

Exercise on Homography Estimation

xiahaa@space.dtu.dk

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In this exercise, you will work on using DLT for homography estimation.

1 DLT

Recall the relation established using homography matrix

$$\begin{aligned} \mathbf{x}_2 &= \mathbf{H}\mathbf{x}_1, \mathbf{x}_1 = [u_1, v_1, 1]^T, \mathbf{x}_2 = [u_2, v_2, 1]^T \Rightarrow \\ \mathbf{x}_2 \times \mathbf{H}\mathbf{x}_1 &= 0 \Rightarrow \\ \begin{bmatrix} 0 & -1 & v_2 \\ 1 & 0 & -u_2 \\ -v_2 & u_2 & 0 \end{bmatrix} \begin{bmatrix} u_1 h_{11} + v_1 h_{12} + h_{13} \\ u_1 h_{21} + v_1 h_{22} + h_{23} \\ u_1 h_{31} + v_1 h_{32} + h_{33} \end{bmatrix} &= 0 \Rightarrow \\ \begin{bmatrix} 0 & 0 & 0 & -u_1 & -v_1 & -1 & v_2 u_1 & v_2 v_1 & v_2 \\ u_1 & v_1 & 1 & 0 & 0 & 0 & -u_2 u_1 & -u_2 v_1 & -u_2 \end{bmatrix} \begin{bmatrix} h_{11} \\ h_{12} \\ h_{13} \\ h_{21} \\ h_{22} \\ h_{23} \\ h_{31} \\ h_{32} \\ h_{33} \end{bmatrix} &= 0 \end{aligned}$$

Note: the third equation of the third row is the linear combination of the first two rows, so it doesn't contribute anything to the solution.

By using 4 point pairs, we can create an equation like $\mathbf{A}\mathbf{x} = 0$. Apply SVD and pick the singular vector corresponding to the minimum singular value, you will have \mathbf{x} .

- **task 1:** use *main_homo_est.m* to generate simulated 4 points and use DLT to do homography estimation. Make you function as *Hest.m*.
- **task 2:** Once you have done, uncomment the block *task 2* in *main_homo_est.m* and try you code using real images. The provided code will load one image and wait for you to click. You just pick the four corners of the colored square. Then there will be another image loaded and you again choose 4 corners of the colored square. Finally, it will call you *Hest* to estimate the homography and do the image warping.

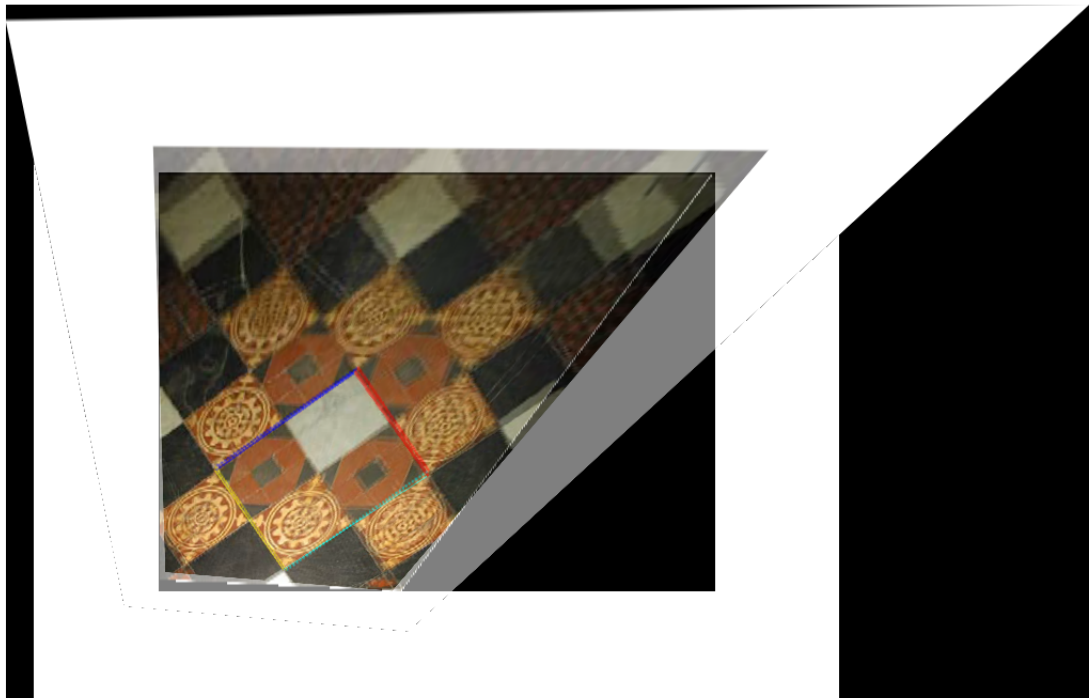


Figure 1: Example of warping result.