1.1 p = M1*P, q = M2*P where M1 and M2 are both 3x4 matrix so there exists an equation M1 = H*M2.

1.2 Because

x1 =K1* $[I\ 0]$ *$[\mu, \nu, \omega, 1]^T$ = K1*$[\mu, \nu, \omega]^T$

x2 = K2*[R 0]* $[\mu, \nu, \omega, 1]^T$ = K2*R*$[\mu, \nu, \omega]^T$

K1, K2 and R are all 3x3 matrix and the 3D translation is zero vector, there should exist an $H = K2^{-1} * R * K1$ which satisfies $x1 \equiv H * x2$ and this H is a 3x3 matrix.

1.3.1 There's 8 DOF.

1.3.2 8/2 = 4 So we need 4 pairs of points to solve h.

1.3.3 Let's assume that $x1 = \alpha * H * x2$. Then we can get

$$\begin{bmatrix} x1 \\ y1 \\ 1 \end{bmatrix} = \alpha \begin{bmatrix} h1 & h2 & h3 \\ h4 & h5 & h6 \\ h7 & h8 & h9 \end{bmatrix} * \begin{bmatrix} x2 \\ y2 \\ 1 \end{bmatrix}$$

This means that $x1 = \alpha(h1 * x2 + h2 * y2 + h3)$, $y1 = \alpha(h4 * x2 + h5 * y2 + h6)$, $1 = \alpha(h7 * x2 + h8 * y2 + h9)$.

Divide the first and second equation by the third one and rearrange it. We can get

h7*x2*x1+h8*y2*x1+h9*x1-h1*x2-h2*y2-h3 = 0

h7*x2*y1+h8*y2*y1+h9*y1-h4*x2-h5*y2-h6 = 0

So finally, we can get Ai = $\begin{bmatrix} -x2 & -y2 & -1 & 0 & 0 & 0 & x2*x1 & y2*x1 & x1 \\ 0 & 0 & 0 & -x2 & -y2 & -1 & x2*y1 & y2*y1 & y1 \end{bmatrix}$

1.4 When we rotate 2θ, the transformation matrix is $\begin{bmatrix} cos2\theta & -sin2\theta \\ sin2\theta & cos2\theta \end{bmatrix}$ = $\begin{bmatrix} cos^2\theta - sin^2\theta & -2cos\theta sin\theta \\ 2cos\theta sin\theta & cos^2\theta - sin^2\theta \end{bmatrix} = h^2$

1.5 Because there's no way for a 2x2 matrix to represent translation.

1.6 Because when we apply a projective transformation H to a line, the projective transformation of this line L is $L' = H^{-T} * L$. Since all the points that pass through the line L must satisfy the line equation $x^T * L = 0$ and this equation can be reformed to $x^T * H^T * H^{-T} * L = 0$. And $x' = H * x$, so we can get $x' * L' = 0$. It's still a line.

2.4.1

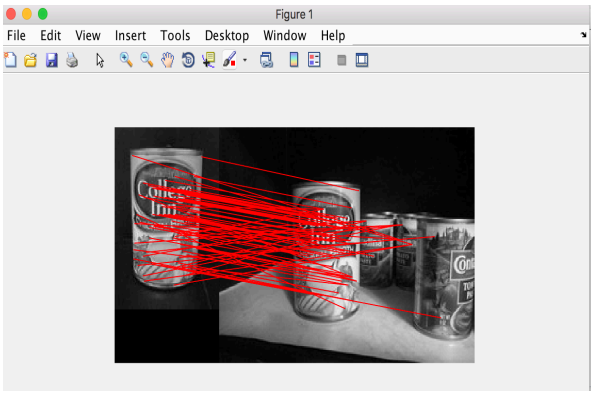

figure1. ratio = 0.98

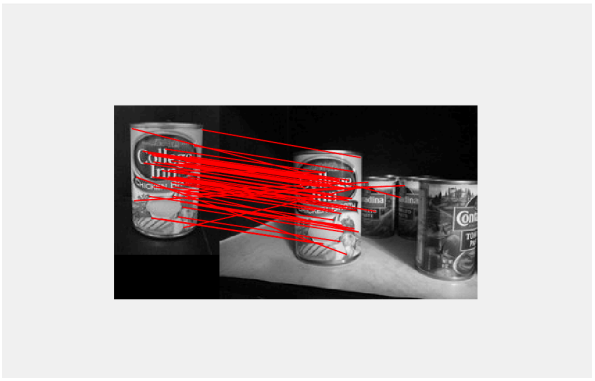

figure2. ratio = 0.9

The result which ratio = 0.9 seems better, because the noise ratio is lower than the result whose ratio is 0.98.

3.4.4

This is because the size of the hp_cover and cv_cover is not the same. We should resize the hp_cover to fix this.

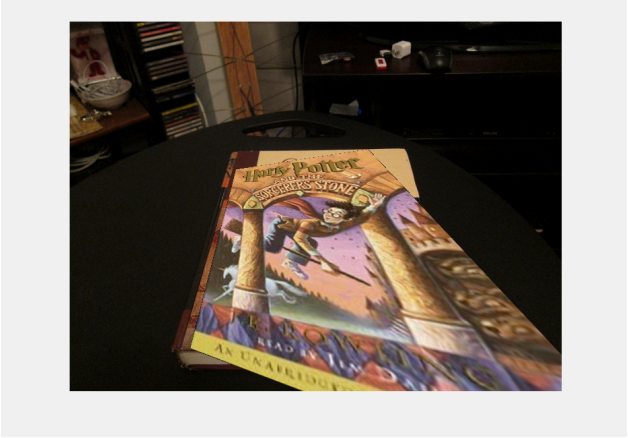

figure3. result image

The final H is $\begin{bmatrix} 0.225 & -0.393 & 247.403 \\ -0.229 & 0.043 & 219.758 \\ -7.543e^{-04} & 0.0013 & 1 \end{bmatrix}$.