SEM image quality monitoring based on single image real-time SNR estimation

Research framework

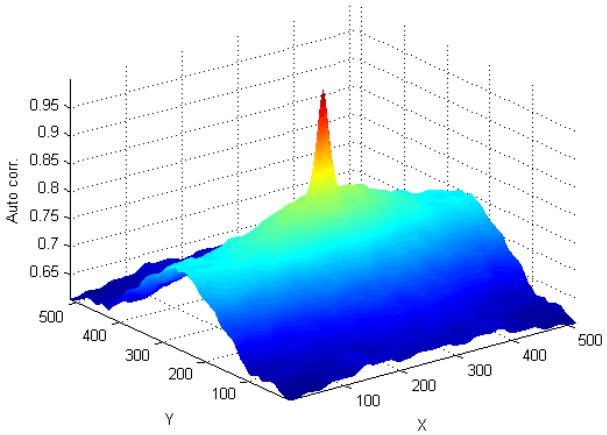
It is a well-known fact that scanning electron microscopic (SEM) image acquisition is mainly affected by nonlinearities and instabilities of the column and probe-specimen interaction. These phenomena lead to unstable quality images. For optimal use, in automatic mode, of these images it is necessary to monitor their quality. This work focuses on this monitoring through the computation of the signal-to-noise ratio (SNR) which is a commonly used measure in the field of signal processing to estimate the strength of a signal with respect to the background noise.

Proposed approach

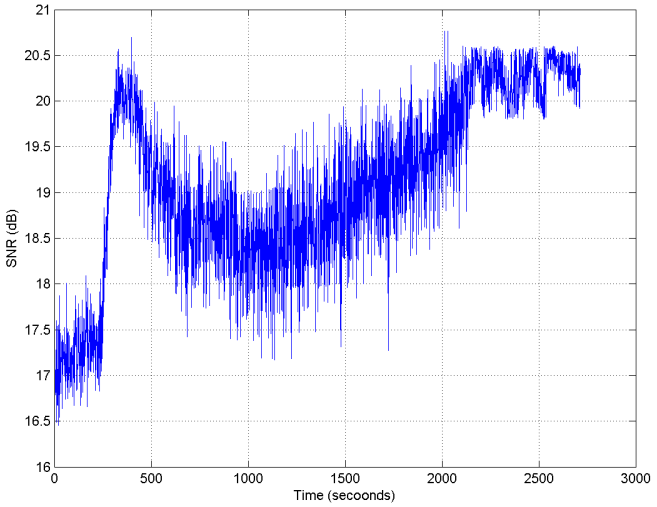
So far, two images of the same specimen area have been used in many research works to compute the signal-to-noise ratio based on cross-correlation technique. The disadvantages associated with these methods are that they require the two images to be perfectly aligned, and a long processing time. Alternative methods have used a single image to compute the SNR based on the simple approximation and first-order extrapolation of cross-correlation. Even though the results are good enough, these methods are highly dependent on the nature of images and are not suitable for real time use.

In this work, assuming the level of noise is high, and the presence of drift in imaging process, we overcome above difficulties by developing a simple and robust noise estimation method based on non-linear filtering and then computing the SNR using a single image. In turn, it is used to monitor the SNR of a scanning electron microscope images to estimate image quality during micro-nano structure manipulation and characterization tasks.

Major article: Marturi, N.; Dembélé, S.; Arnoult, C. & Piat, N. Performance evaluation of scanning electron microscopes using signal-to-noise ratio, 8th International Workshop on Microfactories, IWMF'2012, Finland (2012).



Cross-correlation of a SEM image (JEOL-JSM 820 SEM)



SNR evolution with respect to time for a tungsten gun JEOL-JSM 810 SEM

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