Computer Vision Assignment Report

# Optimisation for disparity

In my implementation of dense stereo disparity, I have used multiple techniques in order to improve the final distance result produced for a detected object. In the first stage we perform some image pre-processing before feeding the images into the SGBM stereo processor. I have tried different techniques, each with varying levels of success.

## Smoothing Filters (Gaussian, Bilateral, Weighted Least Squares)

Smoothing noise out of the input image / disparity map helps to reduce the influence noise has on our distance output. I have compared the effects of Gaussian noise removal, and edge preserving filters

## Histogram Equalisation

The second stage is obtaining the distance value from the object bounding box. The areas I focus on are foreground/background separation and averaging a disparity value across as many meaningful values as possible.

## Thresholding

Not all bounding boxes will be tight to the detected object, therefore containing significant background information that can affect our distance value. Ideally, we remove the background information, and a method to do this is to threshold our image. I use the idea of Otsu Thresholding, that adaptively thresholds an image based on the centre of two histogram peaks – the theory being that the two peaks represent the foreground and background information and we remove the background.

## Mean vs Median vs Percentile

We face a multitude of choices calculating the final distance value from our disparity values. The first choice would be to take the mean; however, this is not robust against outlier values and is severely affected if there is a large amount of background information in the bounding box. The median is more robust against outlier values and so tends to be the better choice compared to the mean. Another choice would be to take a percentile of the values. We test the 25th and 75th percentile i.e. the upper and lower regions of the disparity map. In conclusion, the performance of [x] is better than the rest in most situations.

# Optimisation for object detection

A basic optimisation for the object detection is to crop useless information out of the input image, namely the bonnet of the car. I have also opted to crop out the left side of the image where the dead zone for disparity exists – as this area is not of interest to us (we cannot obtain a distance here).

One of the harder scenarios for object detection is when objects of interest are in sections of the image that are poorly lit, so I have attempted contract enhancement to mitigate the issue.

## Contrast Enhancement via “Contrast Limited Adaptive Histogram Equalization (CLAHE)”

By converting the image to the HSV colour space, we can isolate the luminance channel V and perform CLAHE on it in order to improve the background contrast of an image while minimizing foreground information loss due to over-brightening. This exposes features in the background, allowing for better object detection.

# Sparse vs Dense Stereo

I have completed a basic implementation of sparse stereo imaging for disparity. To fairly compare the technique to dense stereo, we will do a comparison with all the optimisations mentioned earlier disabled, and we take the median of the disparity values in the bounding box.