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Nonlinear Transform for Robust Dense Block-Based Motion Estimation

Abstract:

We present a noniterative multiresolution motion estimation strategy, involving block-based comparisons in each detail band of a Laplacian pyramid. A novel matching score is developed and analyzed. The proposed matching score is based on a class of nonlinear transformations of Laplacian detail bands, yielding 1-bit or 2-bit representations. The matching score is evaluated in a dense full-search motion estimation setting, with synthetic video frames and an optical flow data set. Together with a strategy for combining the matching scores across resolutions, the proposed method is shown to produce smoother and more robust estimates than mean square error (MSE) in each detail band and combined. It tolerates more of nontranslational motion, such as rotation, validating the analysis, while providing much better localization of the motion discontinuities. We also provide an efficient implementation of the motion estimation strategy and show that the computational complexity of the approach is closely related to the traditional MSE block-based full-search motion estimation procedure.