Edge-preserving regularization and nonlinear diffusion in image restoration

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The reconstruction of an image u(x,y) that describes a real scene from experimental data (observed image) I(x,y) can be identified as an inverse problem. This problem is generally ill-posed in the sense of Hadamard. The regularization of an inverse problem in image processing requires smoothing homogeneous areas of the object without degrading edges. The location of these edges are unknown and must be detected at the same time as the object is reconstructed and regularized. In this work we apply a modified Tikhonov regularization procedure in order to encourage smoothing within a region and discourage smoothing across boundaries. We examine and compare the behavior of two regularization techniques to avoid edge over smoothed. We also present some experimental results on synthetic images to illustrate the effective performance of our nonlinear diffusion and edge-preserving regularization model.