CSci 4270 and 6270
Computational Vision,
Spring Semester, 2022
Lecture 11 Exercise — Homographies from Conjugate Rotations
Due: Saturday, February 19, 2022 at 11:59pm EST

Suppose camera i, for $i = 1, 2$, is described by the intrinsic parameter matrix $\mathbf{K}_i$, rotation matrix $\mathbf{R}_i$ and translation vector $\mathbf{t} = (0, 0, 0)^\top$. This would give camera matrix

$$\mathbf{M}_i = \big(\mathbf{K}_i\mathbf{R}_i \;\mid\; \mathbf{0}\big).$$

Note that in this notation we have dropped the transpose on the rotation matrix. For this exercise, we'll assume all pixel locations are written in the form (x, y), where x is across the image and y goes down.

Write a Python script that computes the bounds of the mapping of an image from camera 1 onto camera 2 and on the mapping of camera 2 onto camera 1. The script should

1. Read four 3x3 matrices from a file, these are $\mathbf{K}_1$, $\mathbf{R}_1$, $\mathbf{K}_2$ and $\mathbf{R}_2$ (this part is done for you),
2. Compute the homography mapping image 1 onto image 2,
3. Map the four corners of image 1 onto image 2 using this homography,
4. Compute the corners of the rectangle (in image 2's coordinate system) bounding these points,
5. Output the upper left and lower right corners for this bounding rectangle, accurate to the nearest integer, and
6. Repeat steps 2 through 5, reversing the roles of camera 1 and 2.

You may assume the corners of the images are (0,0), (6000, 0), (0, 4000), and (6000, 4000). For simplicity there should just be four lines of output:

- the x and y coordinates of the upper left corner of the first mapping,
- the x and y coordinates of the lower right corner of the first mapping,
- the x and y coordinates of the upper left corner of the second mapping, and
- the x and y coordinates of the lower right corner of the second mapping.

All output values should be rounded to the nearest integer. Importantly, you may not assume that the mapping of the $(0, 0)$ location forms the upper left corner.