Image Processing via L^1 Total Variation Model

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Total variation image denoising model of Rudin, Osher, and Fatemi aims to find the denoised version u(x) of a given image f(x) as:

$$u(x) = \operatorname*{argmin}_{v(x)} \int \left|\nabla v\right| + \lambda \int (v-f)^2 dx$$

A caveat of this model is loss of contrast in image features recovered by it. We analyzed a modification that addresses this issue:

$$u(x) = \operatorname*{argmin}_{v(x)} \int \left|\nabla v\right| + \lambda \int \left|v-f\right| dx$$

The difference is the use of the L^1 norm as fidelity term; discrete versions were previously studied by S. Alliney and M. Nikolova. We proved that this model preserves both the contrast and geometry of image features better. Its desirable properties are shown in the image decomposition example, where features at various scales are separated by different choices of the parameter λ. We also proved that the L^1 model can be used to find global minimizers for well-known variational models of shape denoising that are non-convex and known to possess many local minima.

Original Image

Finest Level Features

Remainder