COMP 558 Assignment 3 (extra question)

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Posted: Thurs. November 26, 2020

Due: Sunday Dec 6, 2020 (by midnight, 11:59pm)

Instructions

If you choose to do this part of Assignment 3 then it will be worth 4% of your final grade, and Assignments 1, 2, 3 (original) will each be worth 12%. If you choose not to do this part of Assignment 3 then your three Assignments will each be worth 40/3 % of your final grade.

You must submit your answers to this part of Assignment 3 to the "Assignment 3 extra" folder. If you submit to the regular Assigment 3 folder, then we will ask you to resubmit and you will be penalized.

This part of Assignment 3 will not be accepted beyond the deadline of Sunday Dec. 6.

Question 3 (40 points)

In lecture 20, we introduced the concept of a disparity space. This is a 2D space (x_{left}, x_{right}) in which one can label points in the scene according to whether they are visible to neither camera, one camera, or both cameras. Here you will explore the idea of a disparity space in a different way.

Choose a stereo pair from the Middlebury stereo data set. The pairs are already rectified so that the epipolar lines are horizontal and corresponding points lie on the same row in the two images. Convert the two images to gray level before doing the following.

Choose a row that has a variety of disparities and some textured regions. Make a new image whose intensities are the absolute difference of the intensities of the left and right images, namely

$$\left| I_{left}(x_{left}, y_0) - I_{right}(x_{right}, y_0) \right|.$$

The coordinates of the new image are the pairs $(x_{left},\ x_{right})$. The intensities in the new image should be near 0 for corresponding points since the intensities of corresponding points should be roughly the same.

The Middlebury stereo pairs have a limited range of disparities. So the absolute intensity difference image described above allows for a large range of disparities $d = x_{left} - x_{right}$. It is common to reduce the range of disparities by circularly rotating the rows or columns to obtain an image whose coordinates are $(x_{left},\ d)$ or $(x_{right},\ d)$, and to crop this new image so that it covers only a limited range of disparities, namely the disparities in the scene. These new images are some called *disparity space images.* Make such an image using the coordinates $(x_{left},\ d)$.

What to submit in your PDF:

- The two original images (grayscale) with a chosen row indicated.
- An image with gray color map of absolute intensity differences plotted on the $(x_{left},\ x_{right})$ axes. *Describe and account for any structure that you observe.*
- A plot that contains five subplots:
    - A cropped horizontal band of the left image containing 20 rows centered on the chosen row.
    - A cropped horizontal band of the corresponding rows from the right image
    - A (superimposed) plot of the intensities of the left and right image on the chosen row; use a different color for the intensities of the two images;
    - A plot of the actual disparities on the chosen row for the left image, i.e. the Middlebury database also provides left and right disparity images
    - A plot of the disparity space image defined on $(x_{left},\ d)$.
- A discussion of the fifth/last element of the subplot (the disparity space image) which relates it to the other subplots: Are the actual disparities visible to the eye in the disparity space image (as a dark curve)? What happens when there are monocular points? What happens when there are uniform intensity regions?