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STUDY OF CLASSIFICAION METHODS FOR STUTTERING SPEECH SIGNAL ANALYSIS

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ABSTRACT- This paper discussed about various classification methods used for stuttering speech signal analysis. Stuttering is nothing but a speech disorder which is one of the difficult communication problem also referred as speech disfluency founded by speech pathology. Another key factor is syllable repetition which occurs when the person is speaking to others. Above 1% of population is affected by speech disorder. These type of Speech signals were used to classified by some classification methods such as SVM, LDA, ANN and HMM.

Keywords: SVM, LDA, PCA, ANN, HMM

1.INTRODUCTION

In most of the signal processing applications contain signal classification and it is a challenging part for researchers to classify their implementation using by classification methods. Signal classification techniques are performed in stuttering speech recognition and analysis. Mostly used classification techniques are shown in figure 1.

Figure 1. Classification Methods for Speech analysis

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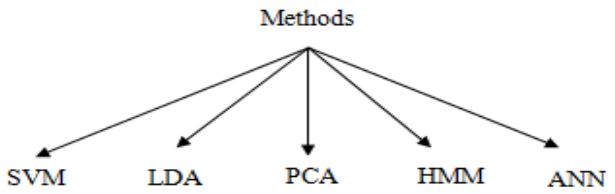

2. CLASSIFICATION METHODS

2.1 Artificial Neural Networks (ANNs)

Artificial Neural Network is one of the classification methods for acoustic signal and it is based on mathematical models. It is used for categorizing and understanding the speech signal. In this method, speech problems are examined in terms of relationship between neurons and hidden layers. In ANN processing elements are called as neurons which are interconnected with information channels and these connections are called interconnections. Every neuron has many inputs and only one output. Neuron is fixed the output acoustic signal when the neurons are exceeding in a certain threshold. In common, problem solutions occurred based on supervised learning or unsupervised learning approach. ANNs also used to classifying the fluent and non-fluent portion of stuttering acoustic signal. The neural networks are achieved in different field such as speech processing, image processing, machine vision and robotic control etc [8]. It has some advantages such as requiring less formal statistical training, ability to identifying all possible communication between predictor variable. The main disadvantage is it contain black box concept and it has more trouble while calculating result [4].

2.2 Hidden Markov Model (HMM)

In 1970 Mellon University and Jelinek at IBM afford the first HMM implementations to speech processing applications. Hidden Markov Model is a stochastic technique used for signal processing applications. The Hidden Markov Model (HMM) is defined as variant of a finite state machine having a set of hidden states Q, an output alphabet (observations) O, transition probabilities A, output (emission) probabilities B, and initial state probabilities II. The current state is not recognizable and each state produces an output with a certain probability (B). Typically the states Q, and outputs O, are understood, so an HMM is said to be a triple (A, B, II). Signal statistical features are mainly used for efficient classification.

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HMM is mostly used in speech processing applications such as speech recognition and stuttering recognition. Children speech disorders and disfluencies are estimated by using HMM and it gives good solution [2].

2.3 Linear Discriminant Analysis (LDA)

Linear Discriminant Analysis is performed in analyzing the data classification and dimensionality reduction. LDA is generally used in many applications such as, speech recognition, pattern recognition, image retrieval etc. LDA is degrade when limited number of observations N compared to the dimension of the feature space n. LDA is plays an important role in classification of voiced and unvoiced segments in stuttering speech signal [1]. A basic phenomenon of LDA is to maximize ratio of class variance for achieving best in acoustic signal classification. This property is used to classify the stuttering speech segment of voiced, unvoiced, redundant and noise portions and these segment speech is will understand able. LDA never changing the location but it aim to provide more class independently and draw a decision region between the given classes [3].

2.4 Principal component Analysis (PCA)

Principal Component Analysis is also called as Karhunen-Loeve Transform and it is defined mathematically as an orthogonal linear transformation which is used for dimension reduction. In speaker recognition, dimension reduction is classified by principal component analysis. It is a statistical analyzer to analyze the data set. PCA method is used to identify the best representation for the distribution of data. Eigen values, decomposition of a data covariance matrix or singular value decomposition of a data matrix is calculated by PCA. PCA is to convert the data to a new coordinate system and the greatest variance by any projection of the data is placed on the first coordinate, it is called the first principal component. In large number of interrelated variables, PCA is used to reduce the dimensionality of a data set, at the same time it retain the possible of variation present in the data set [3].

2.5 SVM (Support Vector Machine)

Support vector machine (SVM) is a most important classification method which is linear

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classifier in speech signal analysis. It is launched by vapnik and it is developed from structural risk minimization (SRM) [7]. Figure 2 shows Example of Support Vector Machines classification.

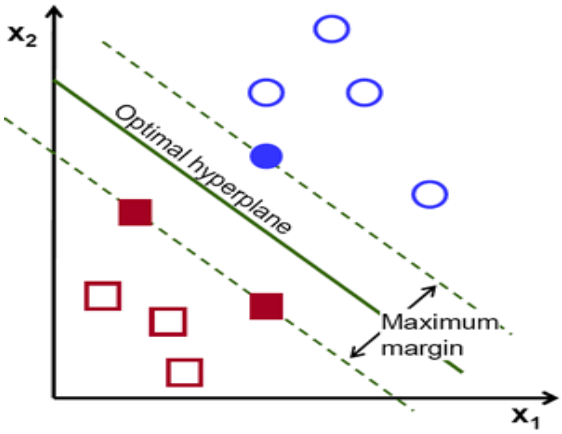

Figure 2. Example of Support Vector Machine classification

Stuttering speech signals are characterized and categorized by using SVM. Stuttering speech has voiced unvoiced, silence and redundant speech segment. The voiced and unvoiced segments of speech signal can be successfully classified using SVM [6]. In Support Vector Machines optimal hyper plane are separate the training data into two classes. Figure 2 shows blue circles are placed in class 1 and red squares are placed in class 2. Higher dimensional feature space f is used to input space for applying SVM directly to the input . It is related to input : nonlinearly. Kernel trick is started to use when SVM algorithm apply to training vectors. it is applied only in Euclidean dot-product of (x.y). After in feature space (,) dot product is computed which is equal to kernel function k(x,y). This function is full fill the mercers conditions using by polynomial kernel is

$$k(x, y) \quad (1)$$

Which is used to map all monomial up to degree d, Gaussian radial basis functions kernel is calculated by,

$$k(x, y) = exp(-\gamma \| \quad (2)$$

SVM finding timal separating hyperplan in f used with training set (,) of N training vectors and corresponding labels , , kernel function k(x,y) and parameter C which is computed by given below Quadratic problem, where finding the vector is maximizes,

$$w(\alpha) = \sum_{i=1}^{N} \alpha_i - \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \alpha_i \alpha_j y_i y_j k(x_i, x_j \quad (3)$$

Under the constrains

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$$\sum_{i=1}^{N} \alpha_i y_i = 0 \text{ and } 0 \leq \alpha \quad (4)$$

Where if the parameter is C>0 x is classified to class +1. Training vector for greater than zero is called support vectors. SVM classified data is more accuracy because phenomenon of SVM is showing the problem in high dimensional space. Kernel function such as linear, multilayer or radial basis function are calculated in SVM and base line correction will be executed to create the hyper plane for groping the component and this component is falling under the group or not. It is delivered unique solution and good out of sample generation depended on parameters choosing with approximately. It has one common disadvantage because of non-parametric technique SVM shows the lack of transference while displaying result [5].

3. CONCLUSION

This paper briefly discussed about classification methods to analysis the stuttering speech signal. In classification methods SVM is acted as most important method for classified the disfluency.

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