Learning a Discriminative Prior for Blind Image Deblurring

2018 年 3 月 21 日

$$B = I \bigotimes k + n$$

ill-posed, need additional prior knowledge.

$$p(blurred\ image|clear\ image) \approx 0$$

$$p(blurred\ image|blurred\ image) \approx 1$$

Hand-craft features are limited and cannot generalize to real cases.

Learn this prior by a discriminator $f(I)$. We say $f(I) = p(blured\ image|I)$.

Cross entropy.

Done by optimization.

$$\min_{I,k} \|I \bigotimes k - B\|_2^2 + \gamma\|k\|_2^2 + \mu\|\nabla I\|_0 + \lambda f(I)$$

I-sub problem

$$\min_{I} \|I \bigotimes k - B\|_2^2 + \mu\|\nabla I\|_0 + \lambda f(I)$$

Both $f(I)$ and $\|\nabla I\|_0$ are highly non-convex.

Half-quadratic splitting trick, introduce two variables u and g and say $u \approx I$, $g \approx \nabla I$.

$$\min_{I,g,u} \|I \bigotimes k - B\|_2^2 + \alpha\|\nabla I - g\|_2^2 + \beta\|I - u\|_2^2 + \mu\|g\|_0 + \lambda f(u)$$

I-sub part.

$$\min_{I} \|I \bigotimes k - B\|_2^2 + \alpha\|\nabla I - g\|_2^2 + \beta\|I - u\|_2^2$$

Which has a closed-form solution

$$I = F^{-1}\left(\frac{\overline{F(k)}F(B) + \beta F(u) + \alpha(\sum_{t\in\{h,v\}} \overline{F(\nabla t)}F(g_t))}{\overline{F(k)}F(k) + \beta + \alpha\overline{F(\nabla t)}F(\nabla_t))}\right)$$

g-sub part

$$\min_g \alpha\|\nabla I - g\|_2^2 + \mu\|g\|_0$$

Pixel-wise optimization problem.

$$g = [\|\nabla I\|^2 \geq \frac{\mu}{\alpha}]\nabla x$$

u-sub part

$$\min_{u} \beta \|I - u\|_2^2 + \lambda f(u)$$

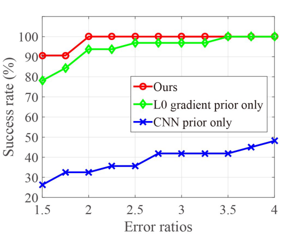
By gradient descent.

k-sub problem

$$\min_k \|\nabla I \bigotimes k - \nabla B\|_2^2 + \gamma \|k\|_2^2$$

which can also be efficiently solved by FFT (?).

Effectiveness of CNN prior.



With adversarial process, the discriminator will be more effective.

The gradient ∇f is the quickest way to change the value of $f(I)$ but not the realness of I.

Just use discriminator trick to implicitly learn the prior knowledge $p(blurred\ image|I)$.

And this trick is of little effectiveness.