An Unbiased Risk Estimator for Image Denoising in the Presence of Mixed Poisson–Gaussian Noise

Abstract:

The behavior and performance of denoising algorithms are governed by one or several parameters, whose optimal settings depend on the content of the processed image and the characteristics of the noise, and are generally designed to minimize the mean squared error (MSE) between the denoisedimage returned by the algorithm and a virtual ground truth. In this paper, we introduce a new Poisson-Gaussian unbiased risk estimator (PG-URE) of the MSE applicable to a mixed Poisson-Gaussian noise model that unifies the widely used Gaussian and Poisson noise models in fluorescence bioimaging applications. We propose a stochastic methodology to evaluate this estimator in the case when little is known about the internal machinery of the considered denoising algorithm, and we analyze both theoretically and empirically the characteristics of the PG-URE estimator. Finally, we evaluate the PG-URE-driven parametrization for three standard denoising algorithms, with and without variance stabilizing transforms, and different characteristics of the Poisson-Gaussian noise mixture.