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Two Improved Multiband Structured Subband Adaptive Filter Algorithms with Reduced Computational Complexity

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HIGHLIGHTS

- The improved multiband structured subband adaptive filter (IMSAF) utilizes the input regressors at each subband to speed up the convergence rate of MSAF. When the number of input regressors is increased, the convergence rate of the IMSAF algorithm improves at the cost of increased complexity. The current study introduces two new IMSAF algorithms with low computational complexity feature. In the first algorithm, a subset of input regressors at each subband is optimally picked out during the adaptation. In the second approach, the number of selected input regressors is dynamically changed at each subband for every iteration. The introduced algorithms are called selective regressor IMSAF (SR-IMSAF) and dynamic selective regressor IMSAF (DSR-IMSAF). The SR-IMSAF and DSR-IMSAF are shown to be capable of outperforming the full-update IMSAF while the computational complexity is kept low. In the following, the general update equation to establishment of the family of IMSAF algorithms is presented. Accordingly, the mean-square performance analysis of the algorithms is studied in a unified way and the general theoretical expressions for transient, steady-state, and the stability bounds for IMSAF, SR-IMSAF, and DSR-IMSAF are derived. The good performance of the introduced algorithms and the validity of the derived theoretical relations are justified by presenting various experimental results.
- We divided the contribution of the paper into the following four sections: A. Establishment of the Family of IMSAF Algorithms The SR-IMSAF and the DSR-IMSAF algorithms are established. These algorithms have the following features: 1) SR-IMSAF algorithm: The SR strategy is applied in IMSAF algorithm. In this algorithm, the input regressors are optimally selected at each subband during the adaptation. The SR-IMSAF has close performance to the conventional IMSAF while the computational complexity is kept low. 2) DSR-IMSAF algorithm: The DSR approach is extended to IMSAF and DSR-IMSAF is proposed. In DSRIMSAF, the number of selected input regressors is dynamically changed at each subband for every iteration. This algorithm has a fast convergence speed and a small steady-state error compared to the conventional IMSAF. In addition, the DSR-IMSAF retains a low overall computational complexity.
- B. General Update Equation We extend the general update equation in [20] to establishment of the family of IMSAF algorithms. The IMSAF, SR-IMSAF, and DSR-IMSAF can be derived from the generic update equation. By substituting the parameters and the matrices in this equation, various IMSAF algorithms will be established. Also, this representation will be useful to analyze the mean-square performance of the family of IMSAF algorithms in a unified way.
- C. Mean-Square Performance Analysis The theoretical transient and steady-state analyses and the stability bounds of the proposed algorithms will be studied in a unified way. 1) Transient analysis: The mean-square performance of the family of IMSAF algorithms is analyzed in a unified way and the transient behaviors are studied. 2) Steady-state analysis: The generic closed form expressions for steady-state mean-square error (MSE) and mean-square coefficient deviation (MSD) of IMSAF, SR-IMSAF, and DSR-IMSAF are derived.

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