Title: Spectral analysis of bone-conducted speech using modified linear prediction.

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Abstract: This paper improves the performance of linear prediction (LP) in precise spectral estimation of bone-conducted (BC) speech. Inherently, BC speech contains a wide spectral dynamic range that causes ill conditioning in the autocorrelation (ACR) method and its variants, where the Levinson–Durbin (L–D) algorithm is commonly implemented. Instead of the conventional LP-based spectral estimation methods, we utilize the covariance-based method, specifically the modified covariance (MC) method, where the orthogonal decomposition algorithm is deployed. In this paper, we derive the MC method from the least squares (LS) technique for BC speech analysis. The MC method reduces the eigenvalue expansion that compresses the spectral dynamic range of the BC speech signal. The effect of spectral dynamic range compression declines the ill-conditioned properties of LP. Through the proposed method using synthetic BC speech, the resulting power spectrum provides more accurate peaks than the conventional methods. The validity of the proposed method is also analyzed by inspecting real BC speech. This study reveals the utmost use of BC speech in speech processing systems. The experimental results demonstrate that the proposed method provides more accurate spectral estimation for synthetic and real BC speeches compared with conventional spectral estimation methods.

Keyword: Autocorrelation Method, Bone-conducted Speech, Ill Condition, Linear Prediction, Spectral Dynamic Range, Spectrum Estimation.

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