

CSE166 – Image Processing – Homework #6

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<http://www-cse.ucsd.edu/classes/fa09/cse166>

Due (in class) 11:00am Tuesday Nov. 24, 2009.

General Homework Guidelines

- Use the Cover Sheet provided.
- Please attach all code that you use. Attach code at end of submission.
- In general try to keep your answers concise. Use as many words as you need and no more. Also work on your presentation skills. This means organize your plots and displays. Always use titles and add captions when appropriate. *Points will be awarded for clarity and presentation.*

Written exercises

1. Restate the definition (e.g., from your old linear algebra textbook) of *positive semidefinite*. Prove that the second moment matrix (as defined in class) is positive semidefinite.
2. The *homogeneous coordinates* for a point with cartesian coordinates (x, y) are obtained by adding a third coordinate of 1 to the cartesian coordinates, i.e. (x, y) becomes $(x, y, 1)$. Show how one can solve for the affine parameters all at once (instead of separating out the translation part as we did in class) using homogeneous coordinates and the following parameter matrix (in place of A and \mathbf{t}):

$$B = \begin{bmatrix} a_{11} & a_{12} & t_1 \\ a_{21} & a_{22} & t_2 \\ 0 & 0 & 1 \end{bmatrix}$$

Matlab exercises

1. Interest Point Detection.
 - (a) Compute the eigenvalues $(\lambda_{max}, \lambda_{min})$ of the Förstner interest operator for the checkerboard image in the figure for GW Second Edition Problem 10.18(right). Use a window size of 3×3 . On top of the original checkerboard image, plot the coordinates (use the '.' pointmarker) of all pixels for which $\lambda_{min} > \tau$, with τ set to 80% of the maximum value of λ_{min} over the whole image. The resulting coordinates should fall on or near the corners of the squares in the image.
 - (b) Repeat the above steps for the fingerprint image in GW Second Edition Figure 10.29(a) or GW Third Edition Figure 10.38(a); this time set τ to 20% of the maximum value of λ_{min} over the whole image. The resulting coordinates should fall on or near the minutia points of the fingerprint, but due to noise, there will also be many spurious responses. As a final step, compute ϕ , the angle of the principal eigenvector for each pixel, and display it as an image.

Things to turn in:

- Code listing and plots for each step.