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**ECE 2390 – Fall 2021**

**Problem Set 2 Report**

TEXT RESPONSES

2b: My results capture some of the same general shapes as the ground truth, but are much more spotty than the ground truth images. For example, the head sculpture overall is fairly clearly defined, but when looking at the overall details of the face, there is too much noise to be very accurate on a point-by-point basis.

3a: Adding in the Gaussian noise seems to have made my results worse. I can barely make out the head sculpture and the rings, for example, because all of the added Gaussian noise has made it difficult to track the exact disparity of a given patch.

3b: Increasing the contrast of one of the images seems to have improved the results in some respects, but worsened the results in others. For example, the features of the head sculpture are more accurately captured, but the rings look much worse. Increasing the contrast seems to have improved the results for the points that are part of a relatively smooth and large texture, because they have not moved very far. However, as is the case for the rings, it is harder to capture their disparity accurately. This may be because increasing the contrast increases the variance of pixel values throughout the image, causing the variance of the SSD values to increase as well. It is more likely that the lowest SSD corresponds to the correct pixel, but when the two do not correspond, the error is more likely to be pronounced.

4a: The normalized correlation version seems to be better than the SSD version; it captures more of the notable figures in the image with less noise. Notably though, I had to increase the window size all the way to 11x11 for it to even work acceptably. The SSD version worked at a passable level with a window size of 3x3.

4b: As with the SSD algorithm, the Gaussian noise version seems to perform much worse than the regular version. In the same way, the increased-contrast version seems to perform better than normal and better than the SSD high-contrast version. Boosting the contrast appears to, again, help the algorithm more accurately capture the high-level bounds of the image.

5a: One of the most important parameters for making stereo correspondence work with the window approach is the size of the window. After changing the value of the parameter multiple times, I ultimately decided to use a constant 3x3 window throughout all of the problems in this assignment. I think this was best, given the size of the objects to be captured throughout the image. Keeping the window size constant also allowed me to more directly compare the results of the different filters applied to the images. Smoothing out the images with a Gaussian (or other) filter likely does not help with stereo correspondence, since it decreases the variability throughout the image and makes it harder to find exact matches for windows. Along the same line of reasoning, increasing the contrast of an image seems to slightly improve the results of stereo correspondence, when comparing to ground truth. Increasing the contrast makes it more likely that an entire object will be recognized, because it increases the variance of the pixel values, thus making it more likely that the lowest SSD/highest correlation is the correct one. However, this also leads to more volatility in the algorithm, as “misses” in matching the window to a patch can be more pronounced. There are also properties native to the image that may make it more suitable for stereo correspondence, as well. If the image has a lot of unique textures, it will be relatively easy to create a disparity map. The smoother an image gets, the more difficult it becomes to reconstruct a disparity map for it. I also think that the disparity\_cap parameter I used throughout is useful for visualizing the results in an intuitive manner, though it is not a true hyperparameter since it doesn’t really affect the result. The disparity\_cap parameter simply acts as a low pass filter to filter out the noisy disparity, and leads to a more understandable image.

IMAGE OUTPUTS

Ps2-1-a-1.png

Graphical user interface

Description automatically generated with low confidence

Ps2-1-a-2.png

Logo

Description automatically generated with low confidence

Ps2-2-a-1.png

A picture containing text

Description automatically generated

Ps2-2-a-2.png

A picture containing text

Description automatically generated

Ps2-3-a-1.png

A picture containing text, outdoor, megalith

Description automatically generated

Ps2-3-a-2.png

A picture containing tree, outdoor, standing, plant

Description automatically generated

Ps2-3-b-1.png

A picture containing text, engine

Description automatically generated

Ps2-3-b-2.png

A picture containing text, tree

Description automatically generated

Ps2-4-a-1.png

A picture containing text

Description automatically generated

Ps2-4-a-2.png

A picture containing text, tree

Description automatically generated

Ps2-4-b-1.png

A picture containing text, tree, outdoor, poplar

Description automatically generated

Ps2-4-b-2.png

A black and white photo of a tree with snow on it

Description automatically generated with low confidence

Ps2-4-b-3.png

A picture containing text

Description automatically generated

Ps2-4-b-4.png

A picture containing text, tree

Description automatically generated

Ps2-5-a-1.png

A picture containing text

Description automatically generated

Ps2-5-a-2.png

A picture containing black, white

Description automatically generated