Computer Vision I

Homework 4

Given October 12, 2018, Due: October 19, 2018

Homographies

1. (Old exam problem) The planar facade of a building is captured in an image taken by a camera. Assume this pane corresponds to the world coordinate frame's $Z = 0$ plane, and scene point (X, Y) on the building projects to image pixel coordinates (u, v).

   (a) What is the planar projective transformation that describes the relationship between (X, Y) and (u, v)? Give your answer using homogeneous coordinates.

   (b) How many degrees of freedom does this transformation have?

   (c) How many point correspondences are required to determine this transformation?

   (d) Would having more correspondences that your answer above be helpful in any way? If no, briefly explain why not. If yes, explain how they could be used.

   (e) Give one invariant of a planar projective transformation.

   (f) Give one invariant of a planar affine transformation that is not an invariant for a planar projective transformation.

   (g) If the building has sets of lines on it running parallel to both the X and Y axes, how could we use the corresponding lines in the image to determine if the building plane is parallel to the image plane?

2. A template g is matched against an image f, both shown below:

   f =

0	0	0	0	0	0	0	0
0	2	4	2	0	0	0	0
0	2	0	0	0	0	0	0
0	0	2	0	0	0	2	0
0	0	0	0	0	0	2	0
1	2	1	0	0	2	4	2
0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0

   g =

1	2	1
0	1	0
0	1	0

   (a) Find the SSD between f and g .

   (b) Find the Correlation between f and g .

   (c) Find the Normalized Correlation between f and g