

# An Efficient Bivariate Image Denoising Technique Using New Orthogonal CWT Filters

OMAR ELFAROUK MAMDOUH IBRAHIM FOUAD FAHMY ,Mamdouh F. Fahmy

## Abstract

The complex wavelet transforms (CWTs) are known for their excellent edge preserving together with nearly shift invariant features. This study presents new orthogonal CWT filter designs. The proposed designs guarantee the perfect reconstruction feature of the CWT system while satisfying in a least squares sense, the CWT Hilbert constraints over the filter's pass-band. This technique also describes a new image denoising technique based on bivariate thresholding of the noisy CWT coefficients. In this respect, a simple model is proposed to model the dependence between the magnitudes of the children and parent wavelet coefficient at every sub-band. This allows the derivation of a closed-form expression for the clean thresholded magnitudes. Several illustrative examples have been narrated to verify the superior denoising performance especially in salt & pepper case.

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