Maximum-Likelihood Approach With Bayesian Refinement for Multichannel-Wiener Postfiltering

Abstract:

Multichannel signal enhancement is an important task, e.g., in modern speech communication. It can be approached in a mean-square error sense by multichannel Wiener filtering, which is often implemented as a cascade of spatial beamforming and spectral enhancement postfiltering. In this paper, we propose a novel Bayesian perspective on the problem of postfilter adaptation. Specifically, we present a two-step procedure for postfilter estimation. We first derive maximum-likelihood (ML) optimal estimators of the target signal and noise power spectral densities (PSD) employing the high-dimensional receiver data in conjunction with blindly estimated channels.When constructing aWiener postfilter for noisy speech based on the respective speech and noise PSD estimates, this ML-based postfilter is capable of performing good speech enhancement, while leaving musical noise. Hence, we extend to a Bayesian estimation approach in a second step. By statistically modeling the ML-based postfilter estimation and further proposing a prior for the ideal Wiener postfilter, we derive a Bayesian refinement of the ML-based postfilter. This refinement then solely depends on theML-based postfilter and is independent of the underlying high-dimensional data. Our Bayesian refinement is therefore implemented as a lightweight table look-up. Both proposed postfilters perform well in terms of segmental signal-to-noise ratio and perceptual evaluation of speech quality in various acoustical setups with nonstationary noise. The Bayes-refined postfilter offers consistent

improvement over the ML-based postfilter and a single-channel speech enhancement baseline.