Image Deblurring and Denoising for Various Fidelity Terms and Regularizers

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1 Introduction

Go over what the problem we're trying to solve it
Talk about the netflix challenge
Talk about the data set we're using

2 Background of Methodology and Implementation

2.1 Total Variation Regularization

The usual Total-Variation deblurring model, as seen in (BECK/TOUBELLE REF) can be formulated as

$$\min_x \|\mathcal{A}(x) - b\|^2 + 2\lambda \mathrm{TV}(x), \tag{1}$$

where $\|\cdot\|$ is taken as either a Frobenius norm or a 2-norm, depending on applications, $\mathcal{A}$ is some linear map which represents blurring the image, λ is a regularization parameter, and $\mathrm{TV}(x)$ is the Total-Variation semi-norm. Two choices similar choices exist for the TV-norm: the so-called isotropic type, and the l_1 type. In this work, we work exclusively with the l_1-based TV-norm, defined as

$$TV_{l_1}(x) = \sum_{i=1}^{m-1}\sum_{j=1}^{n-1}\left(|x_{i,j} - x_{i+1,j}| + |x_{i,j} - x_{i,j+1}|\right) + \sum_{i=1}^{m-1}|x_{i,n} - x_{i+1,n}| + \sum_{j=1}^{n-1}|x_{m,j} - x_{m,j+1}|,$$

for $x \in \mathbb{R}^{m\times n}$, and where the reflexive boundary conditions

$$\begin{aligned} x_{m+1,j} - x_{m,j} &= 0, \text{ for all } j \\ x_{i,n+1} - x_{i,n} &= 0, \text{ for all } i \end{aligned}$$

are assumed. We denote the transformation $\mathcal{A}(x)$ in Equation (1) with a matrix multiplication Ax from here onwards, noting that A represents some blur matrix. Our approach considers a more general problem

$$\min_x f(Ax - b) + 2\lambda \mathrm{TV}_{l_1}(x), \tag{2}$$

where $f : \mathbb{R}^{m\times n} \to [0,\infty)$ is any continuous functional which gives a measurement of the size of the fidelity term $Ax - b$.

2.2 1-Norm Wavelet Regularization

3 Testing

3.1 Something

3.2 Something Else

4 Results

5 Discussion

References