

1096-49-1967

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It is a challenging task to reconstruct images from their noisy, blurry, and/or incomplete measurements, especially those with important details and features such as medical MR and CT images. We propose a novel regularization model that integrates two recently-developed regularization tools: total generalized variation (TGV) by Bredies, Kunisch, and Pock; and shearlet transform by Labate, Lim, Kutyniok, and Weiss. The proposed model recovers both edges and details of images much better than the existing regularization models based on the total variation (TV) and wavelets. Specifically, TGV preserves sharp edges as TV but does not have oil-painting artifacts of TV. Shearlets can efficiently represent anisotropic features such as edges and curves that wavelets cannot.

The proposed model has been tested in the compressive sensing reconstruction context and produced high-quality images using fewer measurements than the state-of-the-art methods. (Received September 16, 2013)