Homography Estimation

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1 Background

Homography is a 3x3 matrix which describes a 2D-2D transformation between two planes. For example, if a camera plane C_1 undergoes a pure rotation R to camera plane C_2, the image coordinates $\mathbf{X_1}$ of C_1 and $\mathbf{X_2}$ of C_2 can be related by

$$\mathbf{X_1} = \mathbf{H}_{12}\mathbf{X_2} \tag{1}$$

where $\mathbf{X}_1$ and $\mathbf{X}_2$ are the homogeneous image coordinates of two corresponding points on C_1 and C_2 respectively. $\mathbf{H}_{12}$ is the *Homography* matrix which transforms image coordinates on C_2 to C_1.

2 Your Task

Use C++ to write a program to estimate the *Homography* matrix between two images. The images are given in the same folder with this document. **You may start once you receive this assignment. The deadline will be notified in the email**.

3 What third-party libraries You can use

You might need OpenCV to perform the feature detection and matching, and necessary visualization. You can also use the other linear algebra libraries such as Eigen for matrix manipulation.

4 What we expect you to implement

Once you have the feature correspondences between two images, the following computation of *Homography* **H** must be written by yourself. The computation of **H** include a RANSAC based model estimation and solving a linear system for elements in **H**. OpenCV or other open source libraries provides functions for *Homography* estimation and those **CAN ONLY BE** used to verify your results.

5 What you need to demo during the interview

- You bring your own computer and run the program to produce **H**. To verify the result is correct, you can visualize two matched feature coordinates and show they are related by **H**.
- You need to go through the code with us and explain how you implemented the algorithm. During the process, we may interrupt and ask questions regarding the code.