systems in artificial intelligence

Keywords: averaged neural network (AVNET); classification and regression tree (CART); gait walking; support vector machine linear (SVM-L)

Software:
XGBoost

Full Text: DOI

References:
[38] D, Best basis-based wavelet packet entropy feature extraction and hierarchical EEG classification for epileptic detection, Expert Syst. Appl., 38, 14314-14320 (2011)