

Title: Ill-condition enhancement for BC speech using RMC method

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Abstract: This paper improves the ill-condition of bone-conducted (BC) speech signal by reducing the eigenvalue expansion. BC speech commonly contains a large spectral dynamic range that causes ill-condition for the classical linear prediction (LP) methods. In the field of numerical analysis, we often face the situation where an ill-conditioned case occurs in finding the solution. Principally, eigenvalue expansion causes ill-condition in numerical analysis. To mitigate this problem, the regularized least squares (RLS) technique is commonly used. Motivated by the RLS concept, we derive the regularized modified covariance (RMC) method for BC speech analysis in this study. The RMC method reduces eigenvalue expansion by compressing the spectral dynamic range of the speech signal. Thus, the RMC method resolves the ill-conditioned problem of LP. In experiments, we show that the RMC method provides compressed eigenvalue expansion than the conventional methods for BC speech where synthetic and real BC speeches are considered. The performance of the RMC method is affected by the setting of the regularization parameter. In this paper, the regularization parameter in practice is iteratively and rule-based derived. The RMC method with such a setting provides the best performance for BC speech analysis.

Keywords: Bone-conducted speech, Eigenvalue, Ill-condition, Linear prediction, Regularized MC, Spectral dynamic range

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