POLITECHNIKA ŚLĄSKA

WYDZIAŁ INŻYNIERII BIOMEDYCZNEJ

ROZPRAWA DOKTORSKA

mgr inż. Katarzyna Minta-Bielecka

Dwugrupowanie jako metoda klasyfikacji wzorców chodu u osób z hemiplegią

PROMOTOR

dr hab. inż. Jolanta Pauk
prof. Politechniki Białostockiej

Zabrze 2020 r.

Abstract

The gait of patients with hemiplegia differs significantly from the normal gait pattern. In addition, the picture of disorders presented by people after stroke is multifaceted. Therefore, development of an automatic tool to support doctors in further diagnosis and therapeutic proceedings is crucial. Previous attempts of classification of patients after stroke led to application of commonly known methods; however, the vast majority of existing approaches are based on the analysis of mutual similarity of parameters according to the chosen measure. Despite the existence of many methods of clustering kinematic, kinetic, and temporal-spatial gait parameters, there is still a lack of methods identifying disturbed gait patters in particular phases of the gait cycle. The aim of the dissertation is to develop effective biclustering methods for classifying disturbed gait patterns of patients with hemiplegia based on selected gait parameters.

The study has been conducted on a group of 41 patients with hemiplegia (21 women and 20 men), over 12 months after stroke. Gait data were measured using a motion tracking system. In the research laboratory, temporal-spatial, kinematic, and kinetic gait parameters were recorded. First, one-way clustering methods, such as hierarchical clustering and K-means, were used. Division of the set into 3 groups was considered the best for each of the analyzed data sets. Clusters extracted from datasets as a result of clustering using both methods were diverse. Usefulness of the indicated methods in the context of the classification of gait parameters in hemiplegic patients is limited due to unsatisfactory adjustment of the rule to walking cycles, the complexity of setting the threshold for the minimum number of walking cycles to determine the pattern, and the need to determine in advance the exact number of groups in data set. Next, biclustering methods such as Cheng and Church algorithm, Borah and Bhattacharyya algorithm, and original algorithm KMB were

proposed. Individual algorithms have extracted from the data sets the largest possible biclusters, while optimizing the mean square residue score. An in-depth analysis of obtained results has shown that, following the used criterion for the quality of biclusters, the original algorithm KMB has extracted the best biclusters. Furthermore, in the majority of cases, the Borah and Bhattacharyya generated the worst results. Summarizing, developed gait patterns classification algorithms can be used to plan targeted therapy for specific gait disturbances.