EE702 Assignment 2 - Stereo Vision

Grampurohit Shreyas Jayant (21D070029)
Soham Nivargi (21D070074)
Varunav Singh(21D070086)

Note: This document contains a general description of the dataset and the methods used for reconstructing disparity maps. For detailed understanding of the methods, please refer to the .ipynb files in the submission folder. The comments are fairly detailed to explain the reasoning for minute concepts. Finally, the results are also present in the submitted .ipynb files, along with the error metrics for each instance.

General Description

We implement **3 methods** for reconstructing the disparity maps from the given binocular images. We have created 4 .ipynb files named appropriately, one using SAD minimization, one using Canny Edge detection with NCC maximisation template matching, and one using Morphological Edge detection with SSD minimization template matching, and one final one for a custom high-difficulty image taken using our mobile-phone camera.

Dataset

We have used the Middlebury 2006 Dataset with 2 views (named view1 and view5). We have also included the zip file for the dataset which we used for our testing, it contains multiple images with 2 views and 2 disparity maps.

We have chosen the patch size depending on our visual cue, as the maps which had better scores were blurred, only maximizing SSIM and RMSE on the whole image, but leaving out regions of edges where depth change happened in a small region.

Algorithms implemented

We implement **3 methods** for reconstructing the disparity maps from the given binocular images.

- Our fastest algorithm is the .ipynb using SAD, it computes in seconds (1-2 seconds) for high resolution images. However it is inaccurate when using images

of high resolution, not managing to generate good maps except for cases where there are high changes in depth/edge. The .ipynb file for this is **stereo_sad.ipynb**.

- NCC gives better results compared to SAD on most images (except Aloe, as it gets missed out one part of the plant entirely), however it is very slow, taking upto 10 minutes for the images in the Middlebury dataset itself. The .ipynb file for this is **stereo_canny_ncc.ipynb**.

- We implement yet another method for reconstructing disparity maps using Morphological Methods for edge detection and Sum of Squared Distances (SSD) metric for template matching. Disparity maps are first computed only on the edges since they will be correct with high confidence. Further smoothing is done by iteratively updating the disparity values at non-edge pixels by taking an average of the disparities of the neighbouring pixels. This method takes only **2 to 3 minutes** for a 370 by 433 image.
  The **stereo_morph_ssd_lampshade.ipynb** implements this method on the lampshade image. The **stereo_morph_ssd_custom.ipynb** implements this method on a custom high-difficulty image taken from our mobile phone camera.