Foundations of Computer Graphics

Chapter Summary Notes

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1 Raster Images

1.1 Introduction

⋆ Images can be presented on **raster displays** which show images as arrays of **pixels**. For example, computer screens and TV's.

⋆ A raster image is a 2D array which stores the **pixel value** for each pixel

⋆ A raster image is **device-independent**

⋆ A vector image is described without any reference to any particular pixel grid

⋆ Vector images are **resolution independent** but must be **rasterised**

1.2 Pixels

⋆ We can abstract an image as a function:

$$I(x, y) : R \to V$$

where $R \subset \mathbb{R}^2$ and V is the set of possible pixel values.

⋆ For example, a RGB colour image has $V = (\mathbb{R}^+)^3$

⋆ In these notes, the bottom-left pixel is $(0, 0)$ and the top-right pixel is $(n_x - 1, n_y - 1)$ given n_x columns and n_y rows.

⋆ The rectangular domain of a $n_x \times n_y$ image is

$$R = [-0.5, n_x - 0.5] \times [-0.5, n_y - 0.5]$$

⋆ Example pixel formats:

- 8-bit RGB fixed-colour range: photographs and web/email applications
- 16-bit fixed-range grayscale: medical imaging
- 16-bit fixed-range RGB: professional photography and printing

1.3 Intensity

⋆ Assume a numerical descrition of pixel colour from 0 to 1

⋆ Monitors are non-linear with respect to input and therefore characterised by a γ value:

$$I = I_{max}(a)^{\gamma}$$

where $0 \leq a \leq 1$.

⋆ We can find γ by finding the value of a that gives an intensity halfway between black and white so $a^{\gamma} = 0.5$

⋆ Usually:

$$a = \left\{0\,,\ \frac{1}{255}\,,\ \ldots\,,\ \frac{254}{255}\,,\ 1\right\}$$

$$\implies I = \left\{0\,,\ I_{max}\left(\frac{1}{255}\right)^{\gamma}\,,\ \ldots\,,\ I_{max}\left(\frac{254}{255}\right)^{\gamma}\,,\ I_{max}\right\}$$

1.4 RGB

⋆ RGB colour can be represented as a RGB colour cube. Coordinates of colours are:

- black = (0, 0, 0)
- red = (1, 0, 0)
- green = (0, 1, 0)
- blue = (0, 0, 1)
- yellow = (1, 1, 0)
- magenta = (1, 0, 1)
- cyan = (0, 1, 1)
- white = (1, 1, 1)

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