CENG 391 Introduction to Image Understanding

December 8, 2017

Homography Estimation with Direct Linear Transform(DLT)

Write a C++/Python program that operates the following tasks.

1. Read the image("in.jpg")
2. Read the correspondences from the file "corrs.txt"
3. Normalize point coordinates so that:
   — Move the average location of the points to the (0,0).
   — Scale coordinates of the points uniformly so that distance to the center(0,0) is $\sqrt{2}$.
   — **Equations:** $\tilde{x} = Tx$ and $\tilde{x}' = T'x'$
4. Construct a matrix A with normalized points as in the following:

$$A = \begin{bmatrix} 0 & 0 & 0 & -x_1 & -y_1 & -1 & y'_1x_1 & y'_1y_1 & y'_1 \\ x_1 & y_1 & 1 & 0 & 0 & 0 & -x'_1x_1 & -x'_1y_1 & -x'_1 \\ . & . & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . & . \\ 0 & 0 & 0 & -x_{20} & -y_{20} & -1 & y'_{20}x_{20} & y'_{20}y_{20} & y'_{20} \\ x_{20} & y_{20} & 1 & 0 & 0 & 0 & -x'_{20}x_{20} & -x'_{20}y_{20} & -x'_{20} \end{bmatrix} \quad (1)$$

5. Find homography(H) by taking Singular Value Decomposition(SVD) of A.
   — Use cv::SVD::(InputArray src) method of OpenCV. "src" is decomposed matrix. The last column of "SVD.vt" gives homography($\tilde{H}$).
6. Unnormalize $\tilde{H}$.
   — H = $T'^{-1}\tilde{H}T$
7. Warp the input image with computed homography by using "warpPerspective()" method of OpenCV and save the result as "warped_img.png"