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An Integrated Real-Time Beamforming and Postfiltering System for Non-Stationary Noise Environments

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Abstract

In this paper, we present a novel approach for real-time multichannel speech enhancement in environments of non-stationary noise and time-varying acoustical transfer functions (ATFs). The proposed system integrates adaptive beamforming, ATF identification, soft signal detection, and multichannel postfiltering. The noise canceller branch of the beamformer and the ATF identification are adaptively updated on-line based on hypothesis test results. The noise canceller is updated only during stationary noise frames, and the ATF identification is carried out only when desired source components have been detected. The hypothesis testing is based on the non-stationarity of the signals and the transient power ratio between the beamformer primary output and its reference noise signals. Following the beamforming and the hypothesis testing, estimates for the signal presence probability and for the noise power spectral density are derived. Subsequently, an optimal spectral gain function is applied that minimizes the mean-square error of the log-spectral amplitude. Experimental results demonstrate the usefulness of the proposed system in non-stationary noise environments.

Keywords

Array signal processing, signal detection, acoustic noise measurement, speech enhancement, spectral analysis, adaptive signal processing.

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