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# Post-processing for Acoustic Echo Canceller Using Modified Affine Projection Algorithm

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## Abstract

A new post-processing method for acoustic echo canceler is proposed to reduce the residual echo and ambient noise. The method is based on the correlation of the desired signal and the estimation error signal of adaptive filter. The residual echoes are attenuated as proportional to the correlation of the desired signal and estimation error signal plays a role as Wiener filter for residual echo. Through computer simulations, it is shown that the performance of noise reduction and echo cancellation is dramatically improved.

## 1. Introduction

Multi-channel sound teleconferencing systems provide a real existence that could not be offered by actual mono-channel systems. Hence one of the promising applications in modern communications is desktop conferencing, which can involve several participants over a widely distributed area. This kind of conferencing with stereo or multi-channel sound will likely grow rapidly in the near future, especially over the Internet[1]. Multi-channel acoustic echo cancellers(AEC) become one of the keys in the successful realizations of conference systems, such as teleconferencing and desktop conferencing. However, the performance of multi-channel AEC is worse than single-channel AEC system. The residual echoes are always remained because the coefficients are not exactly matched echo paths due to ambient noise and its slow convergence speed as well as inherent problem.

To reduce the residual echoes, a post-processing method, which is co-operated with the noise-robust adaptive algorithm, is proposed in this paper. This method is based on the correlation of the desired signal and the estimation error signal. The residual echoes are attenuated as proportional to the correlation normalized with the power of desired signals. The normalized correlation of the desired signal and estimation error signal plays a role as Wiener filter for residual echoes. As results of simulations, it is shown that the proposed stereophonic acoustic echo cancellation schemes are well performed.

## 2. Stereophonic Acoustic Echo Cancellation

Configuration of the stereo echo canceller is shown in Fig. 1. To avoid clutter, we show the echo paths corresponding to only one of the two channels. In reality, similar paths exist in the other channel as well. Let us denote the impulse responses from the speech source in the far-end room to the right and left microphones as $g_1$ and $g_2$, respectively. The impulse responses of the echo-paths from the left and right speakers to the left microphone in the near-end room are assumed to be $h_1$ and $h_2$, respectively. Let $d_n$ be the echo received by the left microphone.

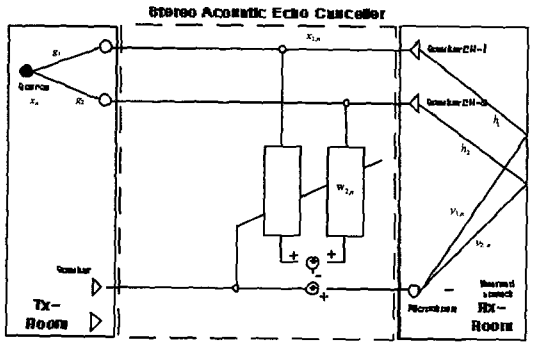


*Fig 1. Conventional configuration of stereo-phonic acoustic echo canceller.*

The acoustic echo canceller is modeled using FIR filters, generates an estimate $\hat{d}_n$ for the echo, which is subtracted from the true echo to form the error signal $e_n$.