

Evaluating Unsupervised Denoising Requires Unsupervised Metrics

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Abstract: Denoising is a crucial challenge in imaging applications. In recent years, unsupervised methods based on deep neural networks have demonstrated impressive performance on natural-image benchmarks. However, no quantitative metrics are available to evaluate these methods in an unsupervised fashion. This is highly problematic for the many real-world applications where ground-truth clean images are not readily available. In this talk we introduce two novel metrics: the unsupervised mean squared error (MSE) and the unsupervised peak signal-to-noise ratio (PSNR), which are computed using only noisy data. We provide a theoretical analysis of these metrics, which shows that they are asymptotically consistent estimators of the supervised MSE and PSNR. Controlled numerical experiments with synthetic noise confirm that they provide accurate approximations in practice. In addition, we report experiments on real-world data from two imaging modalities: videos in raw format and transmission electron microscopy.