JOINT HDR AND SUPER-RESOLUTION IMAGING IN MOTION BLUR

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1 Goal

- Estimate the latent high dynamic range (HDR) - high resolution (HR) image given a set of low dynamic range (LDR) - low resolution (LR) non-uniformly motion blurred multi-exposure images

2 Our work

- First attempt on joint HDR and super-resolution (SR) imaging in the presence of motion blur
- Handle uniform and non-uniform motion blur effects induced by camera motion

3 Our approach

- Image formation model

motion density function, HR-HDR image, downsampling, homography, saturation clipping, no of input frames, LR-LDR image

$$\mathbf{l}_c^i = c\left(\mathbf{D}\sum_{p\in\Gamma}\mathbf{w}^i(p)\mathbf{H}_p(\mathbf{f})\right), \quad \text{for} \quad i = 1,..,\vartheta$$

- Camera motion estimation

saturation mask

$$\arg\min_{\mathbf{w}^i}\left|\left|\boldsymbol{\chi}^i\left(\nabla\mathbf{l}_c^i - \mathbf{D}\sum_{p\in\Gamma}\mathbf{w}^i(p)\mathbf{H}_p(\nabla\tilde{\mathbf{f}})\right)\right|\right|_2^2 + \lambda_{\mathbf{w}}^i||\mathbf{w}^i||_1$$

$$\arg\min_{\mathbf{w}^i}||\boldsymbol{\chi}^i\nabla\mathbf{l}_c^i - \boldsymbol{\chi}^i\mathbf{D}\tilde{\mathbf{F}}\mathbf{w}^i||_2^2 + \lambda_{\mathbf{w}}^i||\mathbf{w}^i||_1$$

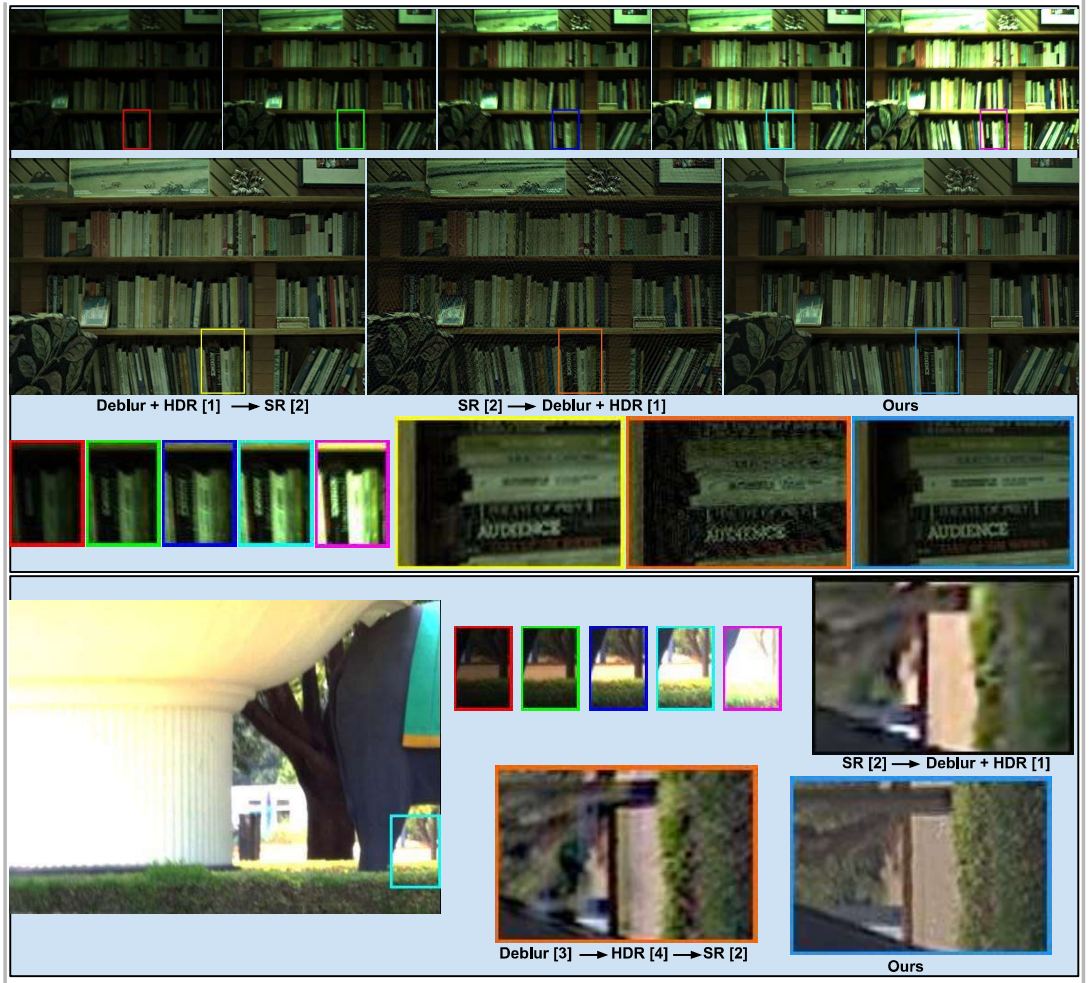
- Image estimation

Gradient operator

$$\arg\min_{\mathbf{f}}\sum_{i=1}^{\vartheta}\left|\left|\boldsymbol{\chi}^i\left(\mathbf{l}_c^i - \mathbf{D}\sum_{p\in\Gamma}\mathbf{w}^i(p)\mathbf{H}_p(\mathbf{f})\right)\right|\right|_2^2 + \lambda_{\mathbf{f}}||\nabla\mathbf{f}||_1$$

$$\arg\min_{\mathbf{f}}\sum_{i=1}^{\vartheta}||\boldsymbol{\chi}^i\mathbf{l}_c^i - \boldsymbol{\chi}^i\mathbf{D}\mathbf{W}^i\mathbf{f}||_2^2 + \lambda_{\mathbf{f}}||\nabla\mathbf{f}||_1$$

4 Results



References

[1] C. S. Vijay, C. Paramanand, A. N. Rajagopalan, and R. Chellappa, "Non-uniform deblurring in hdr image reconstruction,"TIP 2013.
[2] C. Cruz, R. Mehta, V. Katkovnik, and K. O. Egiazarian, "Single image super-resolution based on wiener filter in similarity domain," TIP 2018.
[3] Subeesh Vasu and AN Rajagopalan, "From local to global: Edge profiles to camera motion in blurred images," CVPR 2017.
[4] Tae-Hyun Oh, Joon-Young Lee, Yu-Wing Tai, and In So Kweon, "Robust high dynamic range imaging by rank minimization," TPAMI 2015.