CS 685 Homework 3 (October 15)

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1. (7) **Camera calibration with a 3D known object** . Download from cs.gmu.edu/∼kosecka/cs685/data the file calibration-dataset.mat. (this is possible to load this to python using scipy.io). The file contains 3-D coordinates $\mathbf{X}$ of n points in the world coordinate frame and their image (pixel) coordinates in $\mathbf{x}$. Write a Matlab function, which computes the relative displacement $(R, T) \in SE(3)$ between the world coordinate frame and the camera frame and the intrinsic camera parameter matrix K, used to generate this data set. Hand in the result for this particular data set, as well as printout of the Matlab function used to compute it. The function can be called as follows:
   `[R,T,K] = calibration2Dto3D(X,x)`

2. **Convolution** (2) Install OpenCV on our computer. Given an image generate a smoothed image of the same size, which is obtained by convolution with a box filter of varied size (3x3 7x7, 11x11,1x7 and 7x1). Visualize the results and comment on the effect of the size of the filter on the final result. Post the code and the images on the web site (you can use the build in convolution functions of MATLAB and OpenCV). What is the complexity (in terms of number of operations, additions and multiplications) of the convolution operation as a function of image size and filter size ?

3. **Stereo** (7) Given the stereo pair of two (scan-line aligned images), compute the disparity map of the stereo pair. Use SSD as a patch similarity measure with a fixed window of your choice. Post the code and resulting color coded disparity map and comment on the quality of your results. In case you decide to do this in Matlab you can reduce the resolution of the image by factor of 2 to speed things up. The image pair tsukuba_l.png and tsukuba_r.png can be found at cs.gmu.edu/∼kosecka/cs685/data/.