External Prior Guided Internal Prior Learning for Real-World Noisy Image Denoising

Abstract: Most of existing image denoising methods learn image priors from either external data or the noisy image itself to remove noise. However, priors learned from external data may not be adaptive to the image to be denoised, while priors learned from the given noisy image may not be accurate due to the interference of corrupted noise. Meanwhile, the noise in real-world noisy images is very complex, which is hard to be described by simple distributions such as Gaussian distribution, making real-world noisy image denoising a very challenging problem. We propose to exploit the information in both external data and the given noisy image, and develop an external prior guided internal prior learning method for real-world noisy image denoising. We first learn external priors from an independent set of clean natural images. With the aid of learned external priors, we then learn internal priors from the given noisy image to refine the prior model. The external and internal priors are formulated as a set of orthogonal dictionaries to efficiently reconstruct the desired image. Extensive experiments are performed on several real-world noisy image datasets. The proposed method demonstrates highly competitive denoising performance, outperforming state-of-the-art denoising methods including those designed for real-world noisy images.

CONCLUSION

We proposed a new prior learning method for the realworld noisy image denoising problem by exploiting the useful information in both external and internal data. We first learned Gaussian Mixture Models (GMMs) from a set of clean external images as general image prior, and then employed the learned GMM model to guide the learning of adaptive internal prior from the given noisy image. Finally, a set of orthogonal dictionaries were output as the external-internal hybrid prior models for image denoising. Extensive experiments on three real-world noisy image datasets, including a new dataset constructed by us by different types of

cameras and camera settings, demonstrated that our proposed method achieves much better performance than state-of-the-art image denoising methods in terms of both quantitative measure and visual perceptual quality.

SOFTWARE:

- MATLAB

REFERENCES

[1] S. G. Chang, B. Yu, and M. Vetterli. Adaptive wavelet thresholding for image denoising and compression. IEEE Transactions on Image Processing, 9(9):1532–1546, 2000. 1, 3

[2] J. L. Starck, E. J. Cand`es, and D. L. Donoho. The curvelet transform for image denoising. IEEE Transactions on Image Processing, 11(6):670– 684, 2002. 1, 3

[3] M. Elad and M. Aharon. Image denoising via sparse and redundant representations over learned dictionaries. IEEE Transactions on Image Processing, 15(12):3736–3745, 2006.