

## A Further comparisons with flexible warp methods

In this section we present results on more images; see Figs. 12 to 19. As mentioned earlier in Sec. 5 of the main paper, our purpose is to objectively compare the image alignment results produced of the different methods, thus, we avoid using postprocessing or deghosting techniques so that any misalignments remain obvious. An exception is Photosynth’s panorama tool, where we can only obtain the final postprocessed results. The original images used in this section are shown in Sec. D of this document. These image pairs were sourced from other authors as well as taken by ourselves; see Sec. D for more details.

Our method, following the currently favoured paradigm for image stitching, relies on feature detection and matching to estimate alignment functions. When the number of matched feature points is low, none of the methods compared here will be able to generate satisfactory stitching results. This is the most evident in the *rooftops* image pair in Fig. 18. Fig. 32 shows the matched SIFT features on this image pair, where only a small number of matches are available on the rooftops. The best stitching result in Fig. 18 is by Photosynth, although this is most likely due to the usage of postprocessing and deghosting.

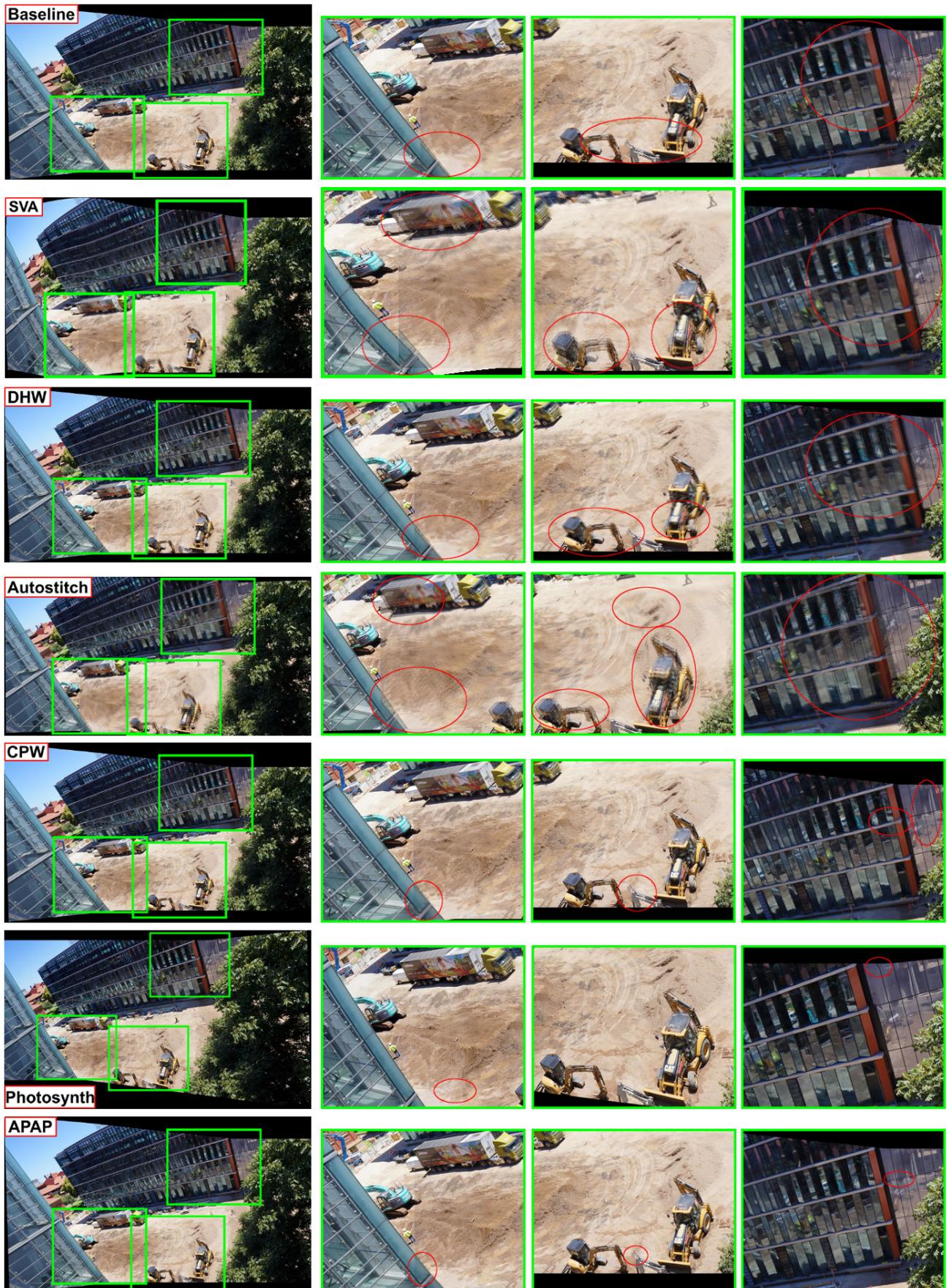


Figure 12: *conssite*



Figure 13: *beach*.

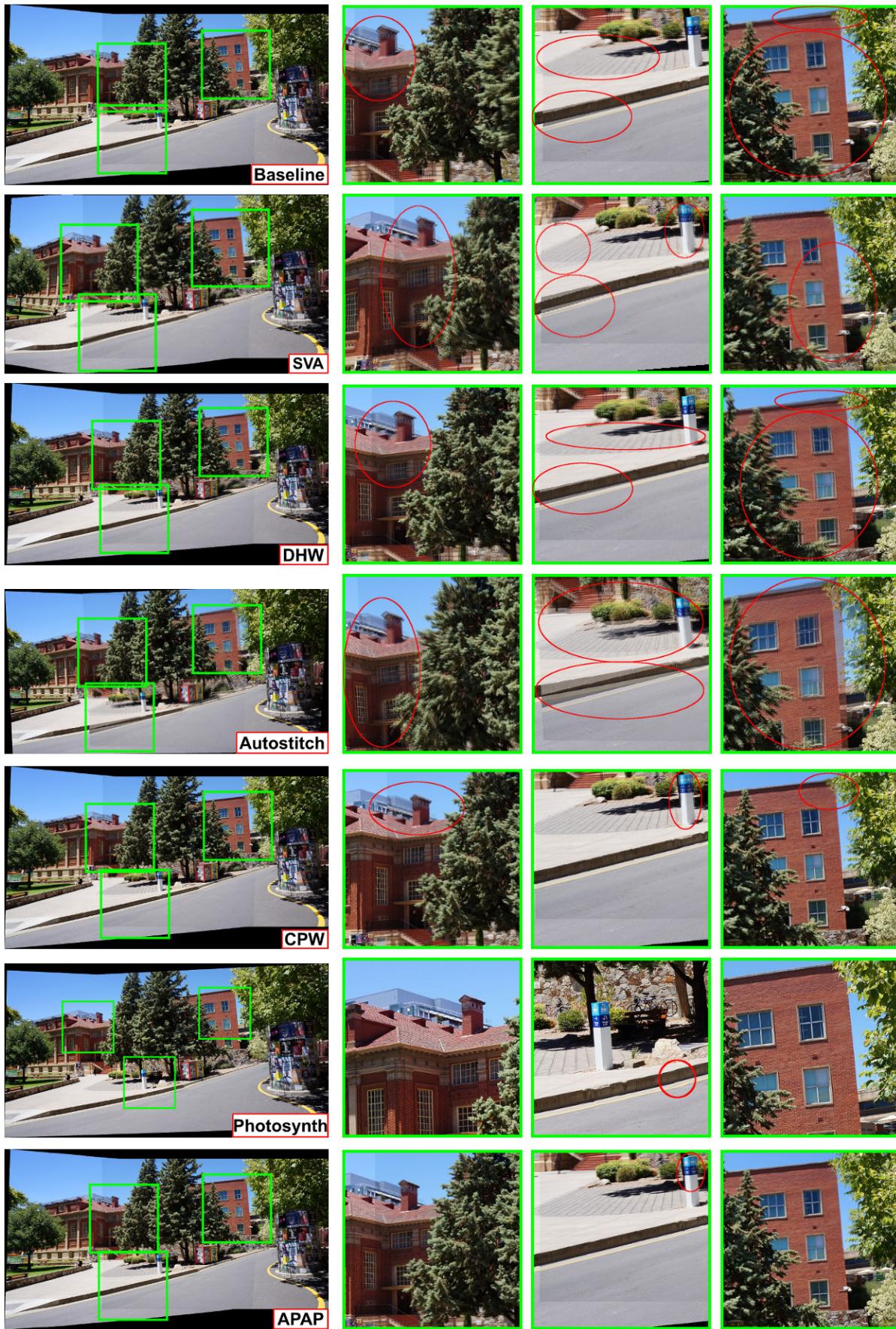


Figure 14: *garden*.

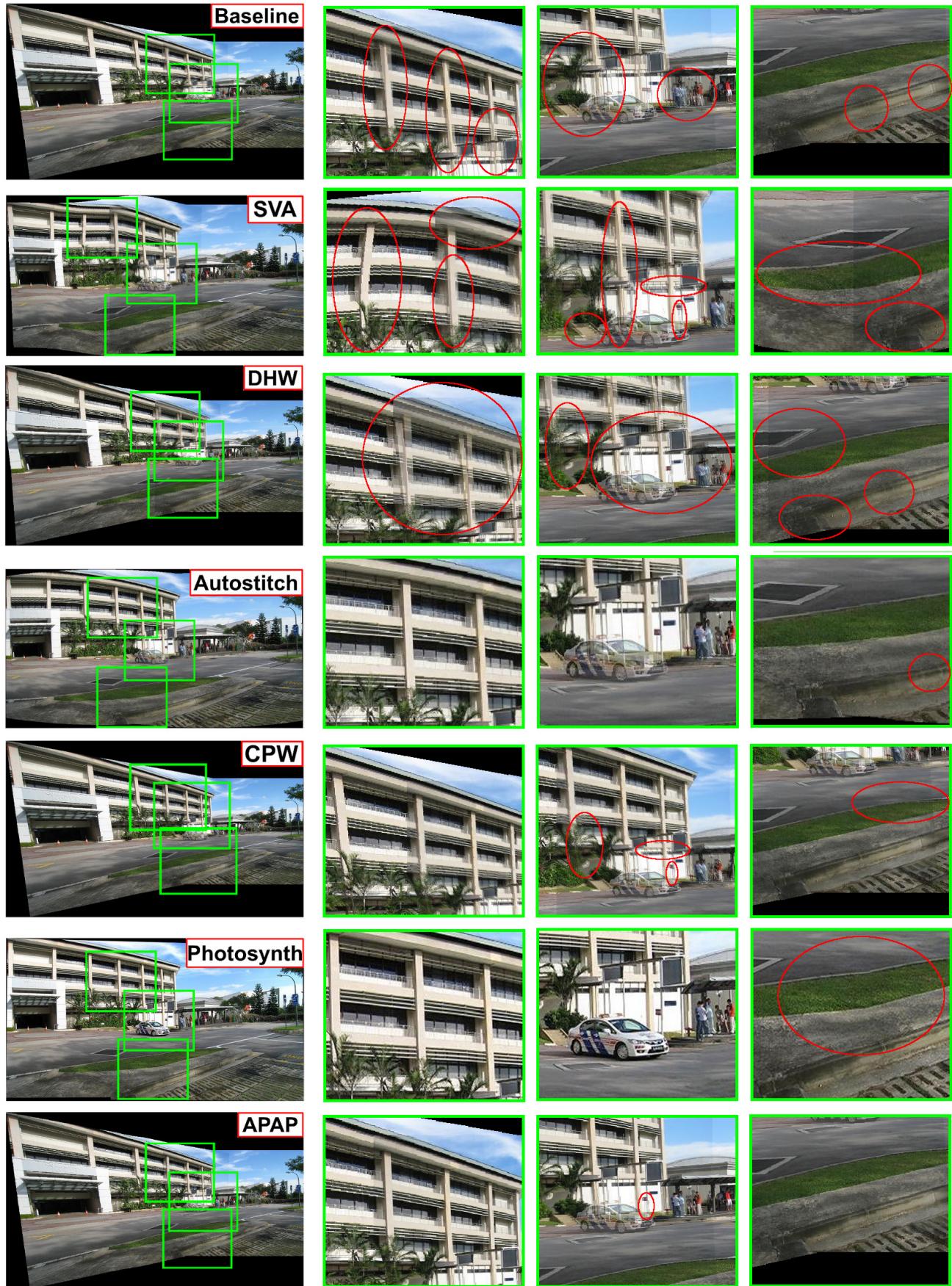


Figure 15: *carpark*.



Figure 16: *apartments*.

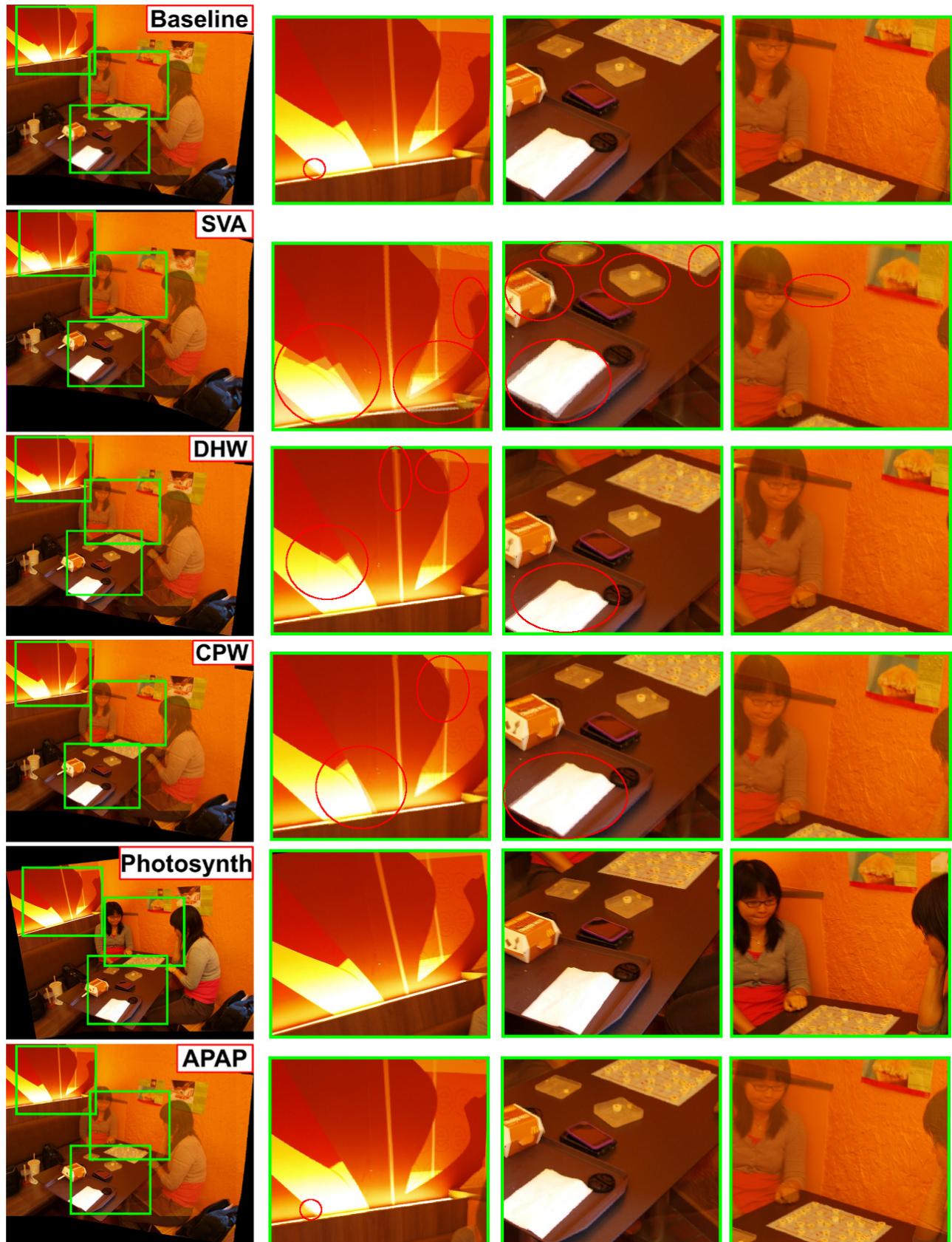


Figure 17: *chess/girl*.

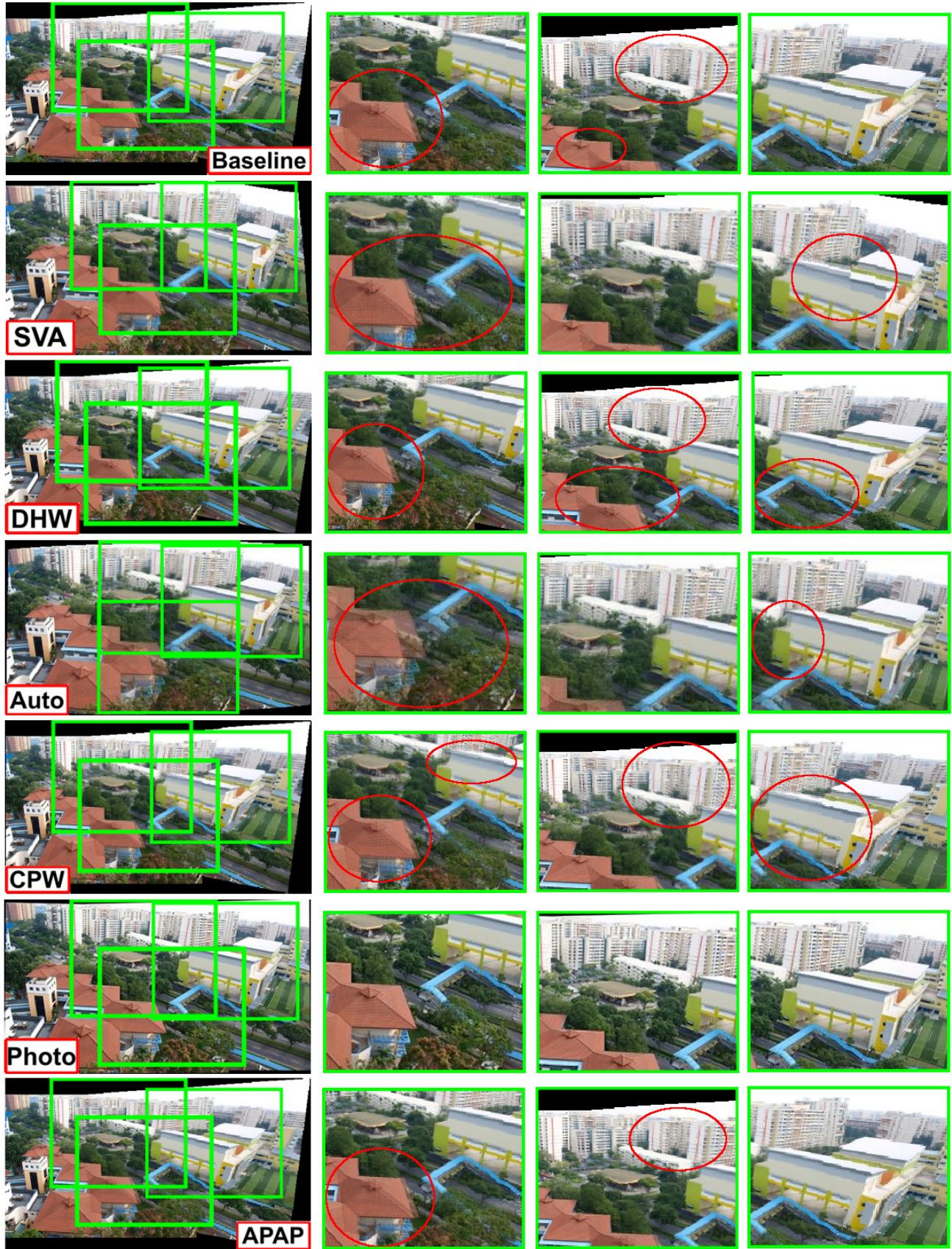


Figure 18: *rooftops*.

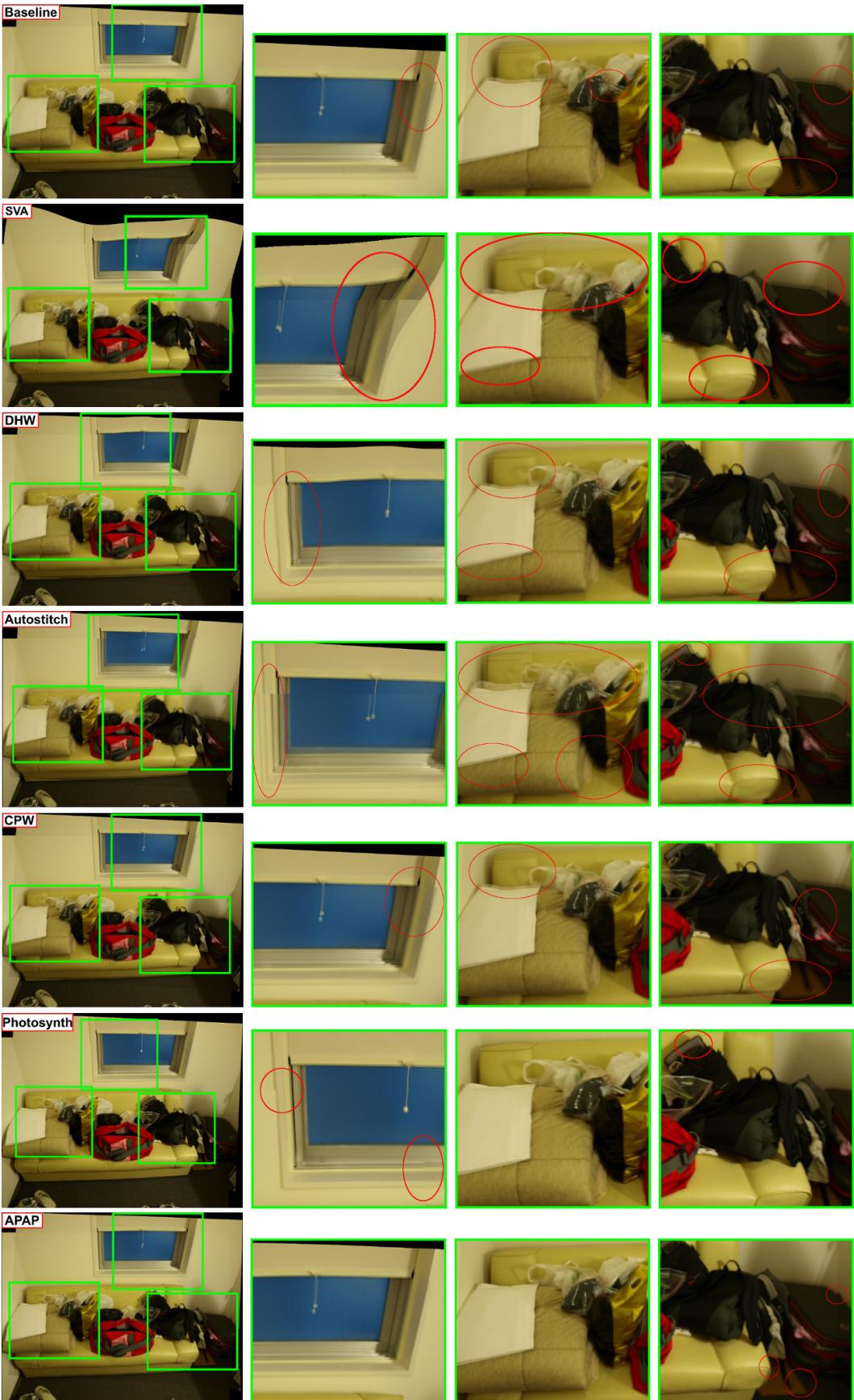


Figure 19: *couch*.

## B Stitching full panoramas with postprocessing

As mentioned in the introduction as well as Sec. 5.3 in the main paper, our premise is that accurate image alignment imposes lower expectations or requirements on the effectiveness of deghosting and photometric postprocessing methods. Such post-processing techniques are imperfect and may not work all the time [7], thus it is vital to minimize errors in the alignment step. Here, we illustrate our point by postprocessing the stitched images obtained by our As-Projective-As-Possible (APAP) method, which provides the most accurate alignment among the compared techniques. We focus on stitching large panoramas from multiple images, since stitching multiple images naturally presents many opportunities for alignment errors to surface.

We generate full panoramas by stitching multiple images onto a canvas using Moving DLT (Sec. 4). After the warps are generated, we warp each image onto a canvas. After each image is warped onto the canvas, we apply seam cutting and feathering blending to composite the pixels. Conducting this “incremental” stitching using Moving DLT allows us to better demonstrate the accuracy of our alignment, since any misalignment errors will be propagated and amplified. We compare our results against Autostitch and Photosynth with photometric postprocessing enabled. Figs. 20, 21 and 22 present results on respectively the *construction site*, *garden* and *train* image sets.

It is evident that significant artifacts remain in the results of Autostitch. The results from Photosynth show signs of the usage of seam cutting-like techniques and sophisticated pixel blending methods. However noticeable artifacts can still be observed, since the post-processing failed to conceal the misalignments. Comparatively, our results present less obvious alignment mistakes and artefacts. In particular, in *train* the motion parallax errors have been dealt with by seam cutting after Moving DLT, without introducing noticeable alignment errors in the other parts of the scene.

Notwithstanding the potentially very bad errors from using basic homography alignment, the results of Photosynth show the remarkable ability of postprocessing methods to reduce or conceal much of the misalignment artifacts. The practical contribution of our method therefore is to allow the remaining errors to be eliminated thoroughly via improved image alignment.

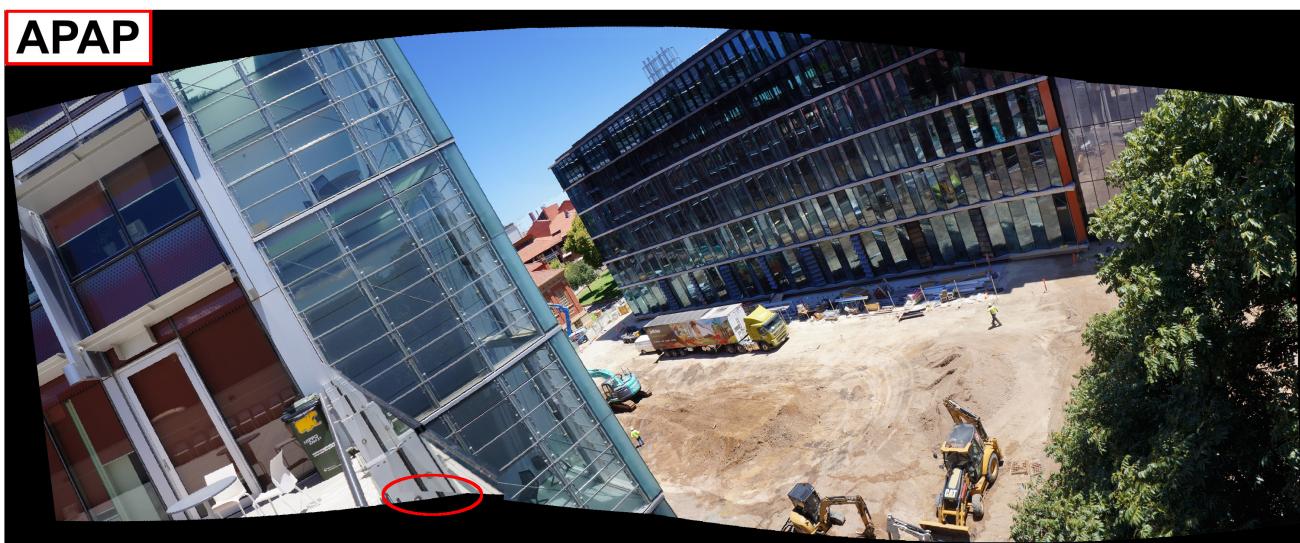
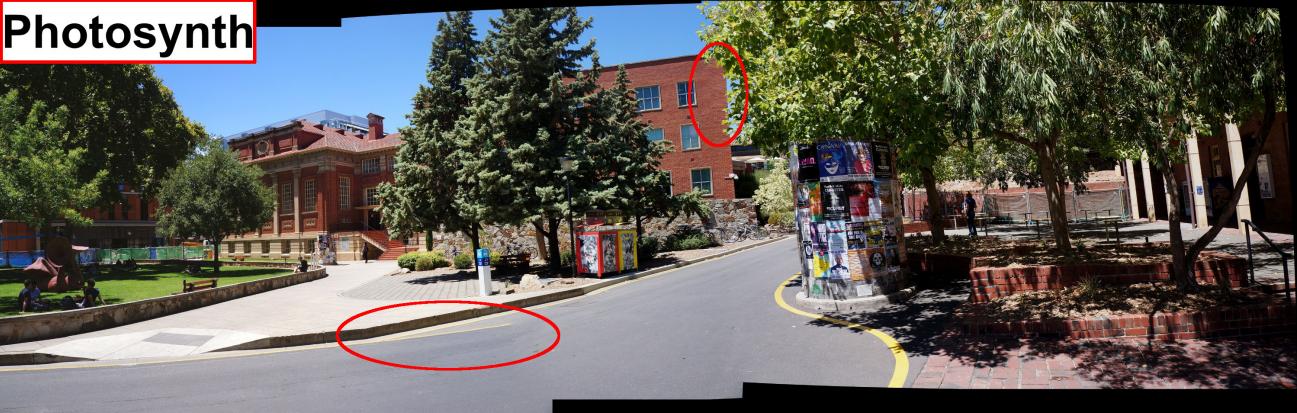


Figure 20: Full panoramas with postprocessing on the *construction site* image set. Red circles highlight errors.

**Autostitch**



**Photosynth**



**APAP**



Figure 21: Full panoramas with postprocessing on the *garden* image set. Red circles highlight errors.

**Autostitch**



**Photosynth**



**APAP**



Figure 22: Full panoramas with postprocessing on the *train* image set. Red circles highlight errors.

## C Stitching images with large depth discontinuities

As noted in [18, Appendix B-8.2] a major challenge for most of the flexible image stitching methods is that of aligning images that contain scenes with large depth discontinuities. We tested our Moving DLT stitching method on such a scene (see Fig. 23). In this scene, the trees, lamppost and bollards in the foreground cause sharp depth discontinuities. The results show that our APAP warps do not fail in such data. This is because the amount of camera translation is small compared to the overall scene depth (nonetheless, this small translation is sufficient to cause the baseline projective warp to break down - see Row 1 Fig. 23). While areas with sharp depth discontinuities may cause large deviations from the projective warp, the amount of deviation depends on the camera translation distance. Our APAP warps will eventually break down as the translation distance (and hence, the deviation from the projective model) increases (as shown in Fig. 5 in the paper), however, in most real life cases such as tourist snaps, the camera translation is likely to be small relative to scene depth.

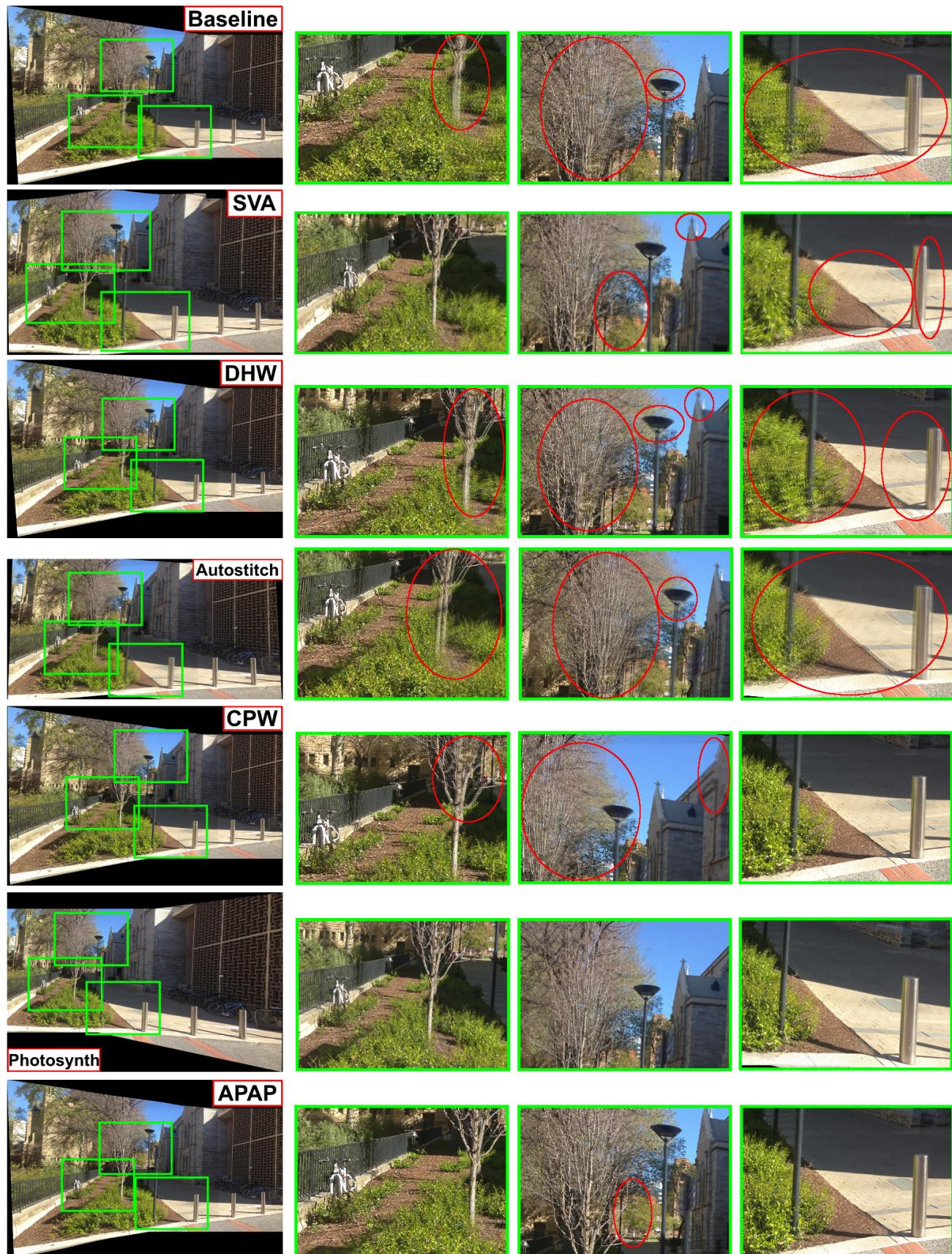


Figure 23: *bikes*

## D Image sets used in the experiments

### Images used in pairwise stitching (Sec. 5.1)



Figure 24: *railtracks*



Figure 25: *temple* (from [22])



Figure 26: *carpark* (from [22])



Figure 27: *apartment* (from [22])



Figure 28: *chess/girl* (from [18])



Figure 29: *couch* (from [18])



Figure 30: *rooftops* (from [18])



Figure 31: *bikes*

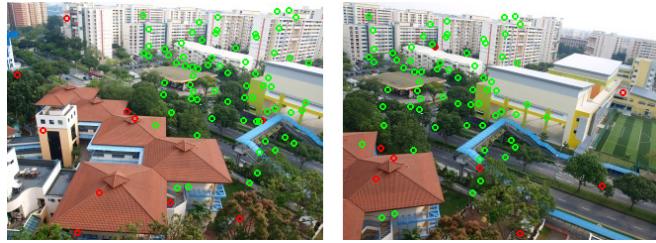


Figure 32: SIFT keypoint matches in *rooftops*. Green indicates inliers, while red denotes outliers.

### Images used in stitching full panoramas (Secs. 5.2 and 5.3)



Figure 33: *construction site*



Figure 34: *garden*



Figure 35: *train*