A Novel Tensor-based Video Rain Streaks Removal Approach via Utilizing Discriminatively Intrinsic Priors Supplementary material

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Abstract

This supplementary appendix provides additional details of the convergency analysis of our algorithm, and details of the conduction of our experiments. Sections 1 illustrates that our algorithm fits the typical ADMM framework and its convergency is theoretically ensured. Section 2 gives some details of our experiments.

1. Convergency

The minimization problem in our paper is

$$\begin{aligned}\min_{\mathcal{R},\mathcal{Y},\mathcal{S},\mathcal{X},\mathcal{T},\mathcal{L},} \quad & \alpha_1\|\mathcal{Y}\|_1+\alpha_2\|\mathcal{S}\|_1 \\ & +\alpha_3\|\mathcal{X}\|_1+\alpha_4\|\mathcal{T}\|_1+\|\mathcal{L}\|_* \\ \text{s.t.} \quad \mathcal{Y} & =\nabla_y\mathcal{R}, \quad \mathcal{S}=\mathcal{R}, \\ \mathcal{X} & =\nabla_x(\mathcal{O}-\mathcal{R}), \\ \mathcal{T} & =\nabla_t(\mathcal{O}-\mathcal{R}), \\ \mathcal{L} & =\mathcal{O}-\mathcal{R}, \quad \mathcal{O}\geqslant\mathcal{R}\geqslant 0,\end{aligned} \tag{1}$$

where $\mathcal{S},\mathcal{Y},\mathcal{X},\mathcal{T}$ and $\mathcal{L}\in\mathbb{R}^{m\times n\times t}$.

Although there are five components in the objective function, they can be categorized as the l_1 part and the nuclear norm part. Actually, let

$$\mathcal{A}=\begin{pmatrix}\alpha_1\mathcal{Y}\\ \alpha_2\mathcal{S}\\ \alpha_3\mathcal{X}\\ \alpha_4\mathcal{T}\end{pmatrix}, \tag{2}$$

where $\mathcal{A}\in\mathbb{R}^{m\times n\times t\times 4}$ and we can get that

$$\begin{aligned}\|\mathcal{A}\|_1 &= \left\|\begin{matrix}\alpha_1\mathcal{Y}\\ \alpha_2\mathcal{S}\\ \alpha_3\mathcal{X}\\ \alpha_4\mathcal{T}\end{matrix}\right\|_1 \\ &=\|\alpha_1\mathcal{Y}\|_1+\|\alpha_2\mathcal{S}\|_1+\|\alpha_3\mathcal{X}\|_1+\|\alpha_4\mathcal{T}\|_1 \\ &=\alpha_1\|\mathcal{Y}\|_1+\alpha_2\|\mathcal{S}\|_1+\alpha_3\|\mathcal{X}\|_1+\alpha_4\|\mathcal{T}\|_1.\end{aligned} \tag{3}$$

Besides, the constraints can be equivalently transformed to

$$\begin{pmatrix}\mathcal{A}\\ \mathcal{L}\end{pmatrix}=\begin{pmatrix}\alpha_1\mathcal{Y}\\ \alpha_2\mathcal{S}\\ \alpha_3\mathcal{X}\\ \alpha_4\mathcal{T}\\ \mathcal{L}\end{pmatrix}=\begin{pmatrix}\alpha_1\nabla_y\mathcal{R}\\ \alpha_2\mathcal{R}\\ \alpha_3\nabla_x(\mathcal{O}-\mathcal{R})\\ \alpha_4\nabla_t(\mathcal{O}-\mathcal{R})\\ \mathcal{O}-\mathcal{R}\end{pmatrix}. \tag{4}$$

Thus, the minimization problem (1) can be rewrote as:

$$\begin{aligned}\min_{\mathcal{R},\mathcal{A},\mathcal{L},} \quad & \|\mathcal{A}\|_1+\alpha_2\|\mathcal{L}\|_* \\ \text{s.t.} \quad & \begin{pmatrix}\mathcal{A}\\ \mathcal{L}\end{pmatrix}=\begin{pmatrix}0 & \alpha_1\nabla_y\\ 0 & \alpha_2\mathcal{I}\\ \alpha_3\nabla_x & -\alpha_3\nabla_x\\ \alpha_4\nabla_t & -\alpha_4\nabla_t\\ \mathcal{I} & -\mathcal{I}\end{pmatrix}\cdot\begin{pmatrix}\mathcal{O}\\ \mathcal{R}\end{pmatrix} \\ & \mathcal{O}\geqslant\mathcal{R}\geqslant 0.\end{aligned} \tag{5}$$

2. Experimental details

References

[1] Authors. The frobnicatable foo filter, 2014. Face and Gesture submission ID 324. Supplied as additional material `fg324.pdf`.