주파수 영역 적응 알고리즘에 의한 선형예측

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LINEAR PREDICTION OF SPEECH BY THE FREQUENCY-DOMAIN BLOCK LMS ADAPTATION ALGORITHM

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In this paper, we investigate the application of the frequency-domain block least-mean-square (FBLMS) algorithm to linear prediction of speech. In FBLMS adaptive prediction, frequency-domain prediction coefficients are obtained and updated once in every block. The use of the FBLMS algorithm for linear prediction of speech gives an important advantage over the time-domain analysis method in that prediction coefficients are calculated with different frequency weighting on the residual signal depending on the articulation indices of several frequency bands. Furthermore, with the proposed algorithm, noise cancelling and linear prediction of speech can be done simultaneously in the frequency domain.

We have first studied the effects of several parameters on the system performance. The parameters considered are the number of prediction filter coefficients, the block length, and the convergence factor of the weight-adjustment algorithm. Particularly, we have studied the use of different convergence factors for different frequency bands in weight adjustment. A frequency-weighted FBLMS algorithm has been obtained by minimizing frequency-weighted block mean-squared-error. In this way, we may use different convergence factors. Besides, we have studied a combined structure of the FBLMS predictor and the spectral subtraction noise canceller for linear prediction of noisy speech. Unlike the conventional method in which the noise canceller is cascaded with the predictor, our approach is such that noise cancelling is done simultaneously with prediction in the frequency domain.

According to the results of computer simulation using real speech, there exist optimum values of the convergence factors that maximize frequency-weighted signal-to-noise ratio (FWSNR) which is correlated with subjective measure. It has been found that the peak performance of FBLMS predictor decreases slightly as the block length increases. When additive noise is present, the enhancement of noisy speech has been done by applying the spectral subtraction method for both the noisy speech and the residual signal of the FBLMS predictor in the frequency domain. Using this approach, we could improve the prediction performance of noisy speech.