PRACTICAL WORK REPORT

Prepared By

Kharef Okba

Okba.Kharef@etu.sorbonne-universite.fr

Professor

Pascal Monasse

Oct 15, 2024

Introduction

In this project, The goal was to find correspondences between the two images of a static scene acquired from different viewpoints and compute the fundamental matrix (F) using the RANSAC algorithm. This matrix is essential for finding the epipolar geometry between the two views, allowing us to infer the spatial relationships between points in the two images.

The project was divided into the following steps:

1. **Feature Detection (SIFT Algorithm):**
   We employed the SIFT (Scale-Invariant Feature Transform) algorithm to extract key points and their descriptors from both images. we got Im1: 1400 Im2: 1395 which resulted in a total of matches: 675.
2. **Random Subset Selection:**
   To compute the fundamental matrix (F), a random subset of matches is selected using the `selectRandomSubset` function. This random sampling helps in applying the 8-point algorithm for fundamental matrix computation.
3. **Fundamental Matrix Computation:**
   The function `tempF` computes the fundamental matrix (F) using the selected matches. The matrix is computed as follows:
   - A linear system is built by normalizing the point coordinates (`x1, y1` from the first image and `x2, y2` from the second image) and filling the matrix `A` with the corresponding values.
   - The system is then solved using Singular Value Decomposition (SVD) to get the matrix `F`.
   - After solving the system, the matrix `F` is denormalized using a scaling matrix `N` to account for the earlier normalization step.

4. **RANSAC for Outlier Rejection:**

   To ensure the computed fundamental matrix is robust to outliers (incorrect matches), we apply the RANSAC (Random Sample Consensus) algorithm in the `computeF` function. The steps are as follows:

   - *Iterative Selection of Matches:*

     RANSAC iterates over multiple random subsets of 8 matches. For each iteration, the fundamental matrix is computed using the `tempF` function.

   - *Inlier Detection:*

     Once a candidate matrix `F` is computed, the function `findInliers` checks how well it satisfies the epipolar constraint for all matches. The distance between the point in one image and the epipolar line in the other image is computed. If this distance is below a certain threshold (`distMax`), the match is considered an inlier.

   - *Best Model Selection:*

     The number of inliers for each computed `F` is compared across iterations. The matrix with the maximum number of inliers is selected as the best estimate for the fundamental matrix.

   - *Refinement:*

     After finding the best fundamental matrix, the final step refines it by recomputing `F` using all inliers. This refinement ensures that the matrix is as accurate as possible, based on the best subset of matches.

5. **Epipolar Line Visualization:**

   The final step visualizes the epipolar lines in both images, corresponding to the matched points. This visualization helps in understanding how points in one image constrain the possible positions of their corresponding points in the other image.

Results:

Figure 01: SIFT detecting features: Im1: 1400 Im2: 1395 matches: 675

Figure 2: displayEpipolar lines