

## Edge-Preserving Noise Removal, Part I: Second-Order Anisotropic Diffusion

The article is concerned with efficient edge-preserving numerical techniques for noise removal via anisotropic diffusion. New minimum-biased (MB) finite difference formulas are introduced to minimize diffusion on both the piecewise smooth portions and their boundaries. Locally one-dimensional time-stepping algorithms are analyzed and a formula for efficient timestep sizes is suggested, to remove the high-frequency components of the error (the noise) more efficiently and to minimize the torture of lower-frequency components of the image. An effective strategy is suggested for an automatic stopping of the diffusion process. It is numerically verified that the MB formulas eliminate, rather than diffuse, the noise of piecewise constant images. With such a property, the MB formulas are successfully applied to noise removal of general images. Numerical examples carried out with various images are presented to demonstrate superior properties of (a) the new MB formulas, (b) the formula for timestep sizes, and (c) the automatic stopping strategy of the diffusion process.