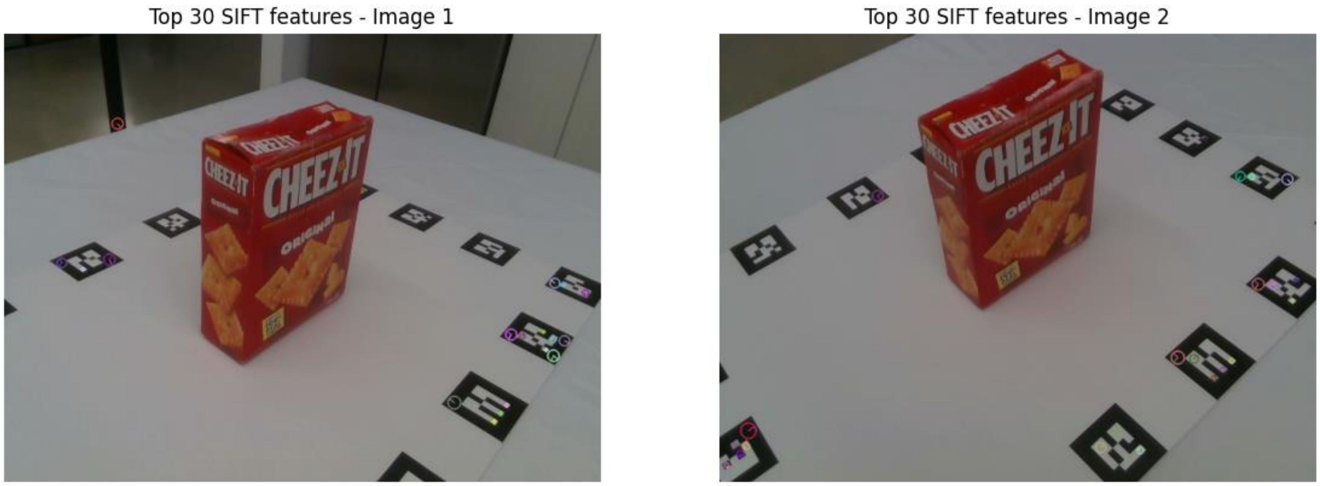
ECES 681Computer Vision Homework 2

Step 1: Detect and match Feature points

To detect feature points in both the images SIFT algorithm is used. Figure 1 shows the 30 strongest features identified. Then to match the features between the images FLANN with Lowe's ratio test is used. Figure 2 below shows the 30 matched features between the images.


Top 30 SIFT features - Image 1

Top 30 SIFT features - Image 2

Figure 1: 30 strongest features using SIFT

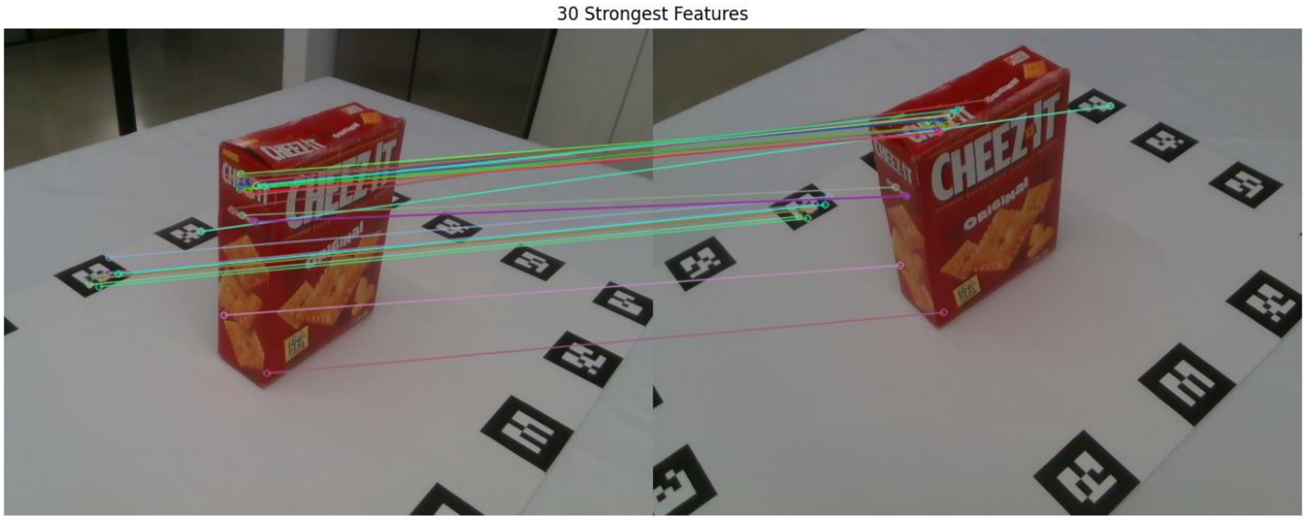

30 Strongest Features

Figure 2: 30 Strongest features matched between two images

Step 2 and Step 3: Compute the fundamental matrix FF and draw epipolar lines

Using the matched points from step 1, fundamental matrix can be calculated using “cv2.findFundamentalMat” using RANSAC algorithm. After this we can eliminate the outlier. Figure 3 shows the matched points after removing the outliers. Figure 4 shows the 3 pixels sampled from image 1 and their epipolar lines drawn on image 2 using the computed fundamental matrix.

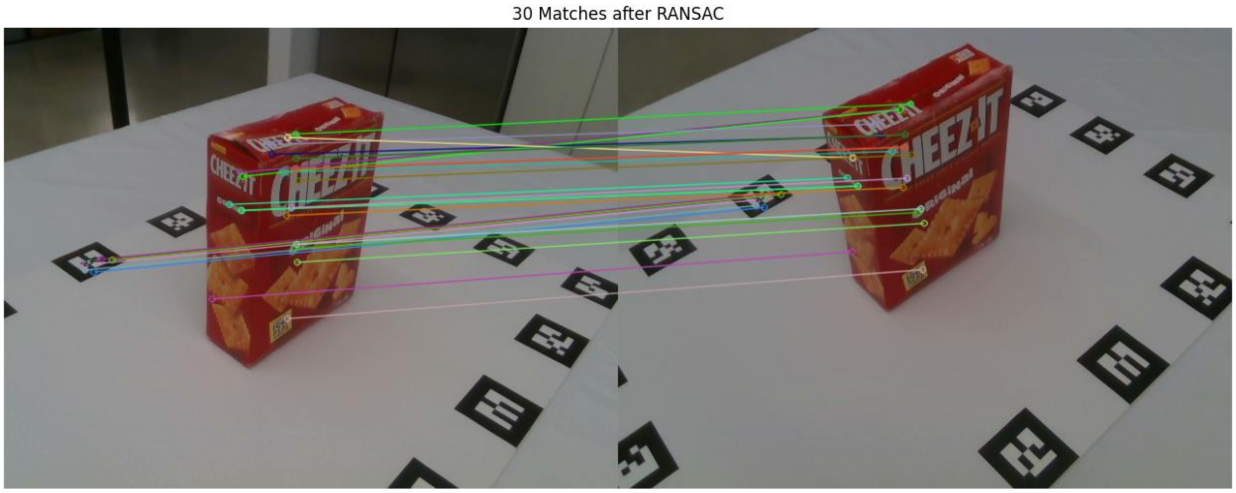
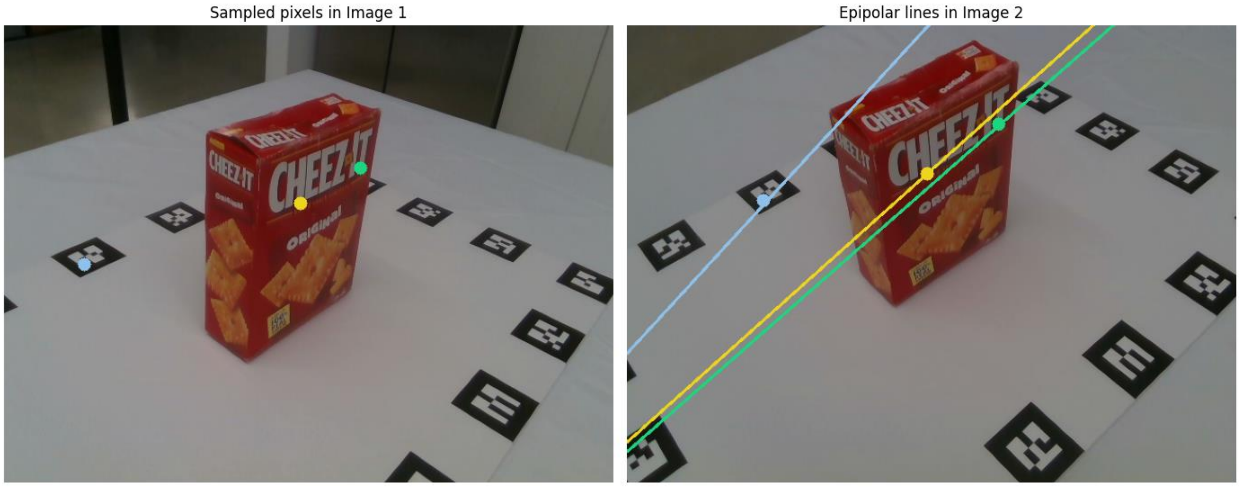

30 Matches after RANSAC

Figure 3: 30 Strongest features after eliminating outliers


Sampled pixels in Image 1

Epipolar lines in Image 2

Figure 4: Epipolar lines in image 2 for 3 pixels in image 1

Step 4: Rectify the Images

Using the “cv2.stereoRectifyUncalibrated()” and the computed fundamental matrix we get two homographies for both the images which can be applied to warp the original images. Figure 5 shows the rectified images, which are horizontally aligned. Finally, figure 6 shows the anaglyph to see the 3D effect using “mpl_stereo” library.

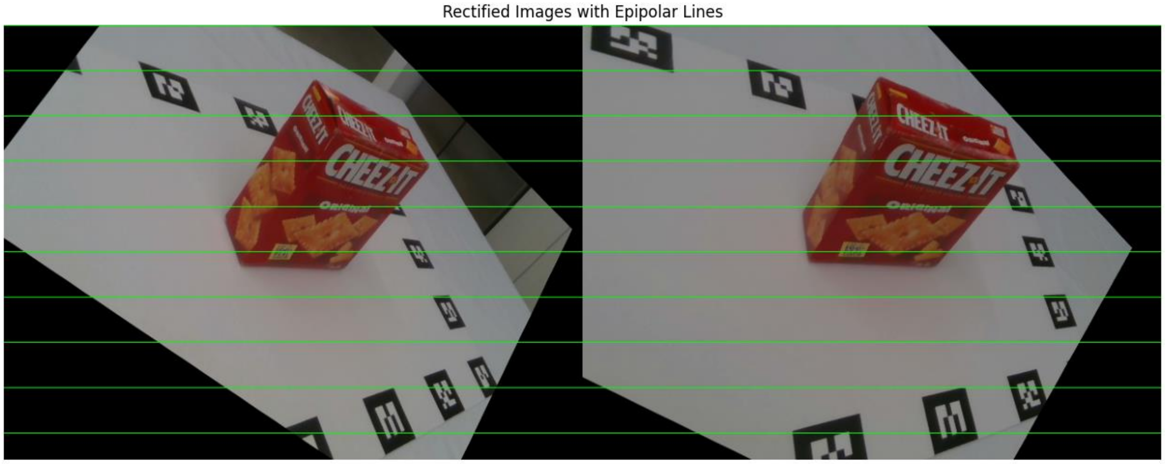


Figure 5: Rectified images

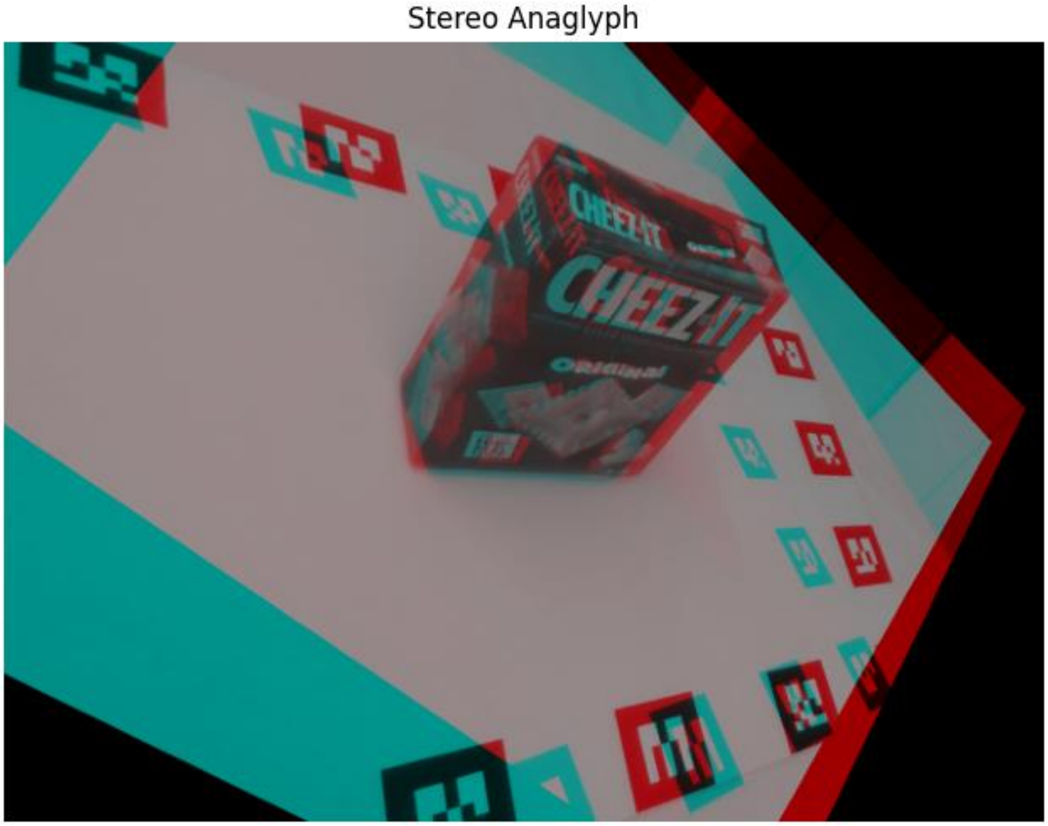


Figure 6: red-cyan anaglyph of the images

How rectification helps in stereo matching?

Stereo rectification warps both images so that corresponding points lie on the same row, which simplifies disparity calculation, which is essential for depth estimation.

Without Rectification

- Corresponding points appear at different heights.
- Stereo matching is difficult and computationally expensive.

After Rectification

- Corresponding points align on the same row.
- Disparity is measured along the x-axis only.

References

1. https://docs.opencv.org/4.x/dc/dc3/tutorial_py_matcher.html
2. https://docs.opencv.org/4.x/d1/de0/tutorial_py_feature_homography.html
3. https://docs.opencv.org/4.x/da/de9/tutorial_py_epipolar_geometry.html