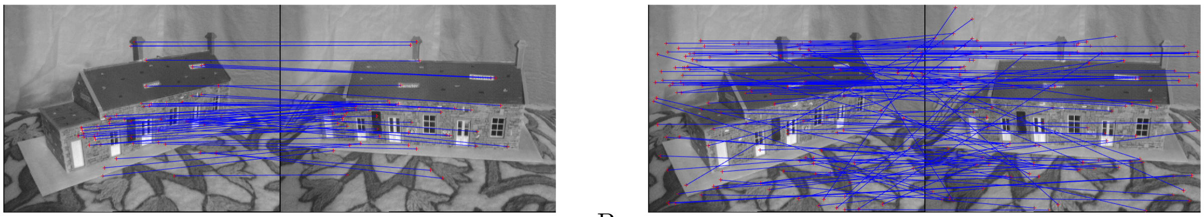
Computer Vision, 7th assignment

Mathis Lamarre

Feature extraction and initialization with epipolar geometry

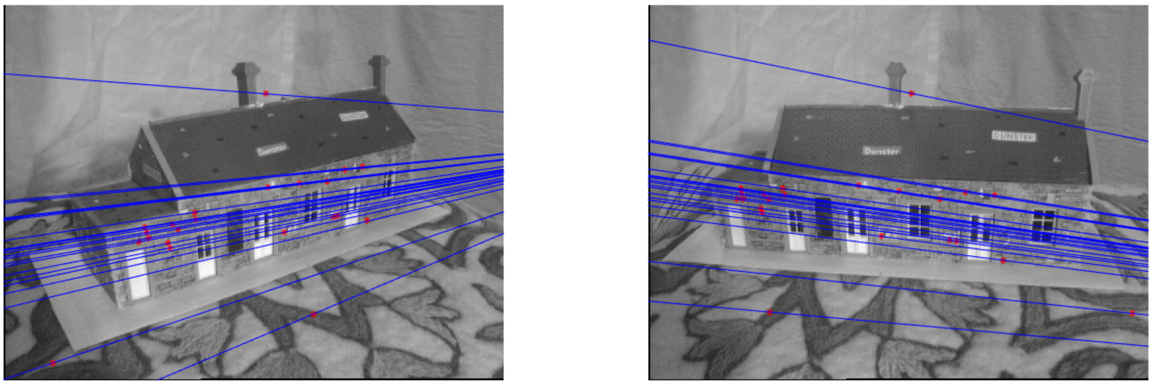
First, with the VLFeat toolbox, features were extracted and matched (0 and 4). Then, the 8-point RANSAC algorithm was ran to compute the fundamental matrix and select the inliers. On Fig.1, we can see the inliers and the outliers of the matched features.



A B

Fig. 1: Images used for the initialization and result of the 8-point algorithm. A shows the inlier matches and B show the outliers.

The corresponding epipolar geometry is shown in Fig.2.



A B

Fig. 2: Epipolar geometry of the images used for the initialization. A and B show the inliers in their respective views.

With the given K matrix, the essential matrix can be computed as $\mathbf{E} = \mathbf{K^T F K}$. The essential matrix can then be decomposed into the projection matrix P with four possible solutions. We keep the one that has the most points in front of the camera.

With the two projection matrices (the one we derived and the first one set to the identity) and the 2D calibrated inlier points (with the K matrix) we can compute their 3D triangulated positions.

Triangulation and adding new views

In order to add new views, we match their 2D features with the 2D features from the 3D-3D correspondence of the first view. After calibrating these points, we run the 6-point DLT RANSAC algorithm to get the P matrix and also the inliers. After checking that the P matrix is correct (positive determinant of the R matrix), we calibrate the points triangulate and triangulate them.

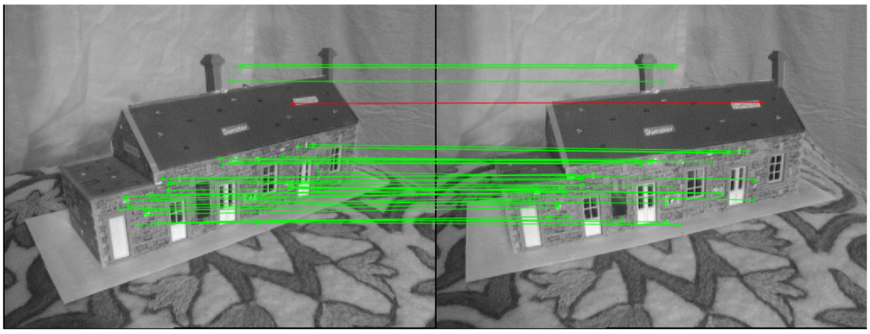


Fig. 3: Inlier (green) and outlier (red) matches after 6-point RANSAC (images 0 and 1).

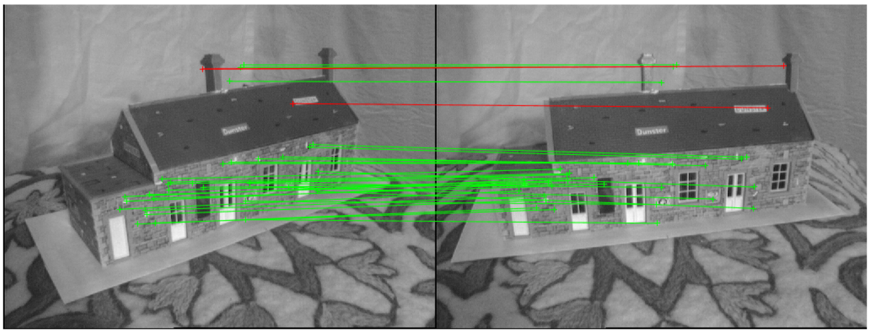


Fig. 4: Inlier (green) and outlier (red) matches after 6-point RANSAC (images 0 and 2).

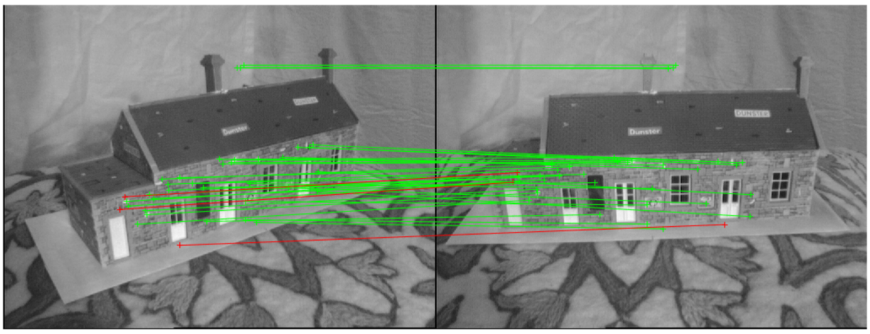


Fig. 5: Inlier (green) and outlier (red) matches after 6-point RANSAC (images 0 and 3).

Plotting

To analyze the results, we plot all the camera poses (the P matrices) and the 3D triangulated points.

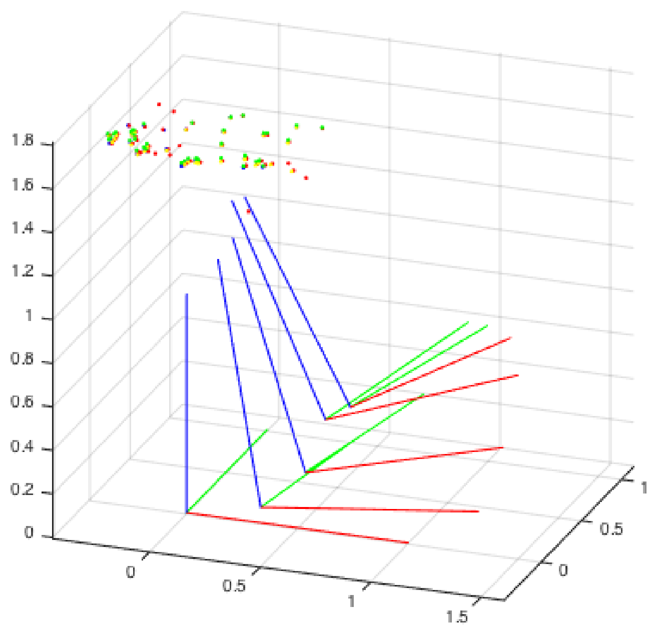


Fig. 6: 3D plot of the camera poses and the 3D triangulated points. The red points are the triangulated points from the initialization, the green ones from the first additional image, the blue ones from the second additional image and the yellow ones from the third additional image.

As expected, the first camera is on the origin (see Fig.6). The subsequent camera move a bit up and rotate to the left, which is what we see when looking at the point of view of the images. The 3D points are not perfect but are overall in the same region.

Dense reconstruction

To do the dense reconstruction, we treated the black and white image as a RGB image by duplicating it 3 times. Then, we computed the depth by selecting the $z - coordinate$ of all the inliers.

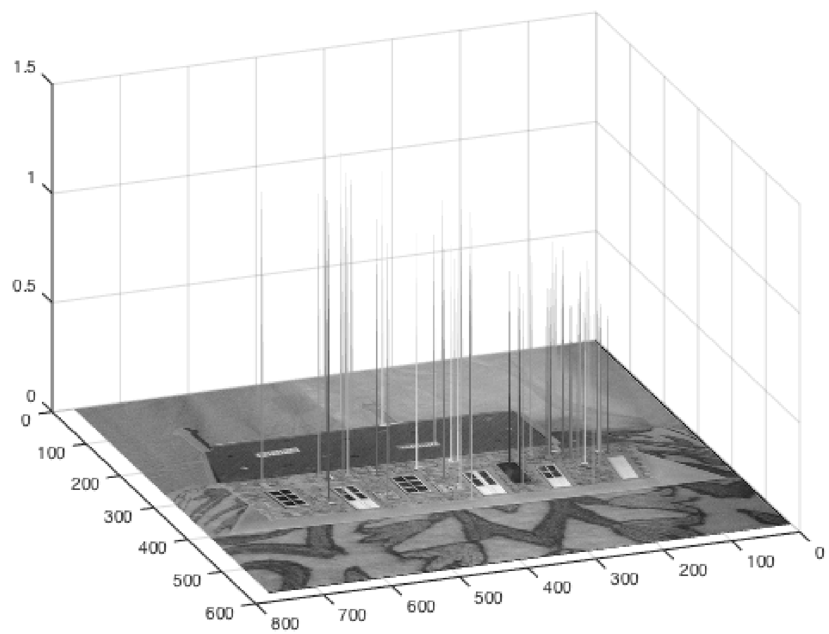


Fig. 7: Dense reconstruction. The height of the peak represents the depth of the feature.