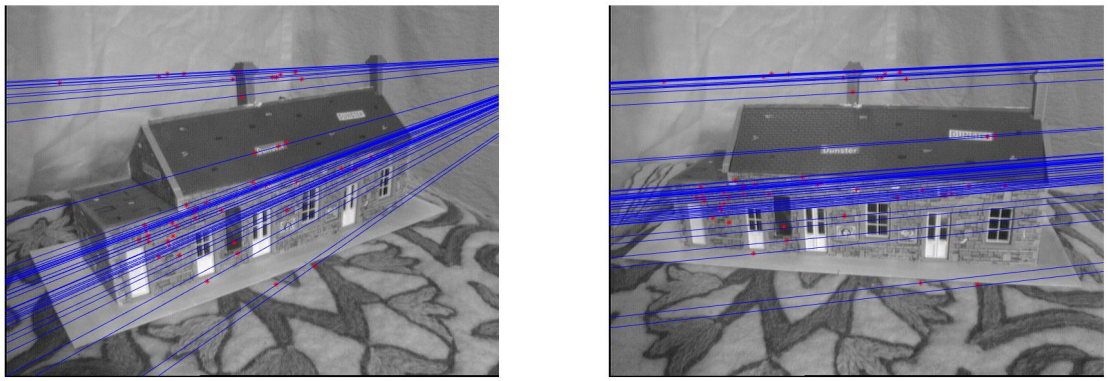
# 1 Structure from Motion

We start off by computing the features of the first and last image using SIFT. We then match these features using the integrated ubcmatch function. Using 8-point RANSAC we can filter out the outliers and compute the fundamental matrix F. We also compute the epipolar lines using the fundamental matrix, this can be seen in Figure 1. Using the provided camera matrix K we then compute the essential matrix $E = K^T F K$. We additionally need to compute the calibrated points x1_calib and x2_calib which we get by multiplying the inverse camera matrix with the homogeneous coordinates x1 and x2. These calibrated points are needed to decompose the essential matrix into the projection matrix. Using this newly acquired projection matrix we can now triangulate the 3D points by using the calibrated points from x1 and x2.

For each image we extract the SIFT features and match these using ubcmatch to the inlier features of the first image. We then compute the calibrated points of this new image in the same way we computed the calibrated points for x1 and x2. Using the 3D points computed previously and the calibrated points we can run the 6-point RANSAC algorithm which gives us the projection matrix P and the inliers for this new image. It is possible that the projection matrix is flipped, to check this we decompose it into the rotation matrix R and translation vector t, if the determinant of R is negative we flip the sign of all values in R and t and use these as the projection matrix. Finally, we can use x1_calib and the calibrated points of the image we are considering to compute the linear triangulation which gives us the 3D points for the new image. These steps are repeated for all the images in between. The Figures below are comparisons between each pair of images, two subsequent images show all matches and inliers for a given pair of images. Appended at the end is the 3D plot of the camera poses and the triangulated 3D points.



(a) (b)

Figure 1: epipolar lines of first and last image.

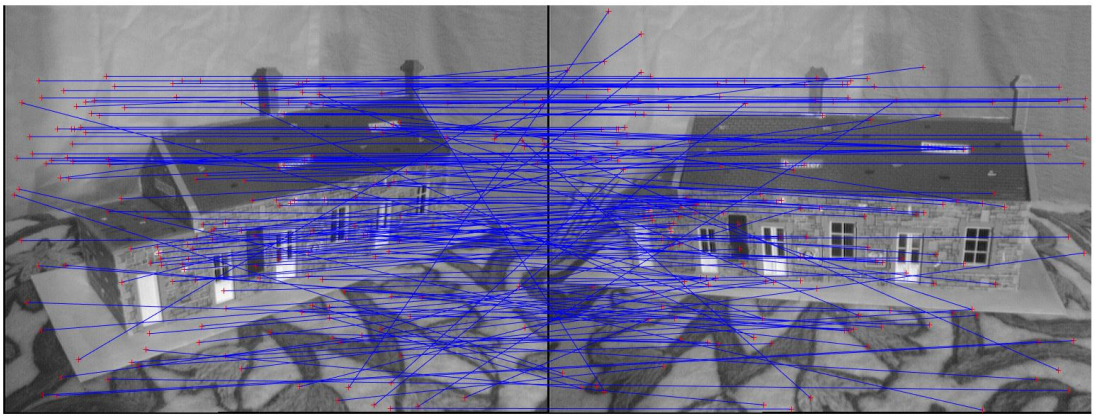


Figure 2: inliers and outliers between image 0 and 4.

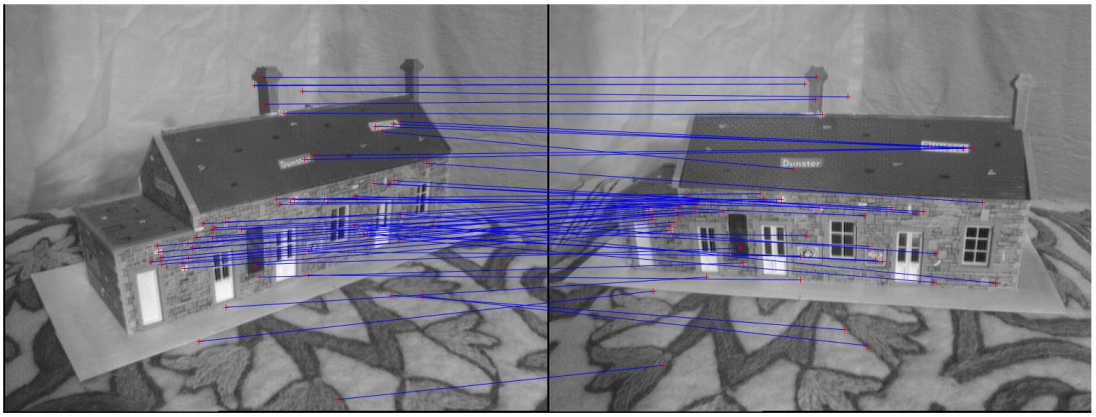


Figure 3: inliers between image 0 and 4.

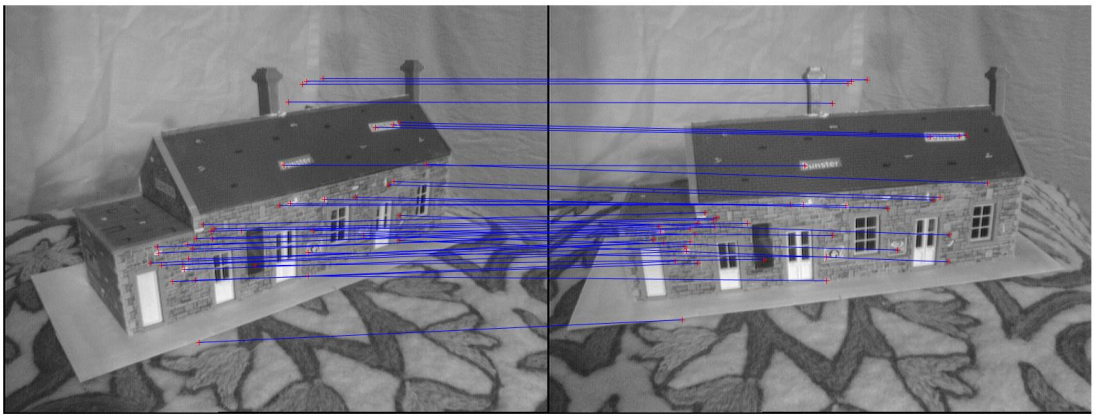


Figure 4: inliers and outliers between image 0 and 3.

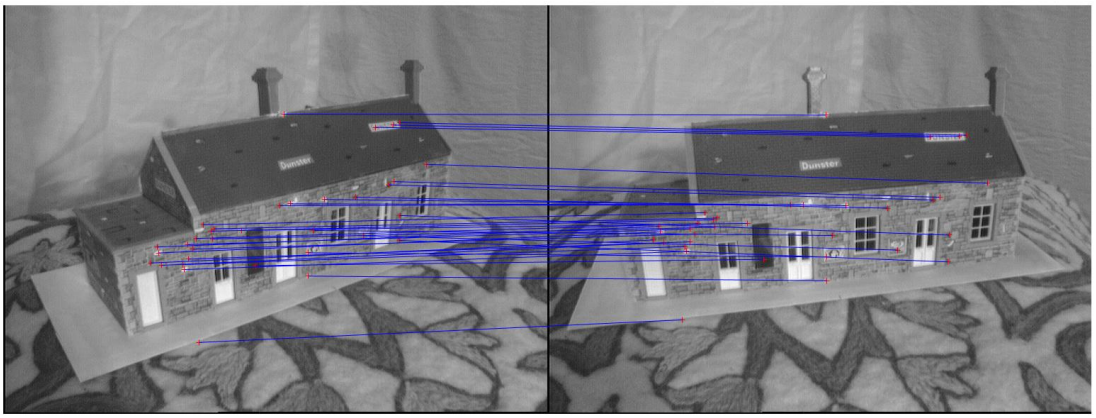


Figure 5: inliers between image 0 and 3.

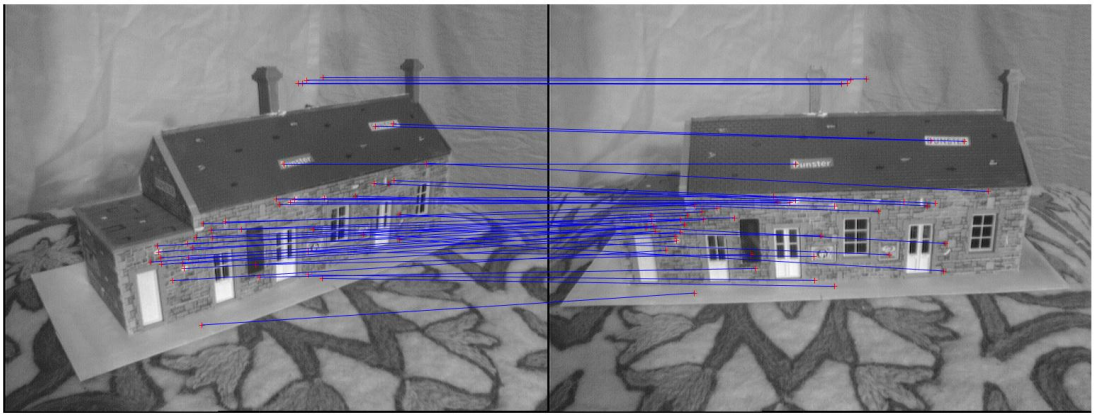


Figure 6: inliers and outliers between image 0 and 2.

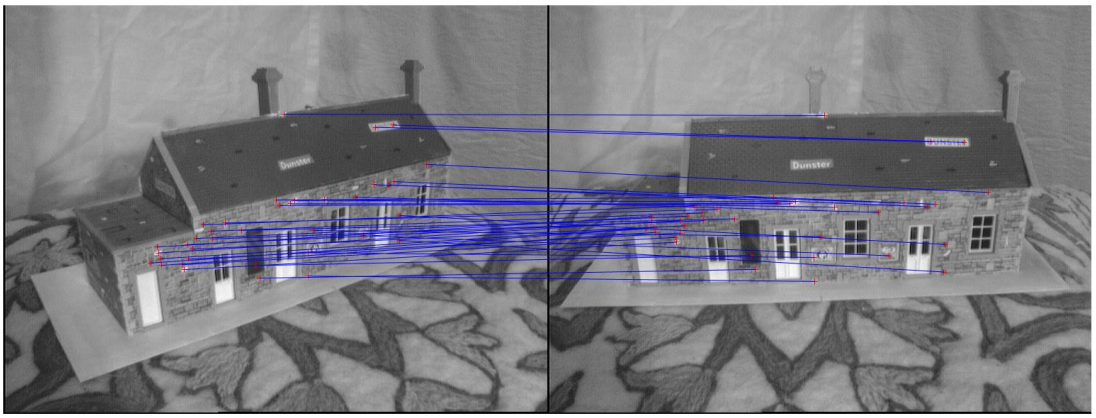


Figure 7: inliers between image 0 and 2.

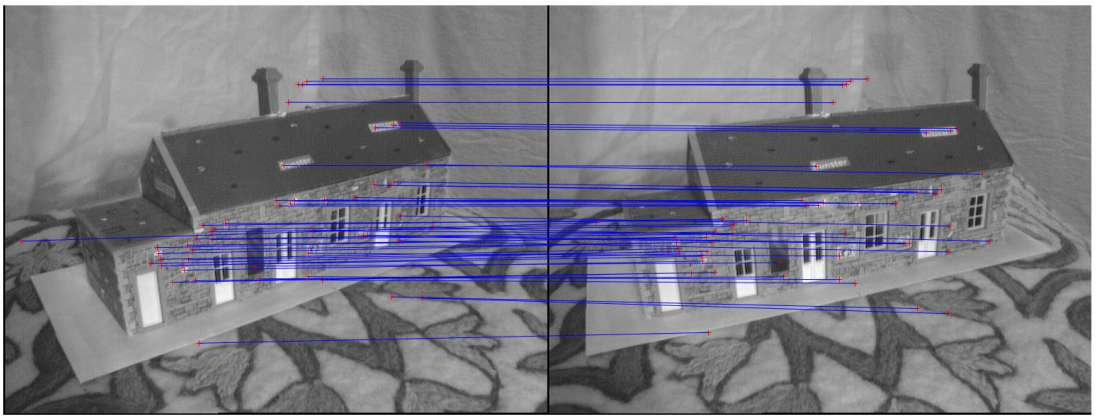


Figure 8: inliers and outliers between image 0 and 1.

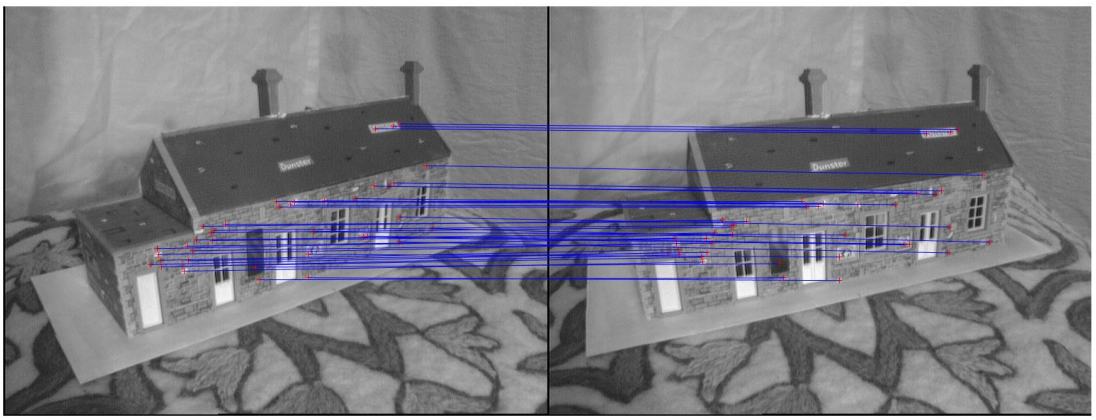


Figure 9: inliers between image 0 and 1.

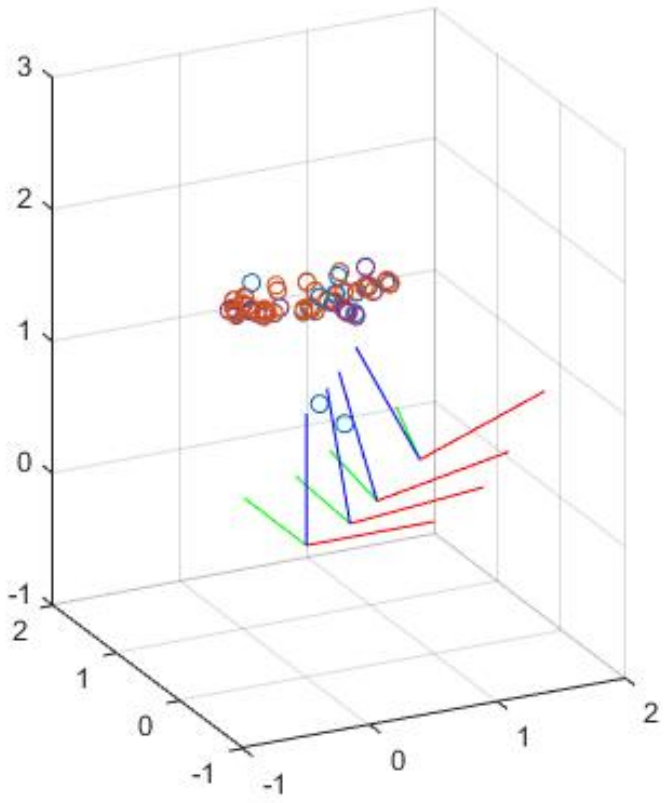



Figure 10: cameras and 3D points.