Accurate Blur Models vs. Image Priors in Super-Resolution Supplementary file

1. Calibrating optics blur

Below we provide a few details on the calibration of actual camera optics blur.

To calibrate the camera blur we displayed a calibration image on a planar monitor. The image, visualized in Fig. 1 was designed as a random black and white binary pattern with high frequencies which help to stabilize the calibration. To image the monitor we placed the camera sufficiently far so that the monitor resolution was higher than the camera resolution. We captured the calibration pattern at two resolutions corresponding to distances of 6m and 12m to the camera. We used a Canon EOS 5D Mark II camera with Canon EF 85mm f/1.8 and Canon EF 50mm f/1.8 lenses at an f/13 aperture.

The camera uses a Bayer sensor. To create a full image we thus had to demosaic the raw RGB image data. For simplicity we used the default demosaicing algorithm of the Dcraw software. Note that this is a non linear algorithm, and hence it may hurt the linear measurement assumption of the imaging model. A more accurate handling of the demosaicing problem is an important venue for future research.

The two captured images x, y provide an HR/LR pair. The image formation model:

$$y = (k * x) \downarrow^2 \tag{1}$$

with known x, y , provides a set of linear equations on the blur kernel k. As a pre-processing step, we correct for small deviations from the model by warping the HR image, y , accounting for translation and scale. Even with the random pattern we generated, the HR image is missing very high frequencies, thus the set of constraints is not well conditioned and we had to include small regularization. We thus solved for the k minimizing

$$\|y - (k * x) \downarrow^2 \|^2 + \lambda_1 \|k\|^2 + \lambda_2 (\|g_h * k\|^2 + \|g_v * k\|^2) \tag{2}$$

subject to positivity constraints on k. Here g_h, g_v are horizontal and vertical derivative filters and λ_1, λ_2 are small regularization constants. The resulting kernel k and its Fourier transform are shown in Fig. 2 of the main paper.

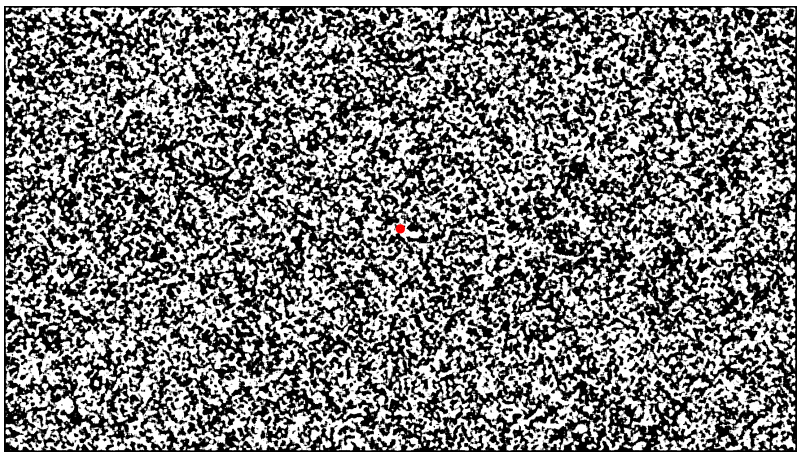

Figure 1. **Calibration target**