Directionlets Using In-Phase Lifting for Image Representation

Abstract:

Directionlets allow a construction of perfect reconstruction and critically sampled multidirectional anisotropic basis, yet retaining the separable filtering of standard wavelet transform. However, due to the spatially varying filtering and downsampling direction, it is forced to apply spatial segmentation andprocess each segment independently. Because of this independent processing of the image segments, directionlets suffer from the following two major limitations when applied to, say, image coding. First, failure to exploit the correlation across block boundaries degrades the coding performance and also induces blocking artifacts, thus making it mandatory to use de-blocking filter at low bit rates. Second, spatial scalability, i.e., minimum segment size or the number of levels of the transform, is limited due to independent processing of segments. We show that, with simple modifications in the block boundaries, we can overcome these limitations by, what we call, in-phase lifting implementation of directionlets. In the context of directionlets using in-phase lifting, we identify different possible groups of downsampling matrices that would allow the construction of a multilevel transform without forcing independentprocessing of segments both with and without any modifications in the segment boundary. Experimental results in image coding show objective and subjective improvements when compared with the directionlets applied independently on each image segment. As an application, using both the in-phase lifting implementation of directionlets and the adaptive directional lifting, we have constructed an adaptive directional wavelet transform, which has shown improved image coding performance over these adaptive directional wavelet transforms.

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