**ECE 6310**

**Introduction to Computer Vision**

**Fall 2022**

Lab 1

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In this lab the students were asked to implement three version of 7x7 mean filter. Each implementation was to be timed multiple times and average time values were to be considered to decide which implementation of the filter was faster. The three different version were: A standard 7x7 mean filter, a Separable 7x7 filter, and Separable – Sliding window 7x7 filter. The filters were written in C language with help of baseline code of 3x3 mean filter. The image format is “.ppm”. The output images files were supposed to have no differences.

A bridge over a river

Description automatically generated with low confidence  
Fig 1 - Input image (bridge.ppm)

The following table shows the how much time each run of each filter took in nanoseconds. Each version of filter was run 10 times.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Standard 7x7 Filter | Separable 7x7 Filter | Separable – Sliding Window 7x7 Filter |
| 1 | 21924000 | 7416800 | 2987100 |
| 2 | 20967600 | 6857800 | 3054300 |
| 3 | 21334800 | 6887500 | 2752600 |
| 4 | 21629200 | 7116800 | 2899100 |
| 5 | 21450900 | 7034500 | 2679800 |
| 6 | 21780800 | 7046600 | 3036400 |
| 7 | 21786300 | 7007400 | 2769300 |
| 8 | 21383900 | 6893600 | 2776300 |
| 9 | 21280300 | 7290400 | 3234300 |
| 10 | 21688500 | 6896000 | 3136300 |
| Avg | 21522630 (21.52263 ms) | 7044740 (7.04474 ms) | 2932550 (2.93255 ms) |

From the table above, we can see that results were as expected. The standard filter requires way more calculations. The four nested for loops required increase the time complexity of the algorithm. Separable filter was approximately 3 times more efficient than the standard filter. This is because we use only three nested for loops, thus decreasing the time complexity a bit. We can also see that the hybrid of separable filter and sliding window filter was the fastest. It was approximately 7 times more efficient than the standard filter and approximately 2.4 times more efficient than the separable filter.

One of the challenges while coding up the separable filter and separable sliding filter, was figuring out the data type for the intermediate image. I had to switch the datatype of the intermediate image to float as compared to the initial and final image. I thought that because of the intermediate calculations, char data type may not be able to store the required data. It may also affect the accuracy of final results since unsigned char may round decimal numbers. Fortunately, there are plenty of stack overflow posts regarding this type of data conversion and accuracy.

Text

Description automatically generated  
Fig 2 – Standard 7x7 mean Filter

Text

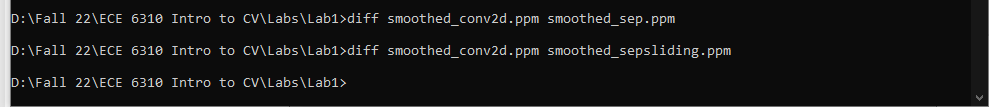
Description automatically generated  
Fig 3 – Separable 7x7 Filter

Text

Description automatically generated  
Fig 4 – Separable Sliding Window Filter

The result images produced had no differences. The differences were checked using FC and diff commands.

A screenshot of a computer

Description automatically generated with medium confidence  
Fig 5 – FC command to check differences  
  
Fig 6 - Diff command to check differences between files.

A picture containing text, grass, outdoor, tree

Description automatically generated  
Fig 7 – Output Image