CSCI576 Assignment 1 Report

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Part 1

Written Questions

Most of this example applies to `article` and `book` classes as well as to `report` class. In `article` class, however, the default position for the title information is at the top of the first text page rather than on a separate page. Also, it is not usual to request a table of contents with `article` class.

Q 1

Solutions:

- $N_l = 450$
  $N_p = 520$
  $N_{FPS} = 25$
  P=12 bits per pixel for 4:2:0 scheme
  $N_l \cdot N_p \cdot N_{FPS} \cdot P = 7.02 \times 10^7$ bits/s.
  So, the bit-rate produced by the camera is 7.02×10^7 bits/s.
- $4 \times 8 + 6 + 6 = 44$ bits per 4 pixels.
  So $P' = 11$ bits per pixel.
  The bit-rate of the re-quantized signal will be
  $N_l \cdot N_p \cdot N_{FPS} \cdot P' = 6.435 \times 10^7$ bits/s. 10 minutes video will contain
  $6.435 \times 10^7 \times 10 \times 60 \div 8 \div 1024 \div 1024 \div 1024 \approx 4.49$ GB.
  So at least 4.5 GB storage for the disk to store the video.

But note that—unlike the `book` and `report` classes—the `article` class does not have a “chapter” command.

Q 2

Solutions:

- Use these quantization intervals [-4, -3.625), [-3.625, -3.375) ... [3.875, 4], if the value is just in the middle of quantization levels then round it to the upper boundary level. Then the quantized sequence is: [1.875, 2.125, 2.125, 3.125, 3.375, 2.625, 2.875, 2.875, 2.875, 1.625, 1.125, 1,125, 1.125, 1.875, 2.125, 2.125, 2.125, 1.875, 2.375, 1.125, 0.125, -1.125, -1.125, -1.625, -1.125, -2.125, -1.375, -1.375, -0.625, 0.125, 0.875]
- There are 33 levels, so it needs at least 6 bits to represent one sample. Totally $6 \times 32 = 192$ bits are needed.

Q 3

Solutions:

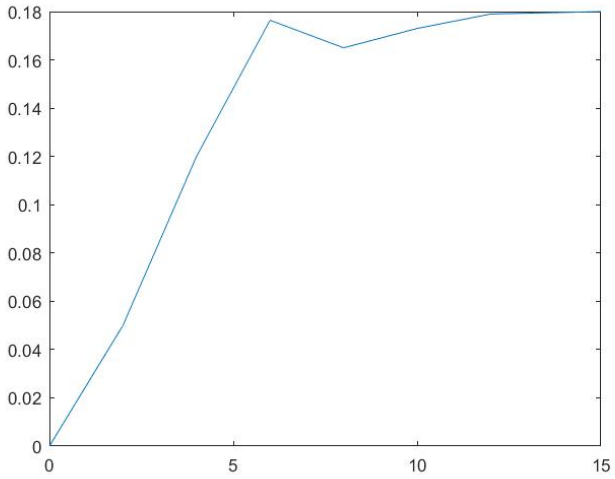
- First calculate the perimeter of the wheel, $\pi \times 0.4244 = 1.3333$, then $36 \times 1000 \div 1.3333 \div 3600 = 7.5$ rotations/s, the frame rate 24 fps is larger than twice of this rotation speed, so the true speed is observed as 7.5 rotations/s.
- 8 fps will cause aliasingand the aliasing frequency will be $8 - 7.5 = 0.5$ rotations/s counter-clockwise.

Programming Analysis Questions

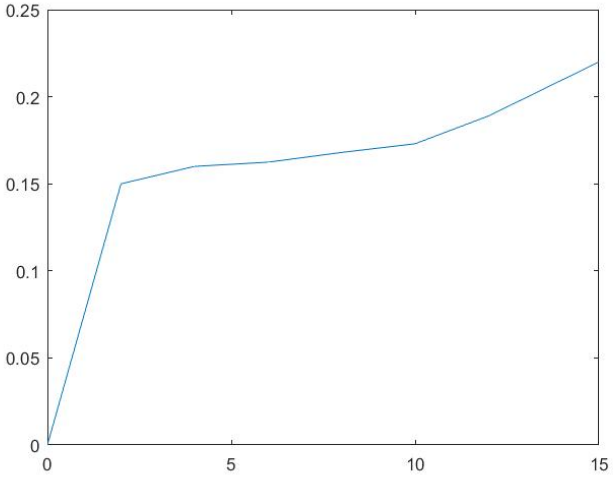
Q 1

The distortion curve is generated by the average error percentage for each pixel compared to the original image.

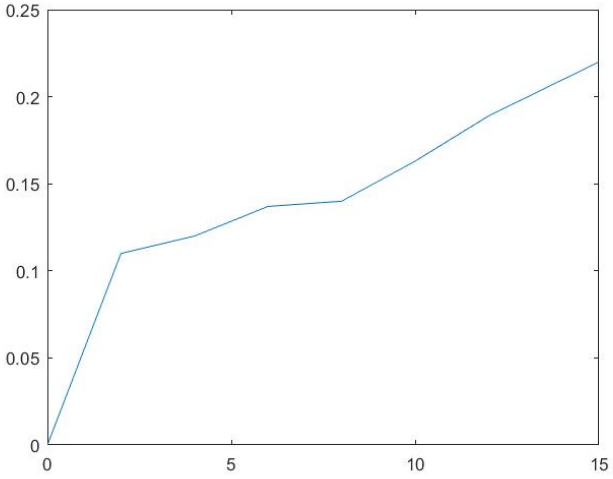
- Distortion cure with Y varying, set U and V to 1:
  -0.176407 inf -0.150256 -0.165809 inf -0.133801 -0.173324 inf -0.0869003 -0.179565 inf -0.00607022



- Distortion cure with U varying, set Y and V to 1:



- Distortion cure with V varying, set U and Y to 1:



The pattern is that the error rate increases fast, then slow down up to a limit. First, the average error rates for these three settings are increasing with the sub-sampling factor increasing. Another observation is that Y value is much important compared to the other two values since the error rate increases much faster.

Q 2

The main idea is to subsample differently. For example, instead of sampling with a constant sample interval, for particular image, the histogram is different and the distribution of the texture is way more different. So, with some calculations like gradient, smaller sample interval is applied to complex part of the image.
Another easier way is to increase the total bits for the image.
Some output results are as followed:

optimized one with Y=4

original image with Y=4.