Use of Non Parametric Methods Based on Contourlet and Contourlet Transform with Sharp Frequency Localization for denoising of Low SNR Images

Sid Ahmed S[4,5], Messali Z[4,5], Ouahabi A[3], Trepout S[1,2], Messaoudi C[1,2], Marco S[1,2]

[1]*Institut Curie, Centre de Recherche, 26 rue d'Ulm, 75248 Paris Cedex 05, France*
[2]*INSERM U759, Campus Universitaire d'Orsay, Bât. 112, 91405 Orsay cedex France*
[3]*Université François Rabelais de Tours, EPU – Polytech'Tours ,37200 Tours France*
[4]*El Bachir El Ibrahimi University, Science and Technology Faculty, 34030 BordjBouArreridj, Algeria*
[5]*Mohamed Boudiaf University, Laboratory of Electrical Engineering (LGE), 28000 M'sila, Algeria*

Low SNR frequently occurs in TEM when low electron dose is used during acquisition as can be the case of biological images obtained by cryo-TEM or EFTEM. We addressed this problem by studying denoising structures to combine multiple noisy copies of the TEM images [1]. The structures are based on bayesian estimation in wavelet domain, contourlet transform domain and contourlet transform with sharp frequency localization. We have evaluated the proposed methods on phantom data and experimental images (cryo-TEM images of vitreous ice and catalase crystal images). Our results supports the performance of the Bayesian approach in the contourlet transform domain in terms of improving the SNR and of recovering fine details that may be hidden in the data. The values of the SNR and the visual quality of the denoised images are considerably enhanced using the denoising structures of multiple noisy copies. Thus, we propose this approach as a tool to improve SNR and to reduce exposure time required for image recording, which correlates with a decrement on the total dose needed for data acquisition.

References:

[1] Sid Ahmed, S., Messali, Z., Ouahabi, A., Trépout, S., Messaoudi, C., Marco, S. (2014). Bilateral Filtering and Wavelets based Image Denoising: Application to Electron Microscopy Images with Low Electron Dose. ACEEE International Journal on Recent Trends in Engineering & Technology (IJRTET). 11:153-164.