Programming Assignment – Computer Vision
Visual Computing (Fall 2016)
Due: November 9, 2016

You will be working in groups of at least 2 in this assignment. Maximum of three are allowed in a group. You are not allowed to work alone. If you cannot find group members by the end of this week, please send an Email to TA.

Notice: This assignment requires some efforts and an early start is suggested.

Goal: To calibrate the camera positions and extract the unknown geometry.

Please download the zipped directory. In this directory, you have been provided with images taken from multiple view points of a horse and the calibration pattern data. The file *calibration.doc* provides some of the essential 3D coordinates for blocks' corner points that you could see in the 2D images.

Choose 2 subsets of these images – each comprising of 3-6 images. Make sure that each of these sets is chosen such that every part of the horse is viewed by at least 2 images. You can choose more images if you want – an efficient implementation could improve results with increasing number of images. The assignment is to write a program to (a) recover the camera calibration matrix and (b) extract the depth of the horse and then test your program on the 2 subsets of images you have created.

Finding the camera calibration matrix

Use the calibration pattern data to generate the 3D to 2D correspondences for each image. Use this data to find the camera calibration matrix from each image.

Finding Depth
This consists of two parts.

(a) First write a function so that when you click on a point on one of the images in your set, an epipolar line is computed and showed on the other two images. This line will limit your search making it easier for you to hand-pick correspondences.
(b) Hand-pick corresponding points across the different images using the epipolar line tool. Use a multi-view formulation for the depth reconstruction process. You may not find the same 3D point in all the images in your set of images, so you may have to select the views where the particular point is visible.

Using such a semi-automatic process aided by the epipolar line tool, extract around 150 data points for the horse. This would provide a nice 3D mesh representation.

Deliverable
As deliverable prepare a document which provides the following for each of the 2 subsets you have used.

a) All the pictures used in the subset

b) Show 3 examples of the epipolar line tool by showing the point clicked on one image and the corresponding line in the other images.
c) Plot the position and orientation extracted from each of the camera calibration matrix to show the camera positions from which the pictures were taken. For showing orientation plot the three axes of the camera's local coordinate system.
d) In the same plot, plot the **3D mesh** recovered from this set of pictures by your depth estimation method.

Finally, create one plot where you plot the **3D points** recovered from one set of images in red and the 3D points recovered from another set of images in blue. If you have done everything accurately, you should see only one horse even after merging the data from multiple image sets. Plot the camera positions and orientations from the two subsets using the distinguishing colors of red and blue in the same plot.