CS294-6 **Fall 2006**

Problem Set #1

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Issued: September 6 **Due: September 20 in class**

Primary Reading: Chapter 1, 3, and 4 of MaSKS.
Advance Reading: Appendix A of MaSKS.
Note: A homework set in this class typically consists of two parts. The first part consists of exercises from the textbook. In each set, there will be a problem with a (*) notation at the start to indicate that it is considered harder than the requirements for the course. Accordingly, the points for solving this problem are reduced.

The second part consists of MATLAB programming exercises. Sufficient programming skills on MATLAB and its Image Processing Toolbox are required, but you can always teach yourself u sing the documentation and demos in MATLAB. **Please print out your codes, source images, and results**.

Problems:

1. **Exercise 3.6** (10 points)
2. **Exercise 3.9** (10 points)
3. **(*) Exercise 4.7** (5 points)
4. **Programming Exercise 4.8** (10 points)
   Hint: Useful MATLAB commands: `imread`, `imshow`, `im2double`, `mat2gray`, and (of course, most useful) `help your_command_here`.
5. **Lab Tour and Programming Exercise** (10 points)

   - Objectives:

     Analyze fixed pattern noise of CCD sensors in a stereo cluster. Compare the results between two cameras in the cluster. Analyze average noise of individual pixels, average intensity per column, power spectrum and the histograms (refer to [1]).
   - Methods:

     CCD camera noise has three major components: photon noise, read noise and fixed pattern noise [1]. Examine the noise by capturing 30 dark images on two different cameras. The dark images are the response of the cameras with no access of light to the CCD (the lens is covered with a lens cover).

     Next, analyze photo response non-uniformity from captured 30 flat-field images. Flat-field images are captured at homogeneous illumination with the lens taken off. A diffuser is used in front of the CCD. The camera shutter/gain is set at values near saturation.
   - Organization:

     Students should come to Professor Bajcsy's lab at 475 Hearst Memorial Mining building and collect image data from a multi-camera vision system, and anaylize the camera noises as described in the class.

The lab session will be monitored by Dr. Gregorij Kurillo [gregorij@EECS.Berkeley.EDU]. Three time slots will be offered: Sep 13 (Wed), 14 (Thur), and 18 (Mon). The session starts at 10:00am sharp and concludes at 10:30am. If you cant make these slots please contact Dr. Kurillo. A bonus lab tour will be also offered by Dr. Kurillo.

References

[1] G. Kamberova, R. Bajcsy, Sensor errors and the uncertainties in stereo reconstruction, in: K.W. Bowyer, P.J. Phillips, eds., Empirical Evaluation Techniques in Computer Vision, pp. 96-116. IEEE Computer Society Press, 1998.