Homography

In the field of computer vision, any two images of the same planar surface in space are related by a homography (assuming a pinhole camera model).

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Mathematical definition

Homogeneous coordinates are used, because matrix multiplication cannot directly perform

Given:

$$p_a = \begin{bmatrix} x_a \\ y_a \\ 1 \end{bmatrix}, p'_b = \begin{bmatrix} w'x_b \\ w'y_b \\ w' \end{bmatrix}, \mathbf{H}_{ab} = \begin{bmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \\ h_{31} & h_{32} & h_{33} \end{bmatrix}$$

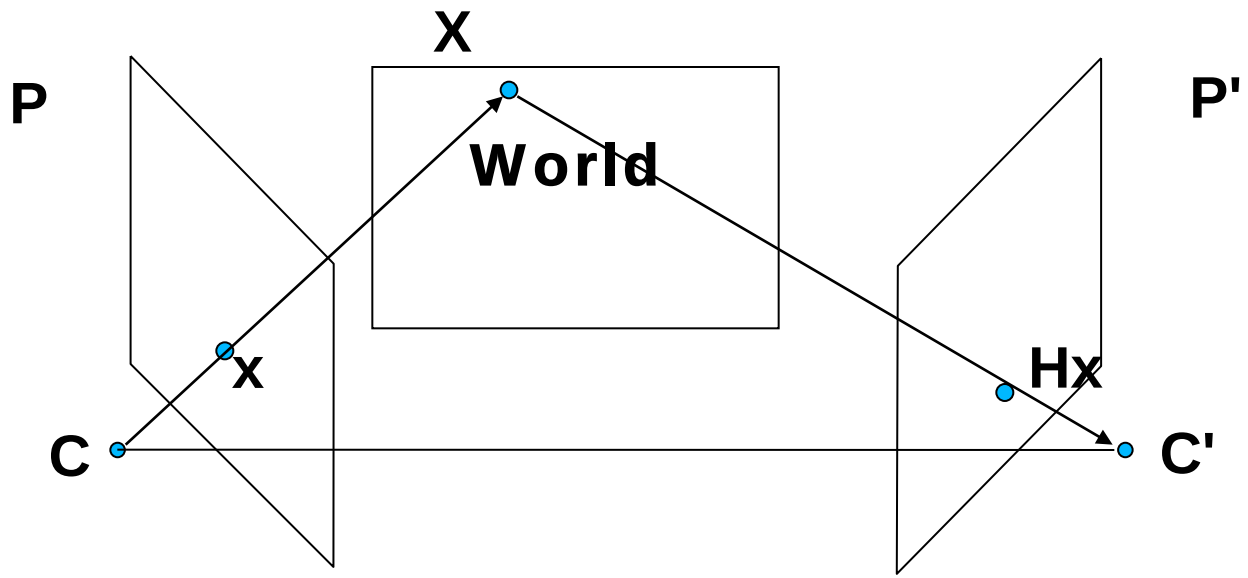
Then:

$$p'_b = \mathbf{H}_{ab} p_a$$

From Wikipedia

$$\begin{bmatrix} 8.7976964e\text{-}01 & 3.1245438e\text{-}01 & -3.9430589e+01 \\ -1.8389418e\text{-}01 & 9.3847198e\text{-}01 & 1.5315784e+02 \\ 1.9641425e\text{-}04 & -1.6015275e\text{-}05 & 1.0000000e+00 \end{bmatrix}$$

Plane Transfer Homography



- Because we assume the world is a plane, x and transferred points x' are related by a homography.
- If world plane coordinate is p, then
- $x = Ap$ and $x' = A'p$.
- $x' = A'A^{-1}x$.

RANSAC for Fundamental Matrix

Step 1. Extract features

Step 2. Compute a set of potential matches

Step 3. do

- Step 3.1 select minimal sample (i.e. 7 matches)
- Step 3.2 compute solution(s) for F

} (generate hypothesis)

- Step 3.3 determine inliers (verify hypothesis)

until a large enough set of the matches become inliers

Step 4. Compute F based on all inliers

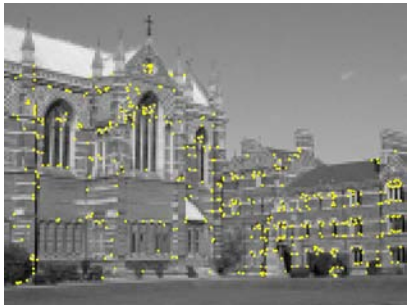
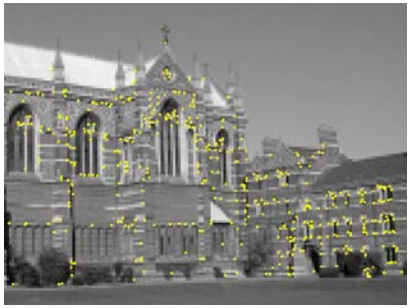
Step 5. Look for additional matches

Step 6. Refine F based on all correct matches

$$\Gamma = 1 - (1 - \left(\frac{\#inliers}{\#matches}\right)^7)^{\#samples}$$

Example: robust computation

from H&Z

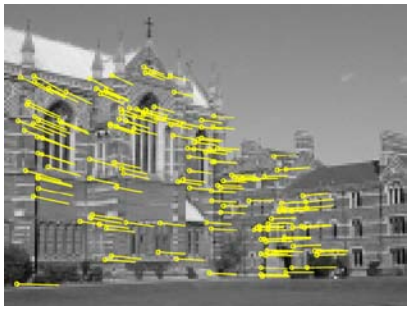
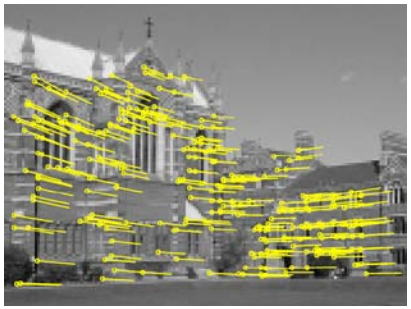



Interest points (500/image) (640x480)


Putative correspondences (268) (Best match,SSD<20, 320)

Outliers (117) (*t*=1.25 pixel; 43 iterations)

Inliers (151)

Final inliers (262)