Linear Prediction of Speech

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Abstract

A model was established for predicting a speech linearly. Two strategies are developed to determine the coefficients. One is windowing the error and the Cholesky decomposition is applied. The other is windowing the signal and the Topelitz equations are solved iteratively. The two strategies are compared using a sample speech finally.

Keywords: Speech, Prediction, Cholesky, Topelitz

1. Background and Principles

In a simplified situation, the speech can be linearly predicted from the previous p samples as

$$\hat{x}(n) = \sum_{i=1}^{p} a_i x(n-i) \tag{1}$$

where a_i are the linear prediction coefficients. Then the error between the signal $x(n)$ and the predicted value $\hat{x}(n)$ is given as

$$e(n) = x(n) - \hat{x}(n) = -\sum_{i=0}^{p} a_i x(n-i) \tag{2}$$

where $a_0 = -1$. The minimum mean square error(MMSE) is adopted as the principle to determine these coefficients a_i.
The square error of the prediction is defined as

$$E = \sum_n e^2(n) = \sum_n [x(n) - \sum_{i=1}^{p} a_i x(n-i)]^2 \tag{3}$$

To minimize E, each coefficient a_i $(i = 1, 2, ..., p)$ is determined as

$$\frac{\partial E}{\partial a_i} = 2(\sum_n x(n)x(n-j) - \sum_{min}^{max}) = 0 \tag{4}$$

Thus

$$content... \tag{5}$$

2. The Second Section

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