Directional Tensor Product Complex Tight Framelets and Image Denoising

Bin Han

University of Alberta, Canada

bhan@math.ualberta.ca

Due to simple implementation and relatively easy construction of 1D wavelets, real-valued tensor product wavelets have been commonly used for high-dimensional problems. However, real-valued tensor product wavelets are known to have some shortcomings, in particular, they lack directionality. For example, for 2D data such as images, edge singularities are ubiquitous and play a more fundamental role in image processing than point singularities. As a consequence, real-valued tensor product wavelets in 2D are only sub-optimal since they can only efficiently capture edge singularities along the horizontal and vertical directions. In this talk, we present a comprehensive theory and construction of directional tensor product complex tight framelets. While keeping the simple tensor product structure, our approach has the advantages of improved directionality and uses finitely supported filter banks obtained through optimization techniques. In particular, we propose a family of directional tensor product complex tight framelets with increasing directions. Their performance for the image denoising problem will be discussed. In particular, their performance for image denoising will be compared with the well-known dual tree complex wavelet transform and other known wavelet-based image denoising methods.