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Three Diffusion-wave Models with Nonlocal Operators for Image Denoising

Images are easy to be contaminated by noise, a kind of high-frequency component, in formation, recording, transmission and etc. The process to remove noise from a noisy image, so as to restore the true image is referred to as image denoising. To be precise, we have the model

$$u_0 = u + n,$$

where u_0 is noisy image, u is clear image, and n is the additive noise. Our target is to recover u from u_0 .

We study three models for image denoising. Our models are based on the diffusion equation and wave equation. Traditionally, local operators are often applied in PDE-based models. In our study, we exploit the nonlocal operators, Riesz potentials and fractional Laplacian, to our models. The numerical results present an improvement in the denoising effect compared with the heat equation.