

\LaTeX Author Guidelines for ICCV Proceedings

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1. Introduction

我们的去噪模型是:

$$\min_{\mathbf{D}, \mathbf{C}, \mathbf{W}} \frac{1}{2} \|(\mathbf{Y} - \mathbf{DC})\mathbf{W}\|_F^2 + \lambda \|\mathbf{C}\|_1 \quad \text{s.t.} \quad \mathbf{D}^\top \mathbf{D} = \mathbf{I}. \quad (1)$$

去噪过程如下:

1. 初始化:

我们从原始噪声图得到相似块矩阵 \mathbf{Y} , 我们采用[1]的方法估计彩色带噪图的噪声水平 σ_0 。初始化权重矩阵 $\mathbf{W}^{(0)} = \frac{1}{\sigma_0} \mathbf{I}$, 初始化字典 $\mathbf{D}^{(0)} = \mathbf{I}$ 。

2. 进入内部迭代优化:

对于每一次迭代, 模型都需要反复迭代求解 \mathbf{D}, \mathbf{C} 直到收敛。For $k = 0, 1, 2, \dots$:

a. update \mathbf{C}

$$\min_{\mathbf{C}} \frac{1}{2} \|(\mathbf{Y} - \mathbf{D}^{(k)}\mathbf{C})\mathbf{W}^{(k)}\|_F^2 + \lambda \|\mathbf{C}\|_1. \quad (2)$$

有闭合解, 每一列单独求解:

$$(\hat{\mathbf{c}}_i)^{(k+1)} = \arg \min_{\mathbf{c}_i} \frac{1}{2} \|(\mathbf{y}_i - \mathbf{D}^{(k)}\mathbf{c}_i)\mathbf{W}_{ii}\|_2^2 + \lambda \|\mathbf{c}_i\|_1. \quad (3)$$

闭合解为:

$$(\hat{\mathbf{c}}_i)^{(k+1)} = \text{sgn}(\mathbf{D}^\top \mathbf{y}) \odot \max(|\mathbf{D}^\top \mathbf{y}| - \frac{\lambda}{(\mathbf{W}_{ii})^2}, 0), \quad (4)$$

b. update \mathbf{D}

$$\min_{\mathbf{D}} \frac{1}{2} \|(\mathbf{Y} - \mathbf{DC}^{(k+1)})\mathbf{W}\|_F^2 \quad \text{s.t.} \quad \mathbf{D}^\top \mathbf{D} = \mathbf{I}. \quad (5)$$

等价于

$$\min_{\mathbf{D}} \|(\mathbf{YW}) - \mathbf{D}(\mathbf{C}^{(k+1)}\mathbf{W})\|_F^2 \quad \text{s.t.} \quad \mathbf{D}^\top \mathbf{D} = \mathbf{I}, \quad (6)$$

闭合解为: $\hat{\mathbf{D}}^{(k+1)} = \mathbf{V}\mathbf{U}^\top, \mathbf{CW}(\mathbf{YW})^\top = \mathbf{U}\Sigma\mathbf{V}^\top$.

c. update \mathbf{W} 根据贝叶斯法则, 权重矩阵的第 i 项为

$$\mathbf{W}_{ii} = \frac{\frac{1}{N} \sum_{i=1}^N \|\mathbf{y}_i - \mathbf{D}\mathbf{c}_i\|_2}{\sigma_{\mathbf{y}_i} \|\mathbf{y}_i - \mathbf{D}\mathbf{c}_i\|_2} \quad (7)$$

3. 外部迭代优化:

更新每个块的噪声水平:

$$\sigma_{\mathbf{y}_i} = \sqrt{\sigma_0^2 - \|\mathbf{y}_i - \mathbf{D}\mathbf{c}_i\|_2^2} \quad (8)$$

然后重复步骤2.

References

- [1] Guangyong Chen, Fengyuan Zhu, and Pheng Ann Heng. An efficient statistical method for image noise level estimation. In *The IEEE International Conference on Computer Vision (ICCV)*, December 2015. 1