2001 p5q4 p12q4

CGIP Solution Notes NAD

(a) (i) spatial resolution:

150,000 cones/mm^2 at the back of a 20mm diameter eye (in the fovea) gives an angular res^n of 1' of arc for the average human.

Vernier acuity can be, say, 20× better

This means that, ~~once we get~~ with full colour pixels, a resolution greater than about 300 dpi will be indistinguishable to the human eye from one at about 300dpi, at 300mm distance ∴ only need to improve displays until we can get this sort of resolution.

(ii) luminance:

the eye is able to distinguish about a 2% change in luminance. At any given time it can cope with a 100:1 range of luminances but can adapt over a range of $10^{10}:1$

This means that a monitor operating on a linear luminance scale, which has a contrast ratio of $n:1$, requires

$$\frac{n-1}{0.02}+1$$

different intensity levels. ~10 bits for a 25:1 CRT but 8 bits is usually sufficient.

(iii) colour:

the eye uses three colour receptors: roughly red, green & blue.

thus three colour sources can be used to fool the eye into seeing a wide range of colours.

→ we can use three-dimensional co-ordinate systems (e.g. RGB, XYZ, HLS) to represent colour.

Also: the eye's response to colour is not as good a resolution as its response to intensity → ~~so we can see that all three limitations interact!~~ we can use this when encoding colour.

(1) Mapping
This converts one representation of the pixels' values to some other representation. Pixels are generally very similar in value to their neighbours & ~~Mapping~~ hence there is a lot of redundancy in their values. Mapping attempts to squash as much of the information about the images into the smallest number of components — or to map the pixel values into a set of numbers with a predictable distribution. Neither of these actually compresses the data but it does allow much more efficient symbol coding.
We won't notice a difference because the mapping is (should be!) reversible.

(2) Quantising
Cuts down the number of bits in each value. Fewer bits means less to code. If we carefully chose which values to quantise (e.g. higher frequency components) then there should be no visual difference provided we don't over-quantise. Otherwise we will be able to tell the difference

(3) Symbol encoding
Is a standard method used in all types of compression. It removes the redundancy in the representation of the values. We should not be able to notice the difference because the process is (should be!) reversible).

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