

Lecture Outline

IIS for Image Processing

Michael J. Watts

<http://mike.watts.net.nz>

- Image data
- Graphic formats
- Image analysis
- Image transformations
- Applications

Image Data

- What is an image?
- Data in a visual medium
- Images on a computer are displayed as pixels
 - each pixel is one colour
 - Resolution

Graphics Formats

- Raster vs Vector
- Raster represents each pixel
- Vector represents shapes
- Meta files combine both

Raster Images

- Image is divided into regularly sized cells
 - pixels
- Each pixel is one colour
- Number of pixels / unit length = resolution
- Bits / pixel = number of colours / pixel
 - 1, 2, 4, 8, 16, 24 bit colour
 - How many colours each?
- File size is a function of resolution and bits / pixel

Image Analysis

- What are the goals of image analysis?
- To enhance the image for increased understanding by:
 - Human observers
 - Machine observers
- To (possibly) obtain some insight into how human beings process visual information

Image Analysis

- The study of images in some form to elicit information that's implicitly stored within the image
 - Techniques used for image analysis
 - Image filtering
 - Edge enhancement
 - Texture analysis
 - Noise reduction

Image Transformations

- Many image processing transformations are non-linear
 - Why?
- Examples
 - Convolution
 - Sobel filters
 - Median filters

Image Transformations

- Convolution
 - General technique
 - Uses a small matrix
 - Kernel
 - Kernel is slid over the image
 - Moves one pixel at a time
 - Values in the kernel are used to transform values in image
 - Basis of many image processing techniques

Image Transformations

- Sobel filter
 - Based on a convolution
 - Edge detector
 - Edges have high contrast
 - Measures the gradient between adjacent groups of pixels
 - Uses specific kernel values

Image Transformations

- Median filters
 - Family of filters
 - Noise reduction
 - Impulse noise
 - Examine groups of pixels
 - Remove spikes in intensity
 - Different methods used

Wavelet Transformations

- What is a wavelet?
- Two main properties
 - Limited duration
 - Average value of zero
- A wavelet fades in and fades out
- Wavelet analysis breaks a signal into its component wavelets

Wavelet Transformations

- Wavelet coefficients can be recombined to form the original signal
- Wavelets have many applications
 - Noise filtering
 - Compression
- Wavelets are used when FFT don't work

Wavelet Transformations

- Ability to perform local analysis and flexible decomposition of a signal
- Can characterise the colour-space and texture of an image
- Has been used for the indexing of images
- Can be used for image compression
 - 25% size of equivalent JPEG

Image Recognition

- The ability for a computer program to identify certain features of an image through:
 - Statistical classifiers
 - Neural networks
 - Rule-based systems

Applications of Image Recognition

- Face recognition
 - Security
 - Policing
- Pest identification
 - Mapping visible damage -> insects
- Counting sheep
 - Methane emissions

Summary

- Images are a complex data source
- Many techniques exist for transforming images
- Image recognition has many applications