Reversible data hiding based on pairwise embedding and optimal expansion path

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Abstract: As an efficient technique for high-dimensional reversible data hiding (RDH), pairwise prediction-error expansion (pairwise PEE) has achieved better performance comparing with the conventional PEE. With pairwise PEE, the correlations among prediction-errors are well utilized by modifying the generated two-dimensional prediction-error histogram (2D-PEH). However, its performance can be further improved since the histogram modification manner (i.e., the employed modification mapping) of pairwise PEE is fixed and independent of image content. To better utilize image redundancy, instead of embedding data based on an empirically designed modification mapping, a content dependent pairwise embedding scheme is proposed in this paper. Based on a specific division of 2D-PEH, the expansion bins selection is formulated as an optimal path determination problem, and the histogram modification mapping is adaptively determined by taking the optimal expansion bins. To reduce the computation cost, a dynamic programming algorithm is proposed to solve the optimization problem with low computational complexity. Moreover, by combining the proposed optimal expansion path with the existing one-dimensional adaptive embedding mechanism, the embedding performance can be further enhanced. The proposed method performs well and its superiority is experimentally verified comparing with pairwise PEE and some other state-of-the-art methods.

Keywords: Reversible data hiding, prediction-error expansion, optimization problem, optimal expansion path.

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