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Objective evaluation of speech dysfluencies using wavelet packet transform with sample entropy

Abstract

Dysfluency and stuttering are a break or interruption of normal speech such as repetition, prolongation, interjection of syllables, sounds, words or phrases and involuntary silent pauses or blocks in communication. Stuttering assessment through manual classification of speech dysfluencies is subjective, inconsistent, time consuming and prone to error. This paper proposes an objective evaluation of speech dysfluencies based on the wavelet packet transform with sample entropy features. Dysfluent speech signals are decomposed into six levels by using wavelet packet transform. Sample entropy (SampEn) features are extracted at every level of decomposition and they are used as features to characterize the speech dysfluencies (stuttered events). Three different classifiers such as k-nearest neighbor (kNN), linear discriminant analysis (LDA) based classifier and support vector machine (SVM) are used to investigate the performance of the sample entropy features for the classification of speech dysfluencies. 10-fold cross validation method is used for testing the reliability of the classifier results. The effect of different wavelet families on the classification performance is also performed. Experimental results demonstrate that the proposed features and classification algorithms give very promising classification accuracy of 96.67% with the standard deviation of 0.37 and also that the proposed method can be used to help speech language pathologist in classifying speech dysfluencies.

Keywords

Dysfluent speech; kNN; LDA and SVM; Sample entropy; Wavelet packet transform