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Class: ECE 2390 - Image Processing and Computer Vision

Homework Assignment 2: Window-based Stereo Matching

NOTE: Before running my code, please install progressbar by running “pip install progressbar” - it will display a progress bar for each part and estimate how long it will run.

```
C:\Users\Zhanneta\GitHub\Image-Processing-and-Computer-Vision-with-Python\ps2_python_Plokhovska_Zhanneta>python ps2.py

-----------------------1-A-----------------------
100% (128 of 128) |###########################################################| Elapsed Time: 0:02:18 Time:  0:02:18
100% (128 of 128) |###########################################################| Elapsed Time: 0:02:08 Time:  0:02:08
-----------------------2-A-----------------------
100% (511 of 511) |###########################################################| Elapsed Time: 5:32:36 Time:  5:32:36
100% (511 of 511) |###########################################################| Elapsed Time: 5:42:00 Time:  5:42:00
-----------------------3-A-----------------------
100% (511 of 511) |###########################################################| Elapsed Time: 3:46:19 Time:  3:46:19
 13% (69 of 511) |########                                                    | Elapsed Time: 1:22:26 ETA:   8:54:43
```

NOTE: Parts 2 through 5 may take over 3 hours to run each because python doesn’t work well for these types of applications and “real images” are large.

NOTE: Some results in this report have been generated using downsized input images to improve runtime. These downsized images are located under input folder and named “*_resized.png”.

NOTE: You can run my code using original or downsized images. Original size is the default. If you would like to run my code using downsized image, you can say “python ps2.py –resize”.

1. Basic stereo algorithm on simple grayscale image
    a. Ps2-1-a-1/2.png

2. Basic stereo algorithm on real image
    a. Ps2-2-a-1/2.png

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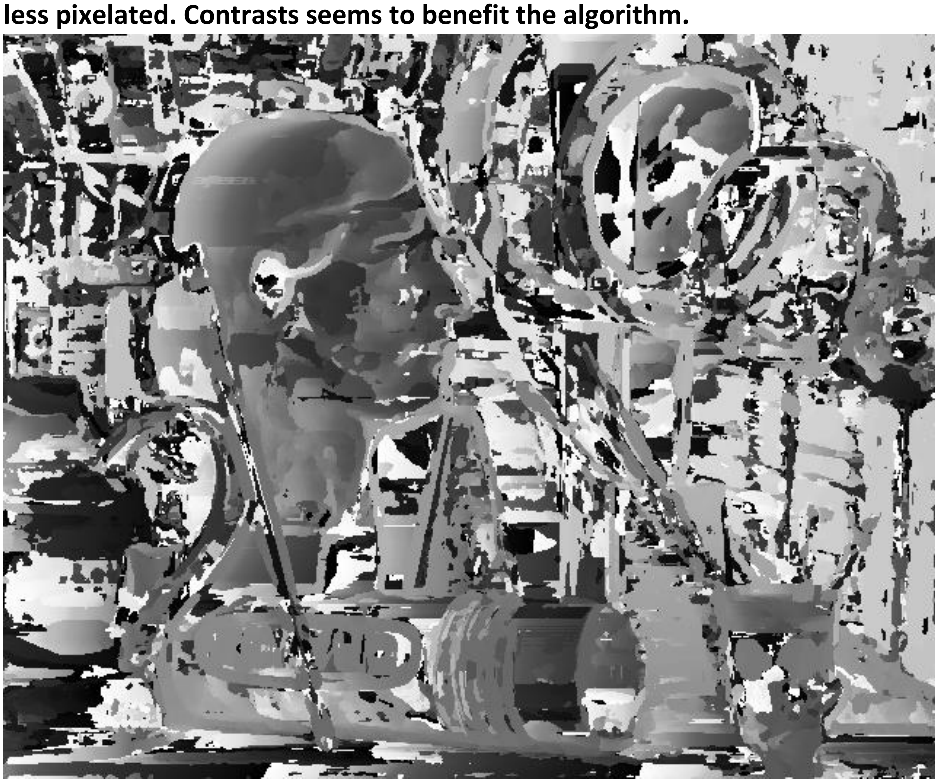
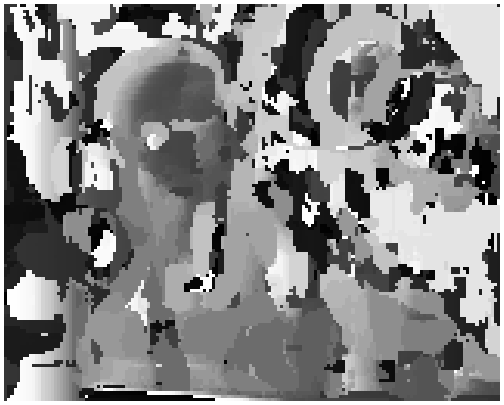
b. Compare your results to pari1-D_dropL/R.png
In the ground truth you can clearly tell one object from another – every object has its own depth (darkness of object background) and it's consistent throughout the object. However, in the images from 2A you can only see some resemblance of these objects but can't tell clearly where one object ends and another one begins. The images in 2A also capture a lot of details from the background (e.g. patterns in the paintings) whereas ground truth only concentrates on the shapes of the main objects.

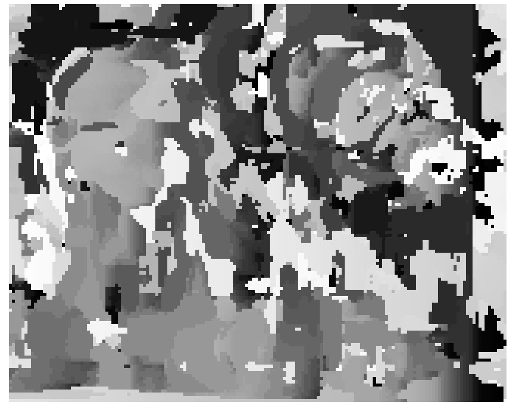
3. Basic stereo algorithm on simple grayscale image with added noise/brightness
   a. Ps2-3-a-1/2.png: analysis of results compared to question 2
   Results from 3A are more pixelated and are less accurate in terms of capturing depth of the objects.

b. Ps2-3-b-1/2.png: analysis of results compared to question 2
Results from 3B capture a lot more differences between L and R than in 2A and 3A. Object became more distinct and uniform compared to 2A and 3A and images seem less pixelated. Contrasts seems to benefit the algorithm.

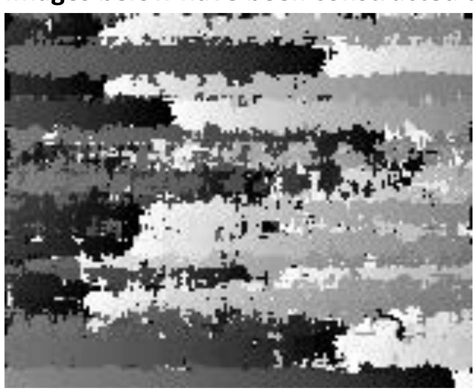


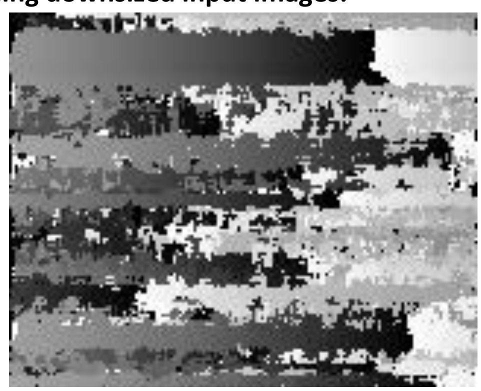
Images below are ps2-3-b-1/2.png and they have been constructed using downsized input images:



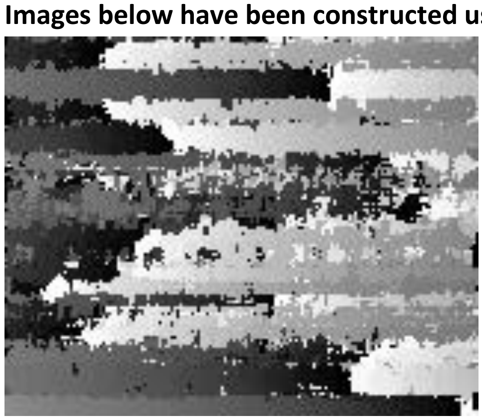


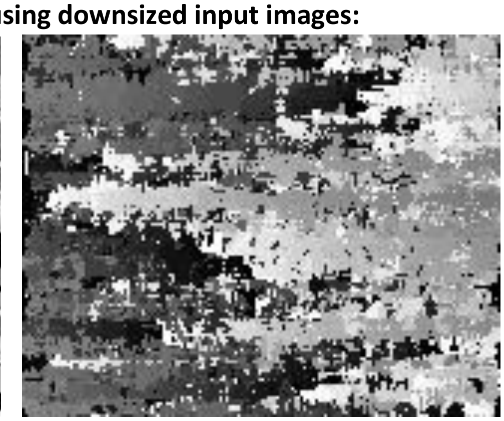
4. Normalized correlation
    a. Ps2-4-a-1/2.png: describe how it compares to SSD and to ground truth
    Results from 4A seem uninformative but I believe this is because I used downsized input images.
    Images below have been constructed using downsized input images:

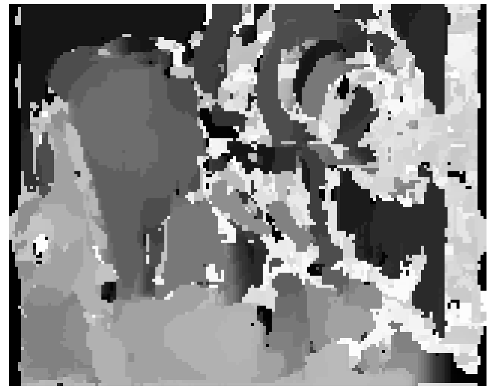




    b. Ps2-4-b-1/2/3/4.png: analyze results comparing original to noise and contrast-boosted images
    Results from performing normalized correlation on noisy images shows much improved results when using contrast whereas noise makes the results seem uninformative and pixelated.
    Images below have been constructed using downsized input images:





5. Normalized correlation on smooth/sharp/etc. images
    a. Ps2-5-a-1/2.png: analyze what it takes to make stereo work using window-based approach
    Image inputs for 5A have been smoothed and contrasted to improve object visibility and to make the results look more like the ground truth. In order to get good results one has to use many combinations of different properties, such as stereo window size, contrast intensity, Gaussian blur window size, and sigma. Different combinations of these properties will produce different results. These properties can be chosen based on what type of information one is trying to get from analyzing a set of stereo images. Images below have been constructed using downsized input images: