Removing Partial Occlusion Blur due to Thin Occluders

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Abstract

We present a method to remove partial occlusion blur arising from thin occluders. When severely defocused, such foreground objects reduce the visibility of background content. In order to remove the contribution of the foreground in such regions, we characterize the position and size of the occluder in a narrow aperture image. In subsequent images with wider apertures, we use this characterization to remove the contribution of the foreground, thereby clarifying the background.

Imaging Model

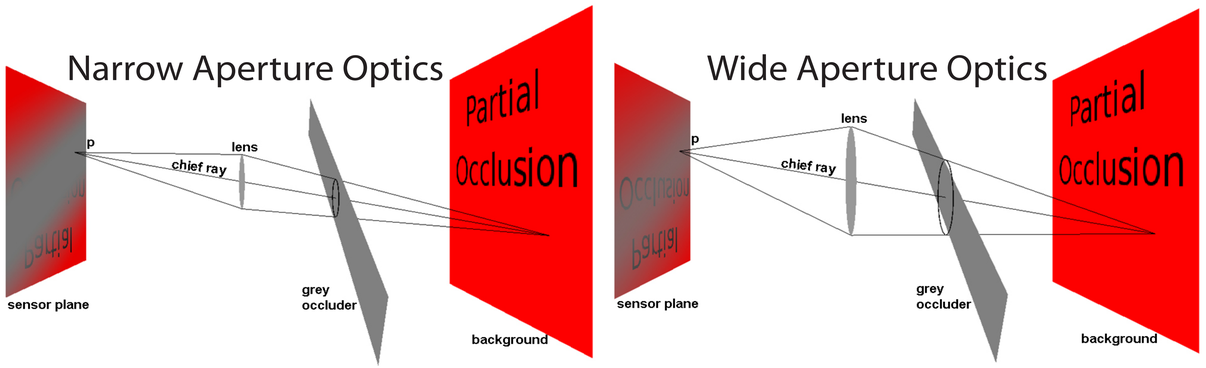
As in image matting, we model the average radiance $\boldsymbol{R}$ incident at pixel $\boldsymbol{p}$ as:

$$\boldsymbol{R(p) = \alpha(p)R_f(p) + (1 - \alpha(p))R_b(p)} \quad (1)$$

where $\boldsymbol{R_f}$ is the radiance of the foreground, $\boldsymbol{R_b}$ is the radiance of the background, and α denotes the relative contribution of the two.

We model α as the convolution of a foreground indicator χ with a disk filter of diameter $\boldsymbol{w}$. Given two images taken with apertures $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$, they follow

$$\boldsymbol{w_1F_1 = w_2F_2} \quad (2)$$

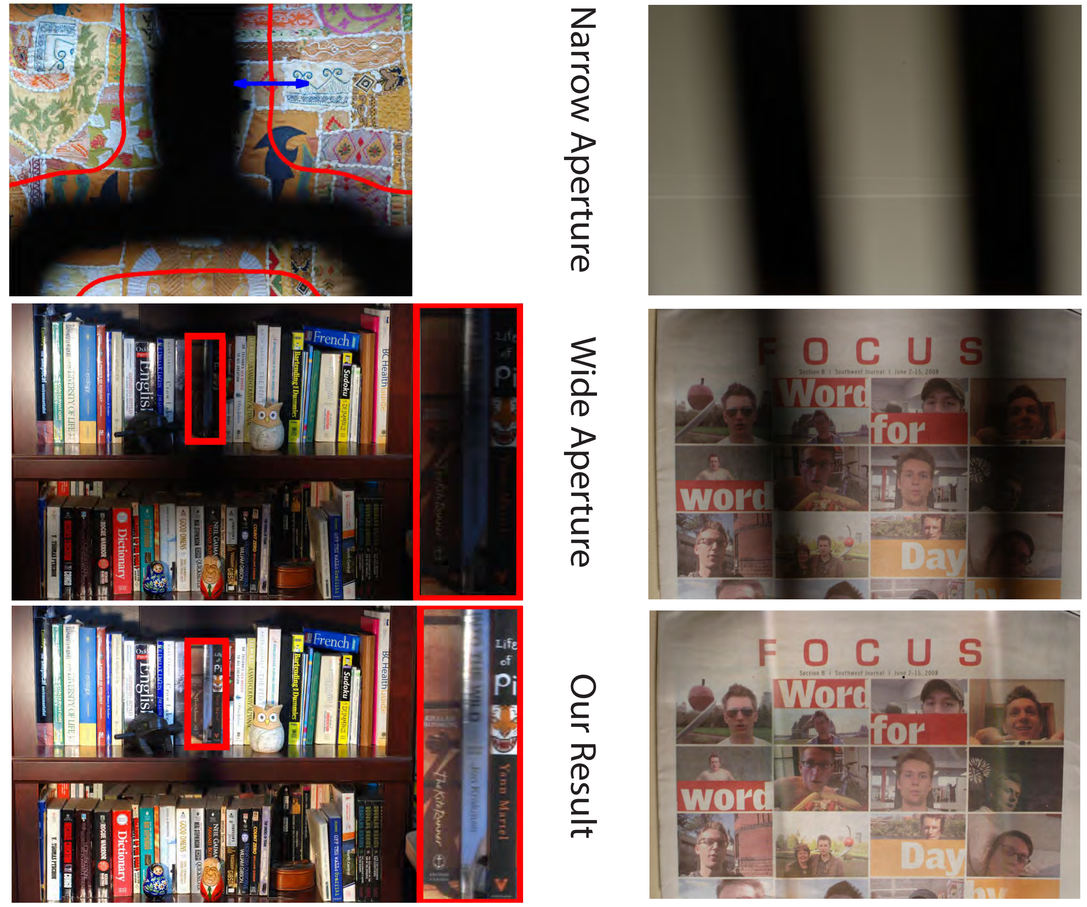


Method

We use two images taken of the same foreground, with different apertures.

Step 1: estimate χ and $\boldsymbol{w_1}$ in narrow-aperture image using the method of [1]:
1A. Flow-based segmentation of completely occluded area.
1B. Model-fitting to estimate $\boldsymbol{w_1}$, which also provides χ from the segmentation.
Step 2: estimate $\boldsymbol{w_2}$ using eq. 2, estimated $\boldsymbol{w_1}$ and $\boldsymbol{F_1/F_2}$ (obtained from JPEG header).
Step 3: estimate α_2 as convolution of χ with a disk filter of diameter $\boldsymbol{w_2}$.
Step 4: remove partial occlusion from wide aperture image using α_2 and $\boldsymbol{R_f}$ via eq. 1.

Experimental Results



Summary

Using two images taken with different apertures, we remove partial occlusion due to thin occluders. The method assumes that the foreground occluding object is stationary, but allows for dynamic backgrounds. This method allows for camera placements that would previously have been impractical.

Key References

[1] S. McCloskey, M. Langer, K. Siddiqi. *Automatic Removal of Partial Occlusion Blur.* Proceedings of the Asian Conference on Computer Vision (ACCV) 2007.