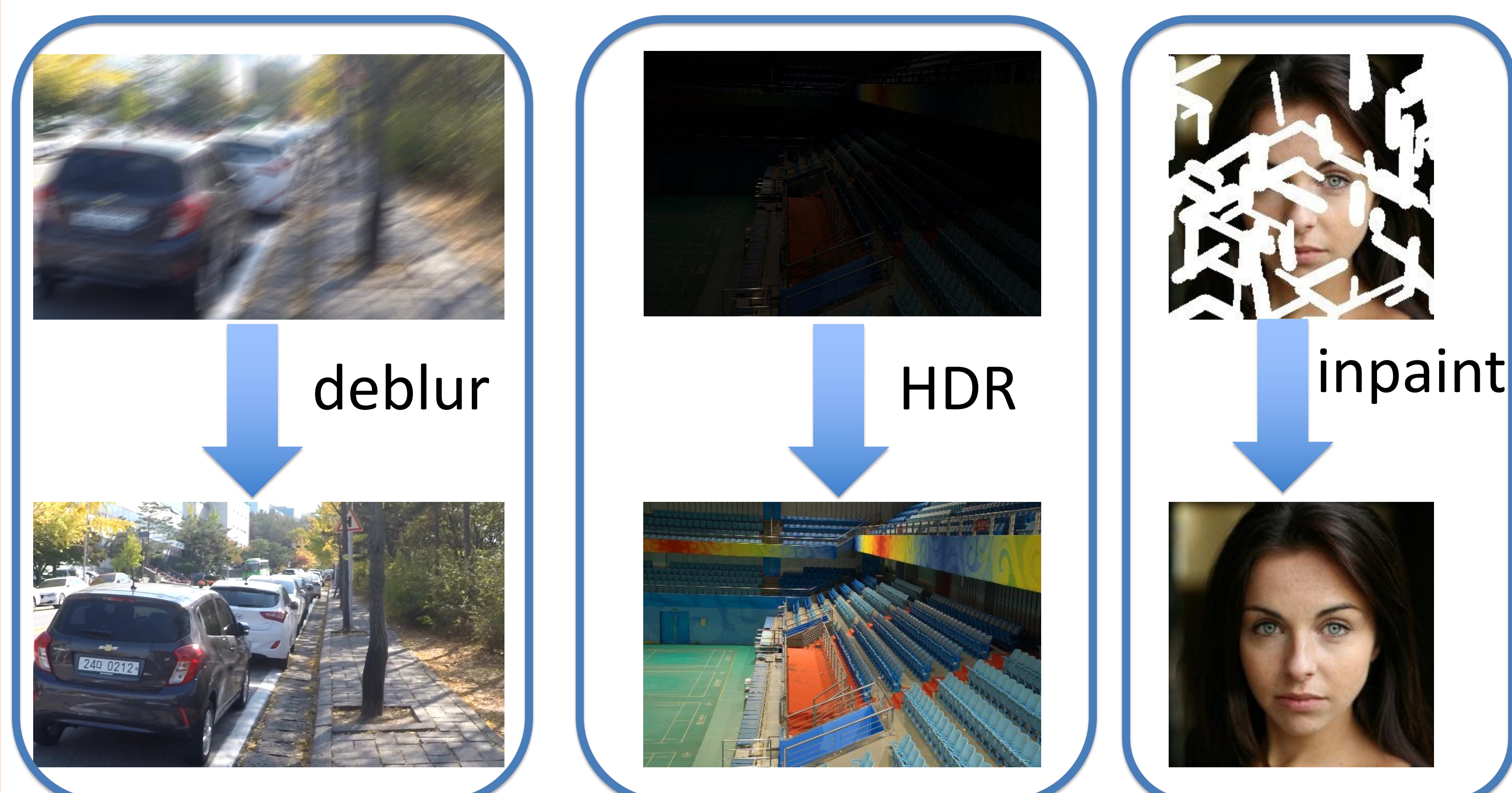# START-TV: A CLOSED-FORM INITIALIZATION FOR TOTAL VARIATION MODELS
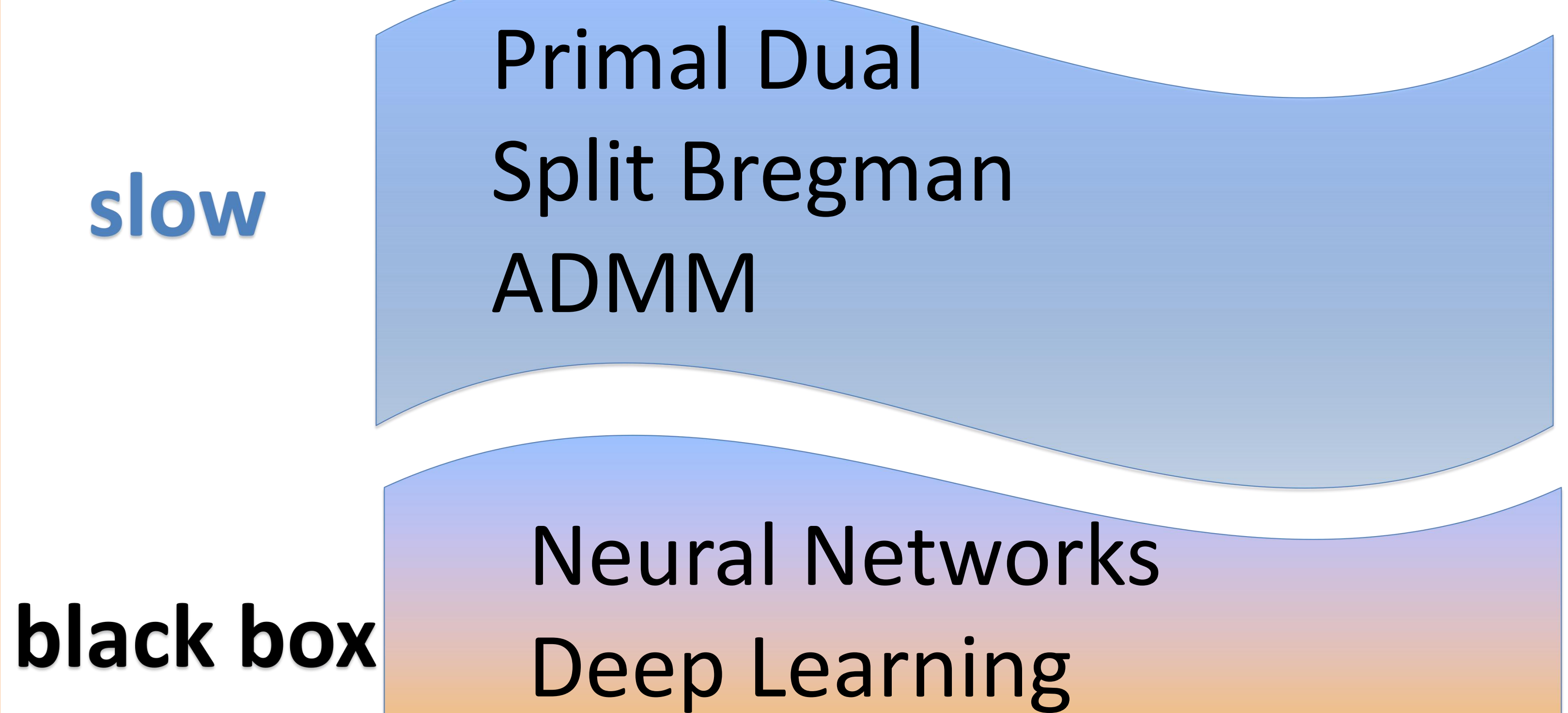
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TV models are classical

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

deblur   HDR   inpaint

However, solving it is challenging

slow
- Primal Dual
- Split Bregman
- ADMM

black box
- Neural Networks
- Deep Learning

Our Local TV Model

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

← local window

Closed-form Solution

assume

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

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

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

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

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

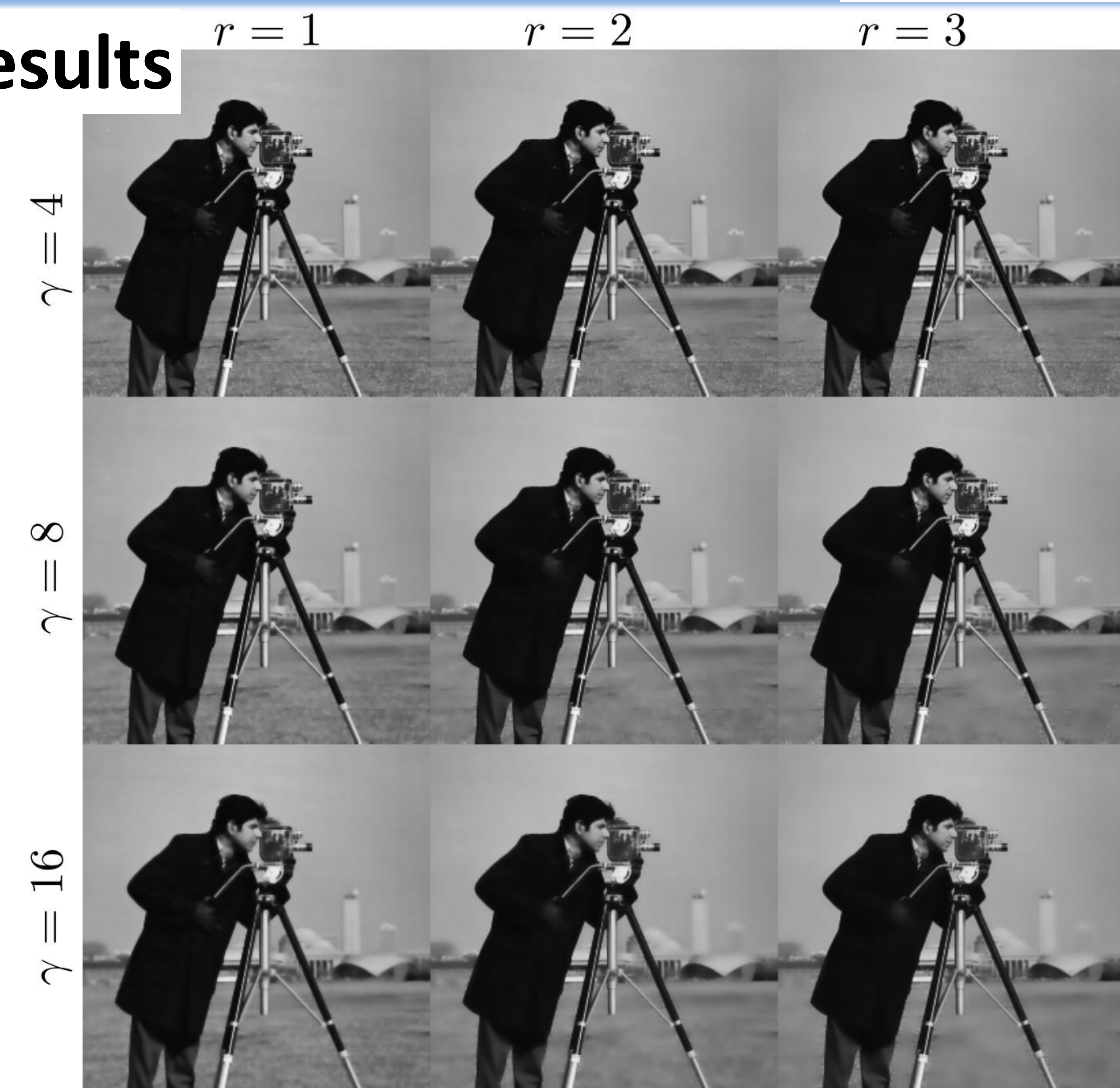$$U = \overline{\alpha^*}F + \overline{\beta^*},$$

Results

$r = 1$ $r = 2$ $r = 3$

$\gamma = 4$ $\gamma = 8$ $\gamma = 16$

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

best parameters

(a) optimal radius r^* statistics

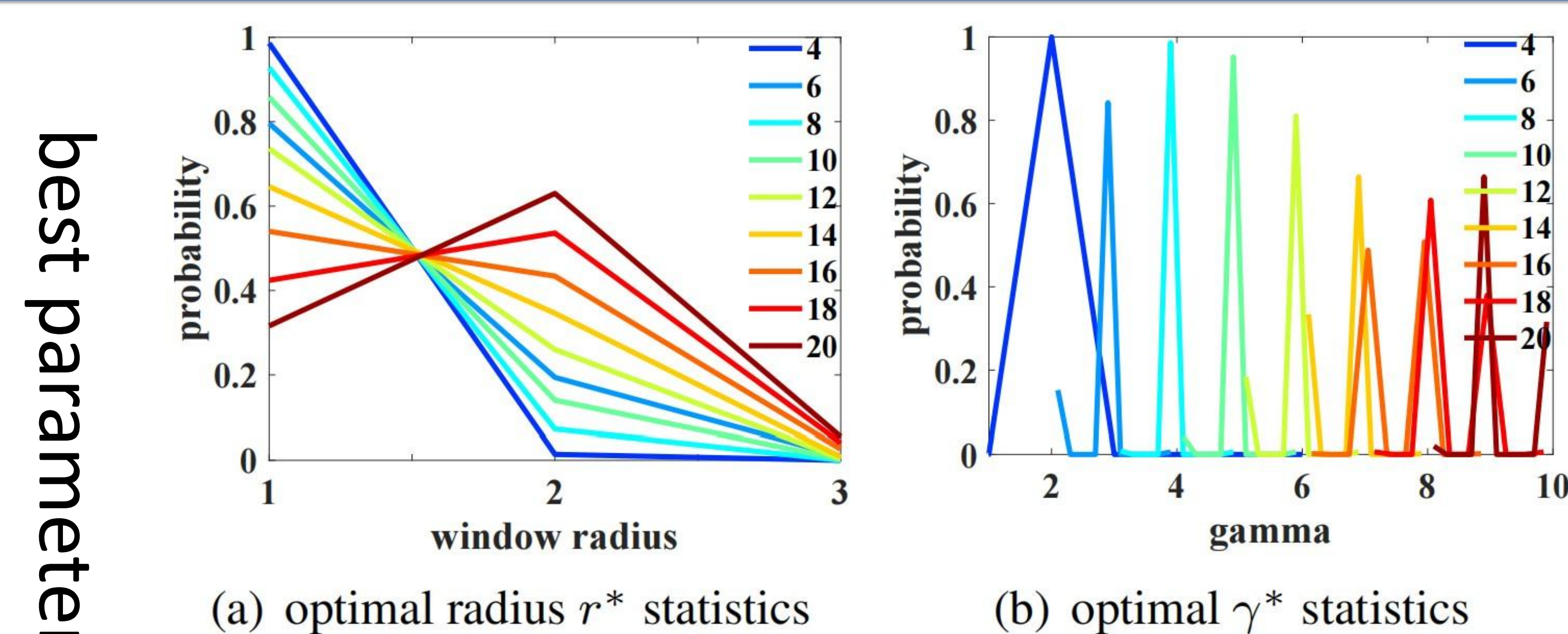(b) optimal γ^* statistics

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