Chapter X

Differentially Fed Artificial Neural Networks for Speech Signal Prediction

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Abstract

Speaker authentication has become increasingly important. It goes with the other forms of security checks such as user login and personal identification number and has a say in the final decision about the authenticity. One of the issues with the authentication algorithms is that the automated devices that take the call have to work with a limited data set. In this chapter, a new class of intelligent element called differentially fed artificial neural network has been introduced to predict the data and use it effectively. It keeps the model simple and helps in taking online and crisp decisions with the available limited data.
Introduction

Online authentication of speakers has turned into a challenging task, especially with the kind of decisions to be taken based on the speaker authentication. This calls for an intelligent element that can make use of minimum data set and arrive at the meaningful conclusion. Artificial neural networks can be conveniently used for pattern matching with a known set of data. The conventional neural networks, however, suffer with the drawback of a lengthy training period and reduced signal to noise ratio at the output. To address these issues, a differential feedback from the output of the network to the input is suggested and discussed. Intuitively, appropriate feedback from the output to the input of a system results in change in the system behavior, including the improved stability and noise immunity. A differential feedback ends up in more interesting properties. They require a reduced training set and provide better noise immunity. Some of the features are unique to these networks that are not found in a conventional neural network.

With the differentially fed neural network in place, a portion of the challenge data is taken for training data. The other part is synthesized based on this. It is then matched with the actual data and the difference is computed. By setting threshold on difference, the speaker identity may be endorsed.

The knowledge base queries would consist of audio or speech samples. Sophisticated pattern matching algorithms would be required to generate the match online. Based on the outcome of the match, decisions would be taken. Such knowledge bases would be used in banks, industries, airport surveillance systems, crime detection and prevention, and so forth. It can prevent unauthorized entries. Online evaluation of the patterns is the biggest challenge. It calls for the usage of sophisticated algorithms. An intelligent algorithm based on differential feedback is discussed in this chapter.

Background

There are various techniques for speaker identification and verification. The model-based algorithms with built-in auto regression can work with limited available data. Hence the stress in this chapter is for the data prediction models. In this section, different models are introduced for speaker verification. Basically two processes are involved with speech signal processing: speaker identification and verification.

Speaker identification is basically the task of determining who is speaking from a set of known voices or speakers. It is a pattern-matching problem. To perform identification, the system must perform a 1:N classification. Generally it is assumed the unknown voice comes from a known set of speakers. Often artificial neural network classifiers are used to accomplish this task. The matching of signal can happen with respect to a scale or shape of the waveform and not necessarily with respect to the numerical values.

Speaker verification or speaker authentication or detection is the task of determining whether a certain speech sample really comes or originates from a certain individual.
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