START-TV: A CLOSED-FORM INITIALIZATION FOR TOTAL VARIATION MODELS

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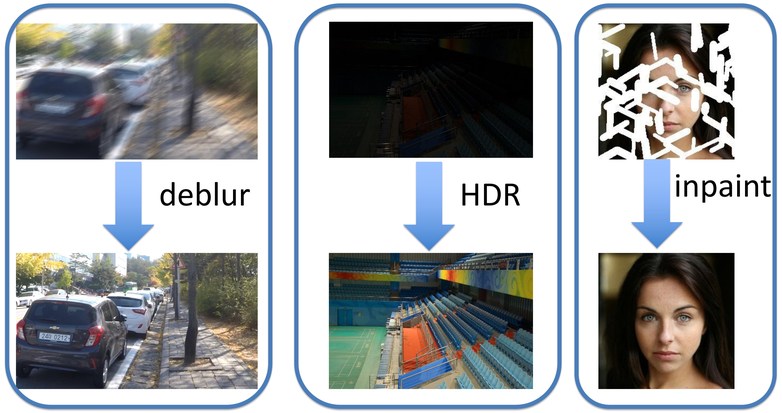
TV models are classical

$$\arg\min_{U}\left\{\mathcal{L}(U)=\frac{1}{2}\|U(\vec{x})-F(\vec{x})\|_2^2+\lambda TV(U)\right\}$$



However, solving it is challenging

slow

Primal Dual
Split Bregman
ADMM

black box

Neural Networks
Deep Learning

Our Local TV Model

$$\arg\min_{U(\vec{x}\in W)}\{\frac{1}{2}\|U(\vec{x})-F(\vec{x})\|_2^2+\gamma TV(U(\vec{x}))\},$$

local window

Closed-form Solution

assume

$$U(\vec{x})=\alpha F(\vec{x})+\beta\,,\ \forall\vec{x}\in W\,,$$

$$\min_{\vec{x}\in W}\{\frac{1}{2}\|\alpha F(\vec{x})+\beta-F(\vec{x})\|_2^2+\gamma TV(\alpha F(\vec{x})+\beta)\}$$

$$\min_{\vec{x}\in W}\{\frac{1}{2}\|\alpha F(\vec{x})+\beta-F(\vec{x})\|_2^2+\gamma|\alpha|(|\nabla_x F|+|\nabla_y F|)\}$$

$$\alpha^*=\begin{cases}1-\frac{\gamma\|\nabla F\|_1}{\sigma_F^2}, & \text{when } \frac{\gamma\|\nabla F\|_1}{\sigma_F^2}\le 1\\ 0, & \text{else}\end{cases}.$$

$$\beta^*=(1-\alpha^*)\overline{F}\,.$$

$$U=\overline{\alpha^*}F+\overline{\beta^*}\,,$$

Results

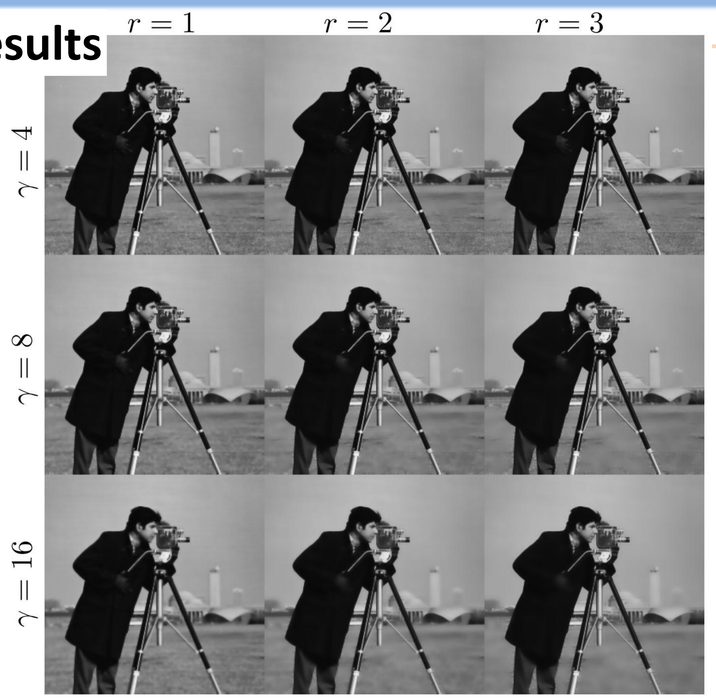
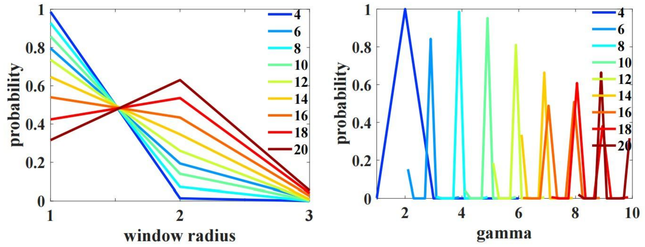


Fig. 1. Different γ and r on the cameraman image.

best parameters



(a) optimal radius r^* statistics (b) optimal γ^* statistics

ig. 2. The statistics of radius r^* and γ^* on BSDS500 with ifferent λ. The λ is indicated by different color.