CSE463 HW3 (Optional)

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1 Introduction

In this homework, a stereo correspondence algorithm was implemented using oversegmented stereo images. The datasets from the Middlebury Stereo Vision Page (Sawtooth, Venus, Bull, Poster, Barn 1, Barn 2) were used. The goal was to match segments between the left and right images along the epipolar lines and compare the results with the ground truth disparity maps.

2 Oversegmentation Methods

Two oversegmentation methods from OpenCV were utilized:

- **SLIC (Simple Linear Iterative Clustering)**: SLIC clusters pixels in the CIELAB color space, producing superpixels with compact and uniform sizes. The algorithm iteratively refines the clusters to minimize the distance between pixels and their corresponding cluster centers.
- **Quickshift**: Quickshift is a mode-seeking algorithm that segments images based on local density estimation. It operates by linking each pixel to the nearest pixel of higher density, effectively creating clusters of pixels.

3 Stereo Correspondence Algorithm

The stereo correspondence algorithm matches image segments between the left and right images along the epipolar lines. The steps of the algorithm are as follows:

1. **Segment the Images**: Apply SLIC and Quickshift oversegmentation to both the left and right images.

2. **Compute Mean Colors and Rows**: For each segment in the left and right images, compute the mean color and the mean row coordinate.

3. **Match Segments**: For each segment in the left image, find the best matching segment in the right image by comparing the mean colors and ensuring they are on the same epipolar line (or close to it). The Sum of Absolute Differences (SAD) is used as the matching criterion.

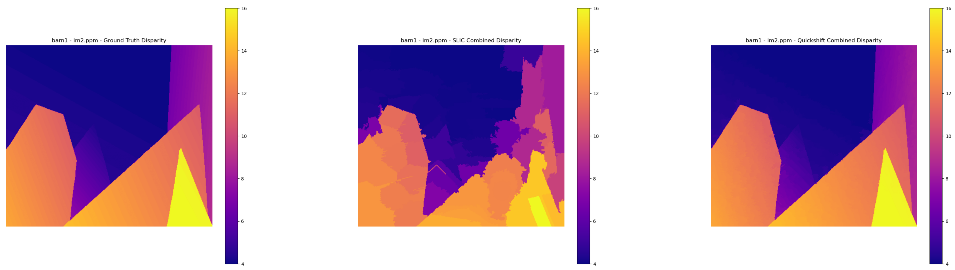
4. **Estimate Disparity**: For each matched segment pair, estimate the disparity value and aggregate the results to form a combined disparity map.

4 Results and Comparison

The algorithm was run on the six datasets and the Mean Absolute Error (MAE) between the estimated disparity maps and the ground truth disparity maps ('disp2.pgm' and 'disp6.pgm') was computed. The MAE values provide a numerical comparison of the results with the ground truth.

5 Intermediate Results

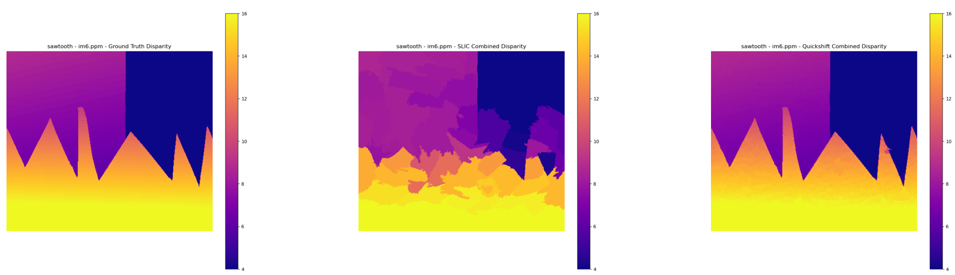
5.1 Barn 1 - im2.ppm



(a) Ground Truth (b) SLIC (c) Quickshift

Figure 1: Barn 1 - im2.ppm: Comparison of Ground Truth, SLIC, and Quickshift disparity maps.

5.2 Sawtooth - im6.ppm



(a) Ground Truth (b) SLIC (c) Quickshift

Figure 2: Sawtooth - im6.ppm: Comparison of Ground Truth, SLIC, and Quickshift disparity maps.

Dataset	Image	MAE (SLIC)	MAE (Quickshift)
Barn 1	im2.ppm	0.5992	0.0404
Barn 1	im6.ppm	0.5707	0.0415
Barn 2	im2.ppm	0.3977	0.0570
Barn 2	im6.ppm	0.2685	0.0463
Bull	im2.ppm	0.3607	0.0568
Bull	im6.ppm	0.4087	0.0554
Poster	im2.ppm	0.5108	0.0333
Poster	im6.ppm	0.4953	0.0385
Sawtooth	im2.ppm	0.8569	0.0634
Sawtooth	im6.ppm	0.8237	0.0612
Venus	im2.ppm	0.3991	0.0763
Venus	im6.ppm	0.4422	0.0753

Table 1: MAE values for SLIC and Quickshift methods across different datasets and images.

6 Discussion

The results show that the Quickshift method performs better than SLIC in terms of lower MAE values. This can be attributed to Quickshift's ability to capture irregular structures more effectively than SLIC, which produces more regular and compact segments.

7 Outputs

All output images and generated MAE values are saved in the 'output' folder.