CS485/685 Computer Vision

Spring 2009 – Dr. George Bebis

Programming Assignment 3

Due Date: 4/23/2009

In this programming assignment, you will compare the two versions of the **8-point** algorithm discussed in class (i.e., see page 156) for estimating the fundamental matrix. Although very simple, the original 8-point algorithm (herein called *"vanilla 8-point algorithm"*) can be very unstable if we do not normalize the coordinates of the corresponding points. Hartley has proposed a simple normalization procedure to make the 8-point algorithm more stable (herein called *"normalized 8-point algorithm"*). Read and understand Hartley's paper "**In Defense of the Eight-Point Algorithm**", *IEEE Transactions on Pattern Analysis and Machine Intelligence* 19(6): 580-593 (1997). The paper can be downloaded from the course's webpage.

Data

The data to be used in your experiments (same to those in the paper) have been posted on the course' s webpage:

- House stereo pair and corresponding points (Fig 1 in paper)
- Corridor stereo pair and corresponding points (Fig 4 in paper)
- Calibration jig and corresponding points (Fig 5 in paper)

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Vanilla eight-point algorithm

Implement the vanilla eight-point algorithm as described in our book.

Normalized eight-point algorithm

Implement the normalized eight-point algorithm as described in Hartley's paper. Consider the case of isotropic scaling only.

Experiments and Comparisons

We will follow the experimental and evaluation procedure described in Section 7 of Hartley's paper. Your objective would be to verify some of the results presented in the paper. **First,** reproduce the graph shown in Fig 6 (left) for the house pair. **Second,** reproduce the results shown in Figure 8 for the house, calibration jig, and corridor pairs. The vertical axis corresponds to the reprojection error (i.e., defined in Section 7.1). This

is similar to the reprojection error we computed in assignment 3 to test the camera calibration method.

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Third, compute the epipoles for each stereo pair. **Fourth**, compute the epipolar lines and overlay them with the images as shown in Figures 1, 4, and 5.

What to turn in

For each programming assignment, you are to turn in a brief report including a print-out of your source code. Your report should include the following: **(1)** methodology (i.e., explanation of the methods used), **(2)** description of the experiments, **(3)** results (i.e., include graphic output of your results), **(4)** explanation of results (i.e., justify your results), and **(5)** a brief summary of what you have learned. Organize your report nicely, label all sections and figures. Neat reports and extra work will win extra credit.