Introduction to **Computer Vision**

COMP3005

Mark Nixon and Jonathon Hare

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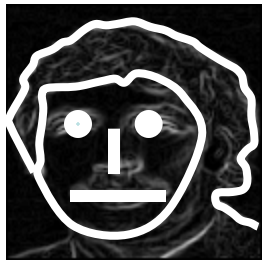
Processing Scheme

Acquire image

Low-level processing

High-level processing



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Operational Computer Vision Systems

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What can image analysis achieve?

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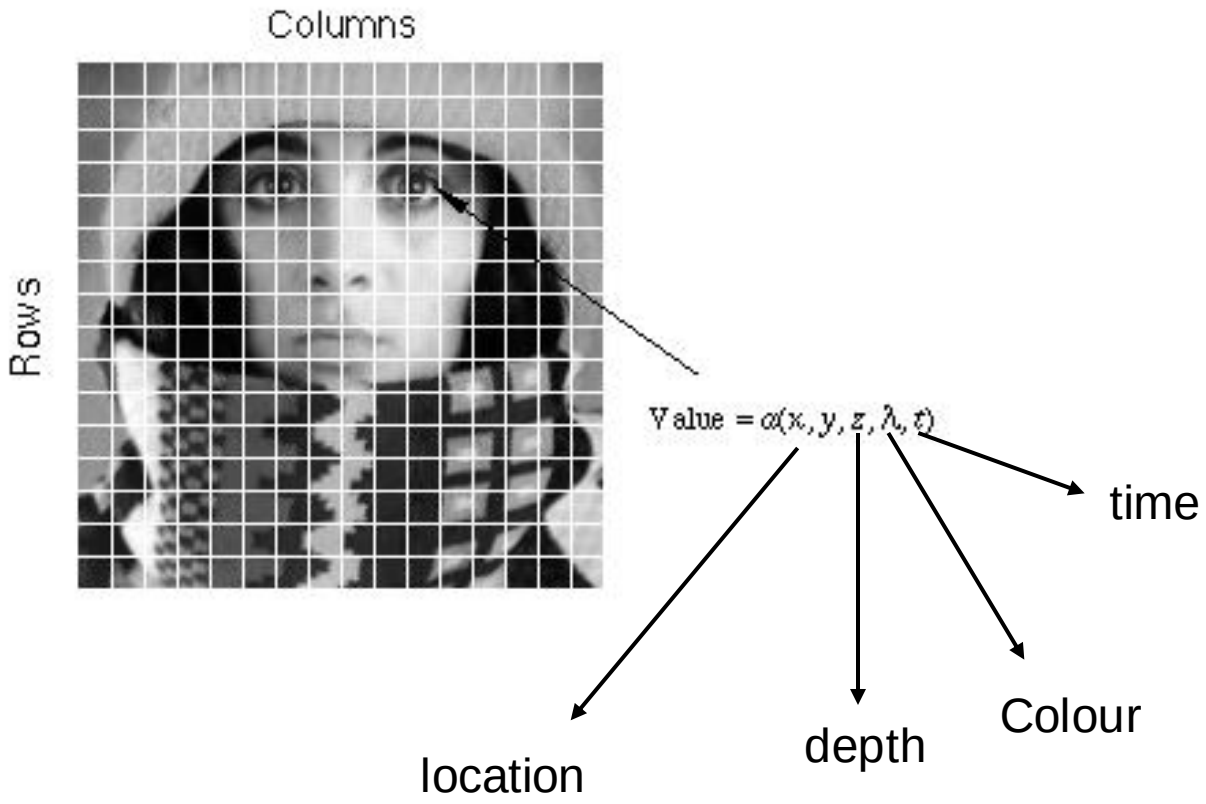
Images consist of picture elements, “pixels”



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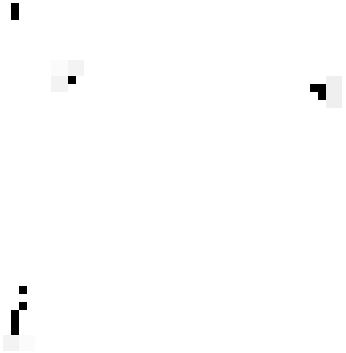
Point Operations

Recalculate point values



Modify brightness

Find Intensity

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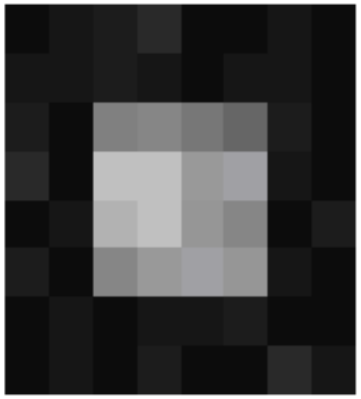
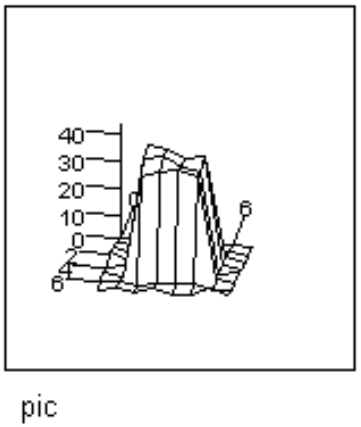
2D Images are thus matrices of numbers



Grey level image



3D view

$$pic := \begin{bmatrix} 1 & 2 & 3 & 4 & 1 & 1 & 2 & 1 \\ 2 & 2 & 3 & 2 & 1 & 2 & 2 & 1 \\ 3 & 1 & 38 & 39 & 37 & 36 & 3 & 1 \\ 4 & 1 & 45 & 44 & 41 & 42 & 2 & 1 \\ 1 & 2 & 43 & 44 & 40 & 39 & 1 & 3 \\ 2 & 1 & 39 & 41 & 42 & 40 & 2 & 1 \\ 1 & 2 & 1 & 2 & 2 & 3 & 1 & 1 \\ 1 & 2 & 1 & 3 & 1 & 1 & 4 & 2 \end{bmatrix}$$

Corresponding Matrix

Pixel

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Group Operations

Process neighborhoods

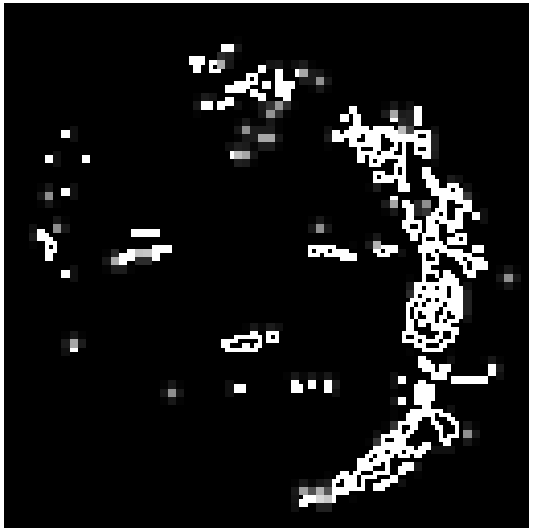

Image Filtering Edge Detection

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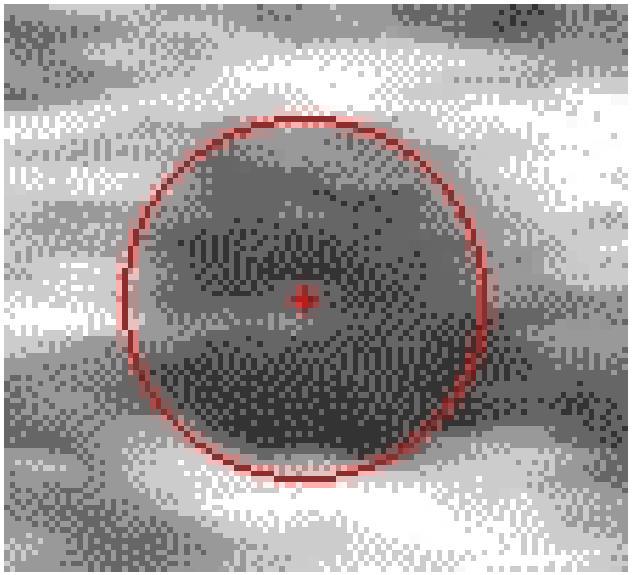
Feature Extraction

Finds shapes

Roads in remotely-sensed image



Artery in ultrasound image

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Applications of Image Processing/Vision

- Image Coding (MPEG/JPEG)
- Product Inspection
- Robotics
- Modern Cameras
- Medical imaging
- Demography (applied politics?)
- Biometrics (recognising people)

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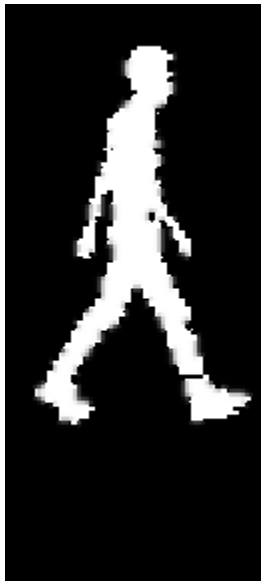
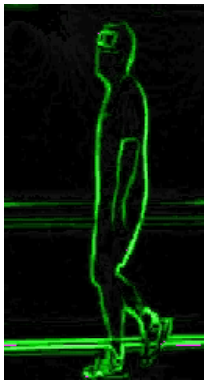
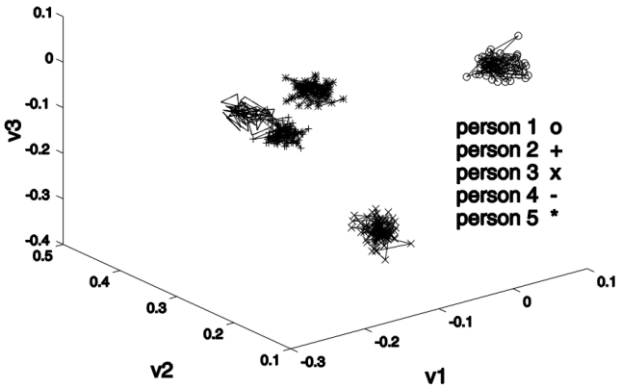
Statistical Gait Recognition

Recognising people from the motion of the whole body







Silhouette Flow Edges Symmetry Feature Space

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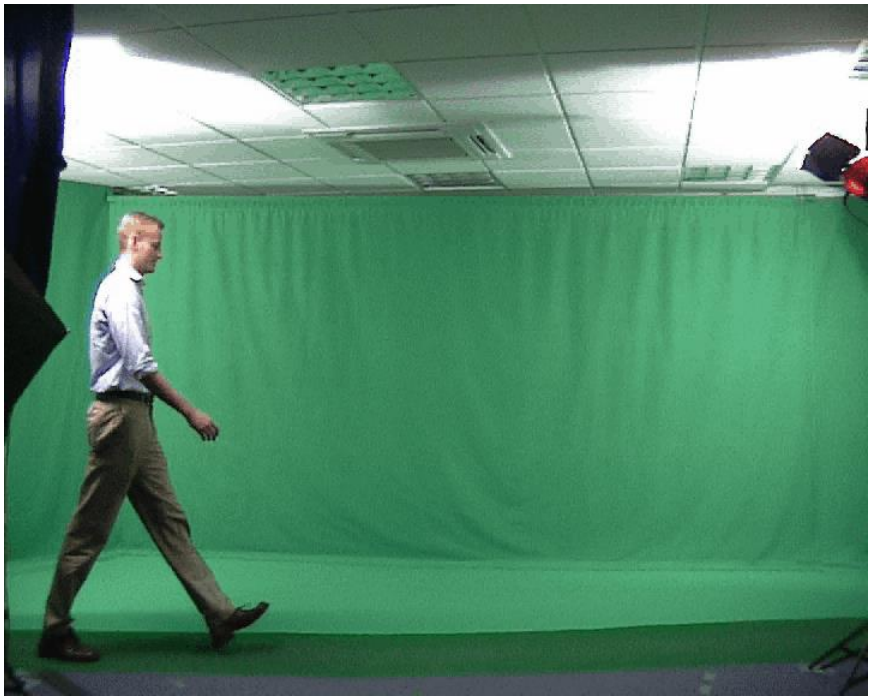
Gait Recognition

- natural walking (well….)



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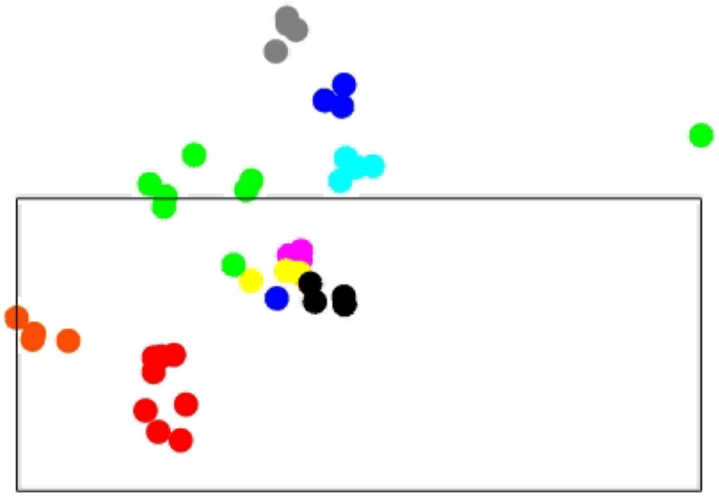
Gait recognition

- Including a funny walk …



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Ear biometrics

- Person identification from ear image
- Uniqueness: used in forensics
- Unique advantage: age invariant
- Unique disadvantage: hair!
- Much smaller field than gait recognition

BBC1, 2005

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Lumbar Spine Location in Fluoroscopic Images by Evidence Gathering

Yalin Zheng*, Mark S. Nixon* and Robert Allen†

*School of Electronics and Computer Science
†Institute of Sound and Vibration Research
University of Southampton

Zheng, Nixon and Allen,
IEEE TMI 2003

Digital Videofluoroscopic Imaging

Zheng, Nixon and Allen,
IEEE TMI 2003

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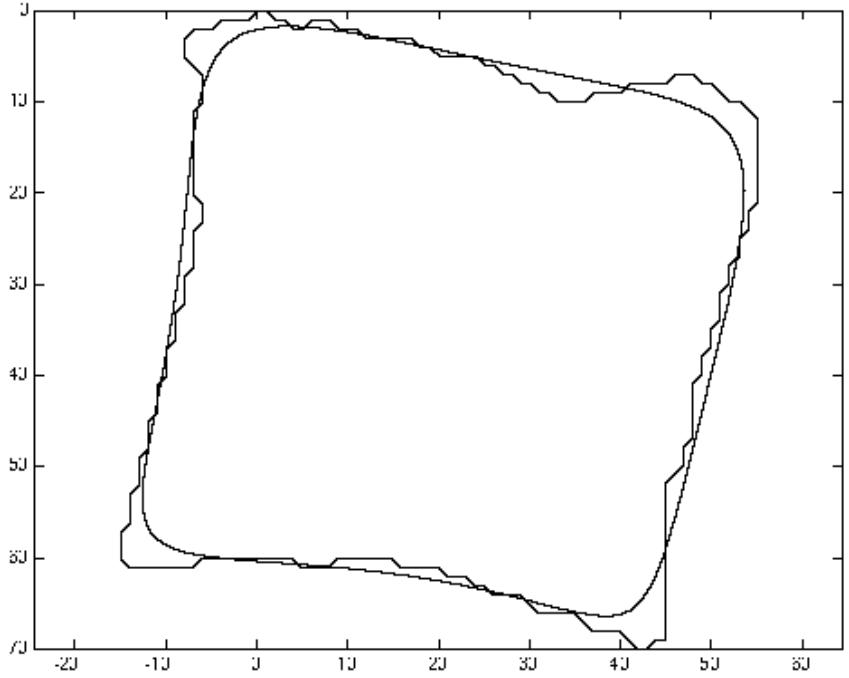
High Level Feature Extraction



Zheng, Nixon and Allen,
IEEE TMI 2003

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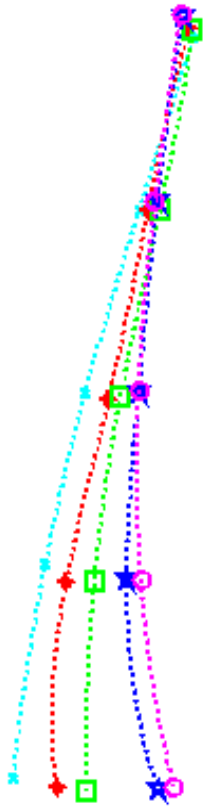
Animated Extraction



Zheng, Nixon and Allen,
IEEE TMI 2003

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Vision and Image Processing Support

- WWW homepages
- Worksheets
- Demos:

  http://www.ecs.soton.ac.uk/~msn/book/new_demo/
- Links
- Notes
- Book

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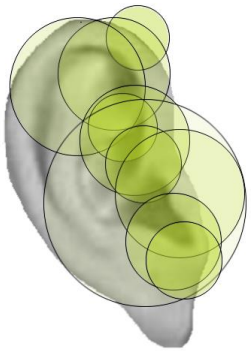
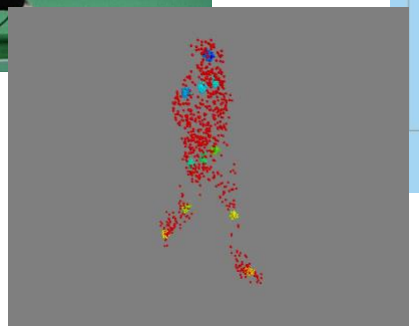
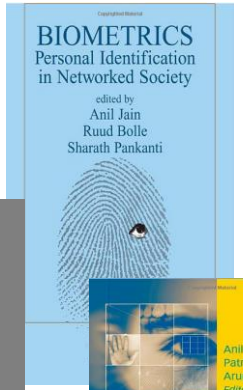
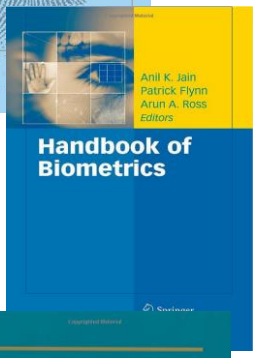
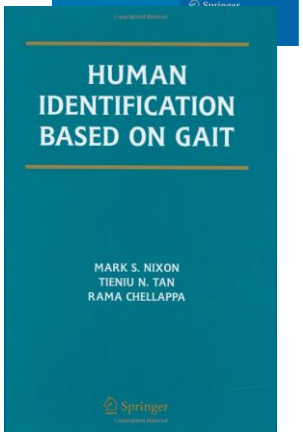
(Southampton's) Biometrics











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Recommended Textbook

http://www.ecs.soton.ac.uk/~msn/book

CONTENTS

1. **Introduction**
2. **Images, sampling and frequency domain processing**
3. **Basic image processing operations**
4. **Low-level feature extraction (including edge detection)**
5. **Feature extraction by shape matching**
6. **Flexible shape extraction (snakes and other techniques)**
7. **Object description**
8. **Introduction to texture description, segmentation and classification**
9. **Moving Object Extraction and Description**
10. **Appendices**

1st Edition 2002; 2nd Edition 2008

3rd Edition 2012 (Current price ~ £47 Amazon)

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Worksheet Support

- Mathcad
- Used in lectures
- Free download viewer
- Used for independent study
- Some Matlab, but incomplete

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Differences between ELEC3021 (Image Processing) and COMP3005 (Computer Vision)

- ELEC3021: analytics and hardware
- COMP3005: algorithms and software
- E.g. try Fourier:

$$\Im\big(f(x,y)\big) = f(u,v) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)e^{\frac{-j2\pi}{N}(ux+vy)}$$

- Gives fantastic insight and practical use, eg .jpg

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Finally

- ✓ Enjoy!
- ✓ Emails:

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