CSE462/562 – Augmented Reality (Fall 2018)

Homework #2

Handed out: 8:00am Wednesday December 5, 2018.

Due: 11:55pm Tuesday December 25, 2018.

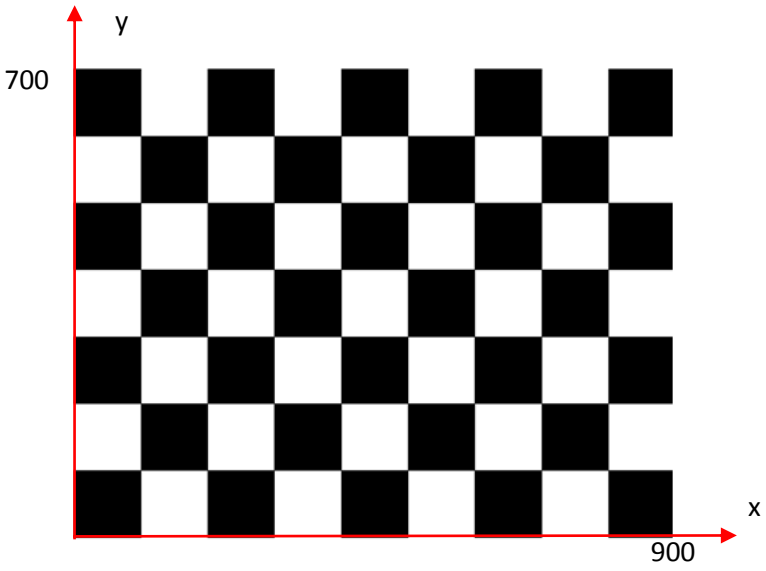
Problem 1 (40 pts): Given the following marker and its three images, you are asked to calculate the homography matrix such that $\rho \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$ and use it for some simple tasks.

1.1. Write a C# function that given a set of point correspondences $\begin{bmatrix} x_i \\ y_i \end{bmatrix}$ and $\begin{bmatrix} u_i \\ v_i \end{bmatrix}$ calculates the corresponding homography matrix.

1.2. Write another C# function that given a scene point $\begin{bmatrix} x_i \\ y_i \end{bmatrix}$ and a homography matrix, calculates the projection of the given point onto the target image.

1.3. Write another C# function that given an image point $\begin{bmatrix} u_i \\ v_i \end{bmatrix}$ and a homography matrix, calculates the projection of the given point onto the scene.

1.4. You are to find at least five point correspondences manualy. Show the calculated matrices for each image using these point matches. Calculate the error for another 3 point matches you identify. Error can be calculated as the Euclidean distance between the image of the point and the projected image. Use the following coordinate system for the scene.



Input images: Homework_2_img1.jpg, Homework_2_img2.jpg, Homework_2_img3.jpg

1.5. Find the projection of the following scene points onto the image.

$S_1 = \begin{bmatrix} 7.5 \\ 5.5 \end{bmatrix}$, $S_2 = \begin{bmatrix} 6.3 \\ 3.3 \end{bmatrix}$ and $S_3 = \begin{bmatrix} 0.1 \\ 0.1 \end{bmatrix}$.

1.6. Find the projection of the following image points onto the scene.

$I_1 = \begin{bmatrix} 500 \\ 400 \end{bmatrix}$, $I_2 = \begin{bmatrix} 86 \\ 167 \end{bmatrix}$ and $I_3 = \begin{bmatrix} 10 \\ 10 \end{bmatrix}$.

Problem 2 (60 pts): Given a scene in 19 images (an example is shown below), place a cylinder of radius 2cm and height 15cm on the white object at the end of the cables. The center of the bottom face of the cylinder should be at the center of the red dot). As a reference you have the USB connectors which can be used to get the right dimensions of the scene. You should do this placement on all the images given in the set. The placement geometry calculation can be done off-line (you should explain how you have done it and why you have done it that way), but projection should be done programatically.

Handin you code and results in a report document (pdf).