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Gradient Histogram Estimation and Preservation for Texture Enhanced Image Denoising

Abstract:

Natural image statistics plays an important role in image denoising, and various natural image priors, including gradient-based, sparse representation-based, and nonlocal self-similarity-based ones, have been widely studied and exploited for noise removal. In spite of the great success of many denoising algorithms, they tend to smooth the fine scale image textures when removing noise, degrading theimage visual quality. To address this problem, in this paper, we propose a texture enhanced imagedenoising method by enforcing the gradient histogram of the denoised image to be close to a reference gradient histogram of the original image. Given the reference gradient histogram, a novel gradient histogram preservation (GHP) algorithm is developed to enhance the texture structures while removing noise. Two region-based variants of GHP are proposed for the denoising of images consisting of regions with different textures. An algorithm is also developed to effectively estimate the reference gradient histogram from the noisy observation of the unknown image. Our experimental results demonstrate that the proposed GHP algorithm can well preserve the texture appearance in the denoised images, making them look more natural.