Forget the checkerboard: practical self-calibration using a planar scene Supplementary material

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Table 1: Additional calibration results with real cameras. Our method consistently matches the performance of Bouguet's calibration toolbox.

		Bouguet	Our method (%)	
			user match	automatic match
B	f_x	552.68	-0.15	-2.76
	f_x	548.39	-0.19	-3.06
	u_0	321.97	0.02	2.65
	v_0	235.25	0.11	2.84
	d_0	-0.184	-6.23	6.28
	d_1	0.254	-8.54	-24.13
	e_{train}	0.17px	0.16px	0.66px
	e_{val}	0.26px	0.26px	0.38px
C	f_x	763.90	-0.08	
	f_x	759.56	0.13	
	u_0	306.74	2.41	no video
	v_0	247.25	7.17	available
	d_0	-0.409	-5.26	
	d_1	0.287	-25.99	
	e_{train}	0.47px	0.46px	n/a
	e_{val}	0.50px	0.50px	n/a

1. Additional results

We present additional calibration results with real cameras in Table 1. Camera B is a low-quality Logitech webcam V-UAR33. Camera C is a very old Creative Labs webcam PD-1000. Camera C has significant distortion (see Fig. 1) and severe rolling shutter effects. The rolling shutter problems did not allow video calibration, but the algorithm successfully calibrated the distortion. The two validation image sets consisted of 15 checkerboard images and in both cases the checkerboard corners covered the whole image area in various configurations. Both cameras are calibrated successfully and very accurately, as seen by the low validation reprojection errors. Thus confirming the results presented in the paper.

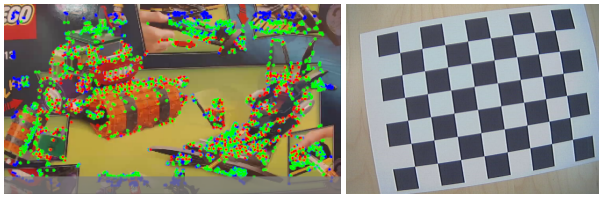

Figure 1: **Left:** Features extracted using an off-the-shelf implementation. Point color denotes different scales. There is a big area around the border where no features are extracted. **Right:** Images from camera C have significant distortion.

2. Limitations of the feature extractor

Although the feature matching stage is outside of the scope of our paper, we briefly address the limitation of the off-the-shelf feature extractor used and how this limits calibration accuracy. We used the ORB feature extractor implemented in OpenCV. The feature matching stage limits the calibration accuracy for two reasons. First, the localization accuracy of the feature extractor is naturally lower than that of carefully selected checkerboard corners. But more importantly, the current implementation leaves the borders of the image unconstrained.

Figure 1 shows that this implementation doesn't extract features around the borders of the image. This leaves these areas unconstrained during calibration. The distortion function is a fourth degree polynomial and when unconstrained can introduce severe errors in this area. The validation image set has features (i.e. checkerboard corners) in these border areas and therefore the aforementioned issue is a likely explanation for the observed higher validation errors with automatically detected features. However, it is important to note that this detail is not related to the contributions of our paper but is just a particular feature of our current ORB-based camera tracking system used with videos. As shown in the tables of the paper and supplementary material, the accuracy of our self-calibration method is similar to that of Bouguets toolbox when similar image features are used in both approaches.