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Image Selective Restoration Using Multi-scale Variational Decomposition

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Abstract: In this paper we propose a multi-scale variational decomposition model for image selective restoration. Firstly, we introduce a single-parameter (BV, G, L^2) variational decomposition functional and theoretically analyze the relationship between the parameter and the scale of image features. And then, by replacing the fixed scale parameter with a varying sequence in the single-parameter decomposition functional, we obtain the multi-scale variational decomposition which can decompose the input image into a series of image slices of different scales. Furthermore, we show some properties and prove the convergence of the multi-scale decomposition. Finally, we introduce an alternating and iterative method based on Chambolle's projection algorithm to numerically solve the multi-scale variational decomposition model. Experiments are conducted on both synthetic and real images to demonstrate the effectiveness of the proposed multi-scale variational decomposition. In addition, we use the multi-scale variational decomposition to achieve image selective restoration, and compare it with several state-of-the-art models in denoising application. The numerical results show that our model has better performance in terms of PSNR and SSIM indexes.

Key words: total variation; variational decomposition; image restoration; scale.

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