

Lecture 1

Definition: Assistive imaging

Enhancement, Restoration, representation or transformation of visual data to aid in visualisation and interpretation by humans or as pre-processing step for computer vision

Definition: Computer Vision

Automatic interpretation of visual data using computers without human intervention

Definition: Image

A multidimensional signal, commonly containing visual information (in general regularly sampled)

Pixel - Picture Element

Spatial Resolution: $X \times Y$ (horizontal by vertical) dimensions of the image

Direct computation gives the number of pixels used to cover the visual space captured by the image relates to the sampling of the image signal

Colour Resolution - The dimension of the colour space - known as quantization

Temporal Resolution: In continuous capture systems (e.g. video) the number of images captured in a given time period

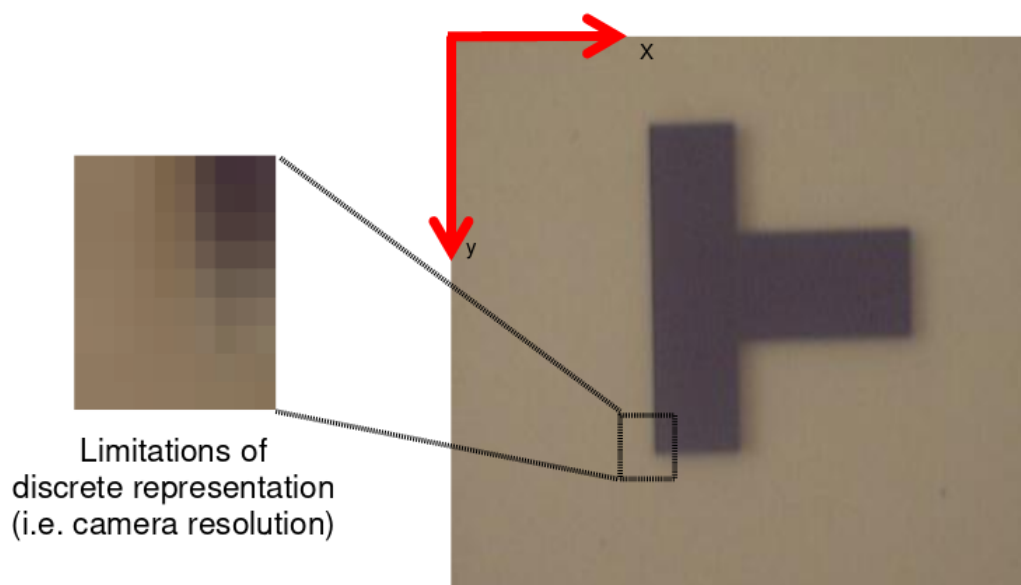
1 Representational Requirements

Scenes have to be sampled (spatially, temporally) and quantized in what is essentially an analogue to digital conversion.

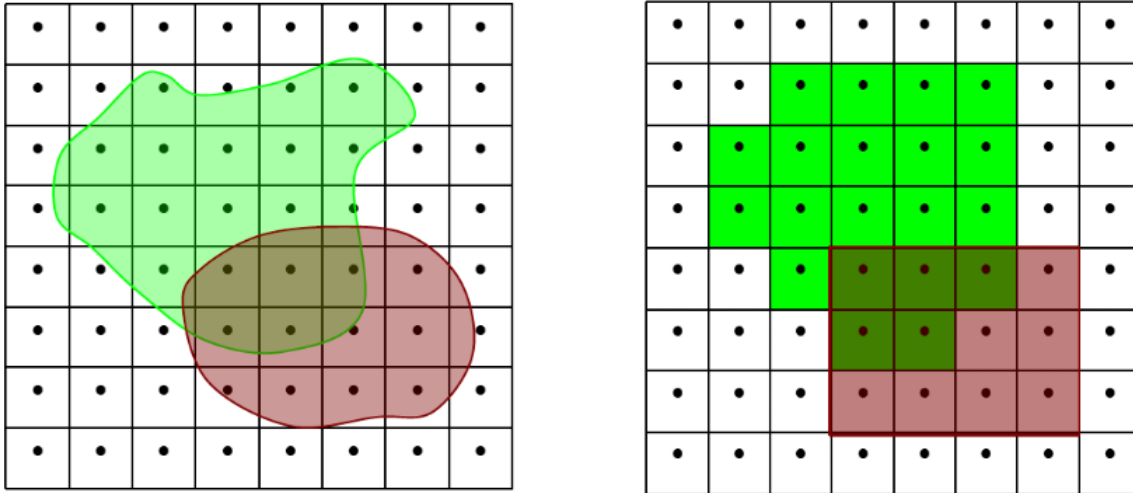
The sampling must be high enough to preserve useful information in the image. Quantisation must avoid aliasing

2 Aliasing

As resolution is limited, there is aliasing effects.



An analogue signal will always suffer some form of aliasing in the digitisation process - at some level



Aliasing effects both the connectivity and topological measurement image features - noise is introduced. Image processing algorithms must be able to cope with the problems arising from this form of sampling noise

3 Colour (or intensity) quantization

At each pixel there is a voltage reading on the image sensor that relates to the amount and wavelength of light received.

It is discretised into a number of bins representing a level of intensity.

4 Image colour channels

Red, green and blue light intensity for each (x,y) pixel gives an $\{r,g,b\}$ integer vector.

Colour image = 3-channel image (x,y,i) for $i=\{0,1,2\}$

Greyscale = 1 channel

5 Pixel co-ordinates

Greyscale images: $\text{image}(x,y) = \text{value}$

Colour images: $\text{image}(x,y) = (r,g,b)$

Pixel location: (x,y) position in the column by row coordinate system.

Positive co-ordinate system: origin = top left

Origin is not universal: OpenCV uses top left and:

column (c) = x co-ordinate
row (r) = y co-ordinate

6 What do pixel values actually represent in image data?

Intensity/colour: Wavelength or intensity of light

Infra-red: Infra-red electromagnetic intensity

- Near and far infra-red are different wavelengths
- Visualisation may require colour mapping

Medical CT/ MRI - Pixel values are proportional to the absorption characteristics of tissue in relation to a signal sent through the body

- Segmentation
- Visualisation of volumetric data

Radar - Pixel values are proportional to target distance from the sensor and reflectivity

- Calibrating values correspond to distance
- Noise

Depth/distance - Pixel values encode distance of object/surface from sensor

- Explicit 3D information rather than just a 2D projection, but partial only view of the captured 3D object

Scientific - Pixel values encode measurements from a given sensor

- Representation: positive and negative floating point image values
- Visualisation: colour mapping/negative value scaling