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Theory and Application of Frequency-based Framelets

Linked with discretization of continuous wavelet transforms, most wavelets and framelets studied in the literature are homogeneous affine (or wavelet) systems generated by square integrable functions. In this talk, we introduce frequency-based nonhomogeneous affine systems and frequency-based dual framelets, which naturally link many aspects of wavelet analysis together. We fully characterize frequency-based dual framelet and provide a natural explanation of the oblique extension principle by showing that every dual framelet filter bank is naturally associated with a pair of frequency-based dual framelets. Based on such characterization, we propose a family of directional tensor product complex tight framelets. Using such directional tight framelets, we shall demonstrate that their performance for image denoising is comparable or even better than several well-known methods such as undecimated wavelet transform and dual tree complex wavelet transform.