

Image Denoising with a Constrained Discrete Total Variation Scale Space

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- Image restoration:



Original image



Noisy image

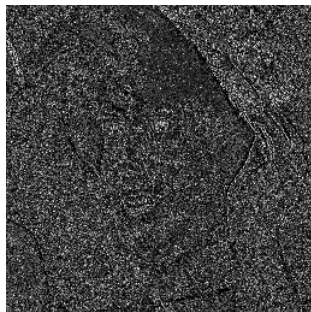
Context: Total Variation Minimization

- Standard Variational formulation: Minimizing Discrete Total Variation

$$\min_u \frac{1}{2} \|u - f\|_2^2 + TV(u)$$



TV minimizer



TV residual

- Geometric information in the residual
→ essentially due to **loss of contrast**

Idea of the approach

- Idea:
 - simplifying (denoising) the image (but loss of contrast)
 - recovering the contrast while preserving the important geometric information: **the relative order of level lines**
- Our approach works as follows:
 - 1 Generation of the trajectory $u(t)$ of the Discrete Total Variation flow

$$\begin{cases} \frac{du}{dt}(t) \in -\partial J(u(t)) \text{ on } (0, +\infty) \\ u(0) = f \end{cases}$$

→ loss of contrast

- 2 Generation of images $\tilde{u}(t)$ that are the closed to the observed image f while respect the relative order of level lines of images $u(t)$.

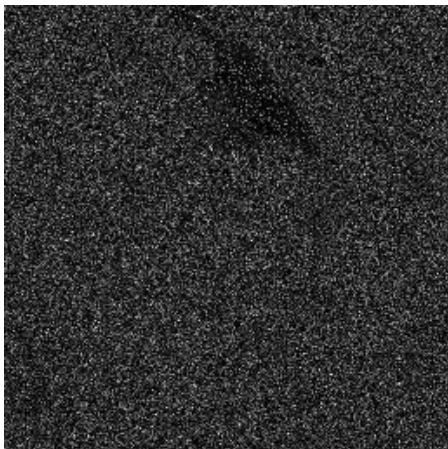
→ Bregman distance

⇒ Solution can be expressed as series of minimization problems (efficient combinatorial optimization algorithm)

Result : Our approach



Our result



Our residual