Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath

The University of Dublin

Assignment 3

DIGITAL IMAGE AND VIDEO PROCESSING

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A1a. $H(X) = -\sum p(x) \log_2 p(x)$

$$= -\frac{5}{8}\log_2\frac{5}{8} - \frac{3}{32}\log_2\frac{3}{32} - \frac{3}{32}\log_2\frac{3}{32} - \frac{3}{32}\log_2\frac{3}{32} - \frac{1}{32}\log_2\frac{1}{32} - \frac{1}{8}\log_2\frac{1}{8} - \frac{1}{32}\log_2\frac{1}{32}$$

$$=$$

A1b. The

A2b. Entropy of the original image, H_o = 7.08178 bits/pixel.

A2c. Entropy of the quantised image, H_{qi} = 2.18741 bits/pixel for Q_step = 43 (assumed from Q1).

A2d. As can be seen, the entropy of the quantized image is much less than that of the original image. Also, the quantisation introduces artefacts such as banding.

A2f. The Mean-Squared Error between the given image and its quantised counterpart is 124.246.

A2g. The image quality goes down significantly if Q_{step} value is too high resulting in artefacts such as banding. Hence, even though original image has higher entropy, using a lossy compression technique such as quantisation results in a drop in image quality.

A3c. $H_{qhaar} < H_{qi}$ => 0.4832 < 2.18741
The transform provides improved subjective quality as well as significant data compression. The improved quality arises mainly from the high amplitude of the low frequency transform samples, which means that they are quantised to many more levels than the basic pels would be for a given Q_{step}.

A3d. The image reconstructed with Q_step/2 had the best quality out of the three. However, as compared to the original image, the quality was still poor. Image with just quantisation applied was also better in quality than compared to the other three.

A3e. The image with Q_step/2 value, as expected, had the highest entropy = 2.41818 and the lowest MSE = 2.82793e+03. Looking at the quantities, it can be said that as the Q_step increases, entropy decreases, MSE increases and quality decreases.

A3f. Yes, as the Q_step value increases, MSE increases with a decrease in quality just like in the case of Haar Transform with quantisation.

A4b. With the increase in number of levels, even for the same Q_step value, the entropy decreases along with image quality.