CS 532: Homework Assignment 2

Due: March 5th 6:00PM

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Collaboration Policy. Homeworks may be done individually or in teams of two. It is acceptable for students of different teams to collaborate in understanding the material but not in solving the problems. Use of the Internet is allowed, but should not include searching for previous solutions or answers to the specific questions of the assignment. I will assume that, as participants in a graduate course, you will be taking the responsibility of making sure that you personally understand the solution to any work arising from collaboration.

Late Policy. 3% penalty for partial 24-hour period of delay.

Submission Format. Electronic submission on Canvas is mandatory. Submit in a zip file, a pdf file:

- source code (excluding libraries),
- points used in the computation,
- resulting images,
- at most one page of text explaining anything that is not obvious. Also include the

code and output images/videos separately.

Problem 1: Teddy Stereo (40 points)

Download the Teddy stereo pair and ground truth from the course web page and implement a winner-take all stereo algorithm using the rank-transform (see Notes 3).
Compute the rank transform in 5-by-5 windows. Then, compute disparity maps on the rank-transformed images, aggregating the absolute differences of rank in 3-by-3 and 15-by-15 windows.
Show the resulting disparity maps in the report. There is no need to store or show the rank-transformed images. Pixels for which any window falls out of the image boundaries can be set to black. The disparity range for these images is from 0 to 63.

Read the ground truth disparity map and divide the values by 4 and round to the nearest integer. Compute the percentage of bad pixels (error rate) by counting the fraction of pixels that differs by more than one disparity level from the ground truth (divided by 4). Differences equal to 1 are considered acceptable. Report the error rates.

Problem 2: Fish Stereo (60 points)

Modify the image-rendering code provided for the first homework to render a pair of rectified images and compute the disparity map between them.

Step 1. Modify the Rendering code. You will need to understand how the example code works in more details and identify where and how to change it to achieve new capture examples. The required modifications to the existing code are:

a) Reduce the image pixel resolution to ¼ of the default size
b) Change the internal camera parameters so that the horizontal and vertical fields of view remain unchanged
c) Disable the part of the rendering code performing the 2D max_filter operation (used to "fillin" blanks)

Step 2. Design the Stereo Geometry and Disparity Search Parameters. Control the pose of the camera (i.e. R and t) to generate/render a pair of rectified images from which to compute disparity. To do so you will need to analyze the scene geometry and camera positioning to make choices determining the following properties:

- Stereo camera baseline
- Disparity range to evaluate

Explain in your report how you justified your choices, explaining what are the minimum and maximum depths your disparity search is considering

Step 3. Run Stereo.

a) Convert the RGB image to greyscale using the following formula

Grey_value = (0.3)Red_Channel + (0.59) Green_Channel + (0.11)Blue_Channel.

b) Run the stereo method developed for problem 1 using a suitable range for disparities. Note the disparity range depends on the 3D scene and the camera baseline value. Show the resulting disparity maps in the report.