

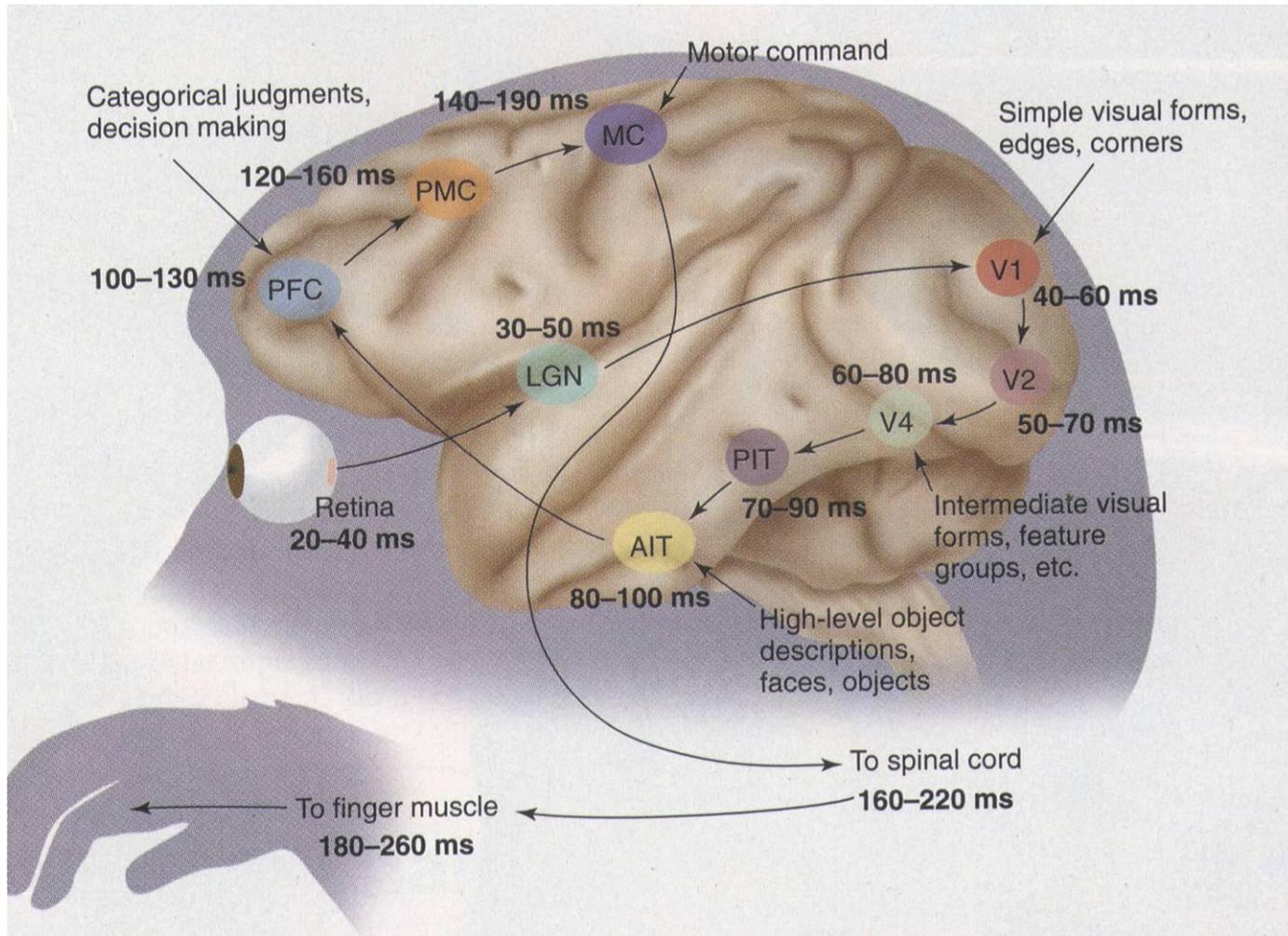
Computer Vision:

Object detection, tracking and and recognition

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Cognitive Systems Engineering



New applications

Computer vision has now found a place in consumer products

- Mobile phones and digital cameras
- Games
- Cars
- Image and video search

Overview

- Local appearance: 2D target detection and image registration
- Shape: 3D object detection
- Motion: looking at people in crowds
- Event and action recognition

1. Image matching with interest points:

2D target detection and registration

Image matching



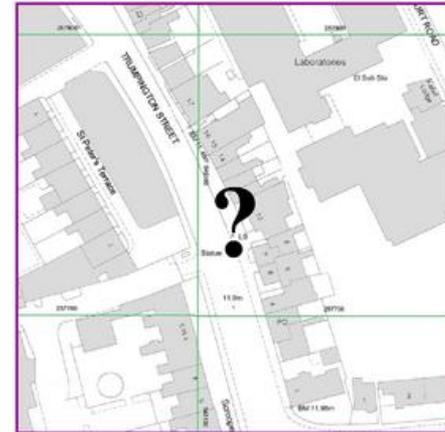
Where am I? What am I looking at?

Johansson and Cipolla 2002
Cipolla, Tordoff and Robertson 2004

Where I am?



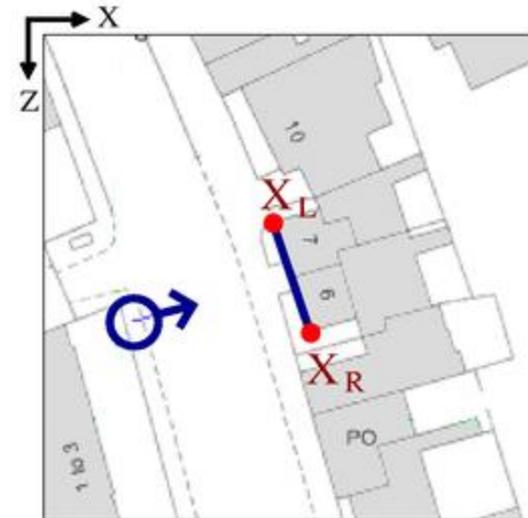
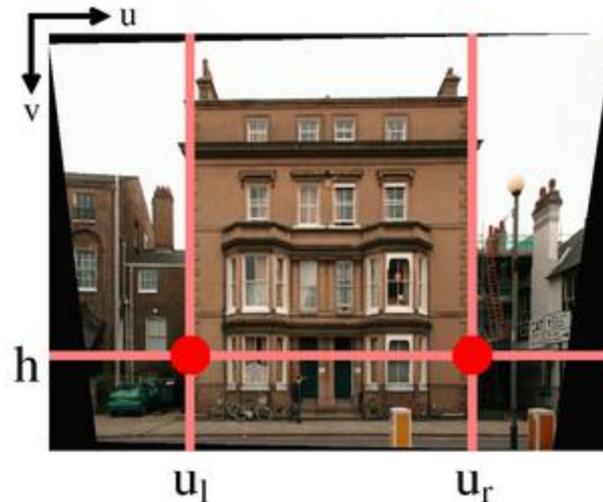
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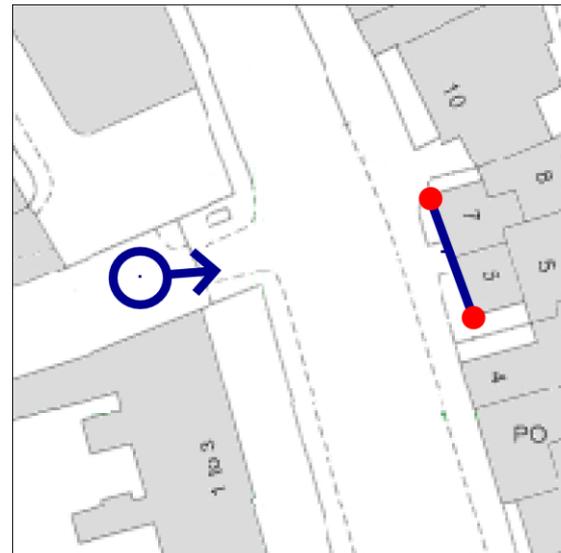
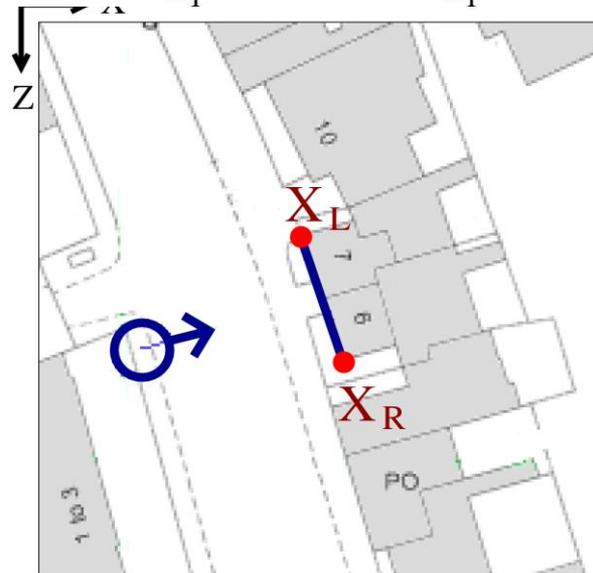
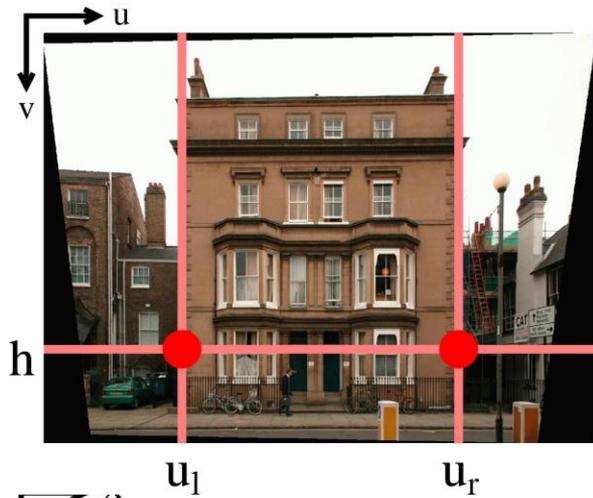
Determine pose from single image by matching

Register database view

First align database view to map



Localisation of query view



2. Using 2D and 3D Shape:

Human hand and body detection

Stenger, Thayananthan, Torr and Cipolla 2003

Williams, Blake and Cipolla 2003 and 2005

Ramanan et al 2006

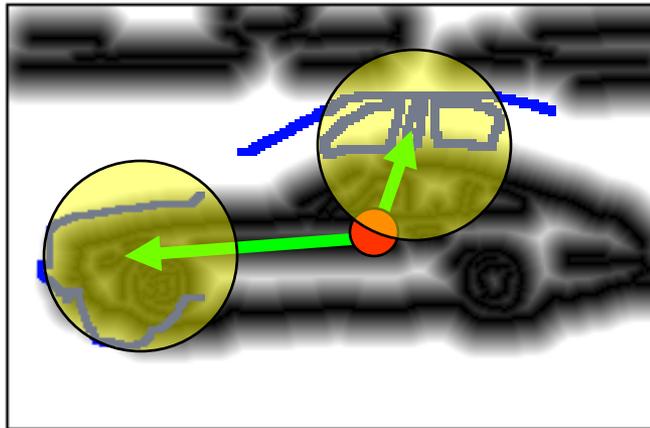
Matching shape templates



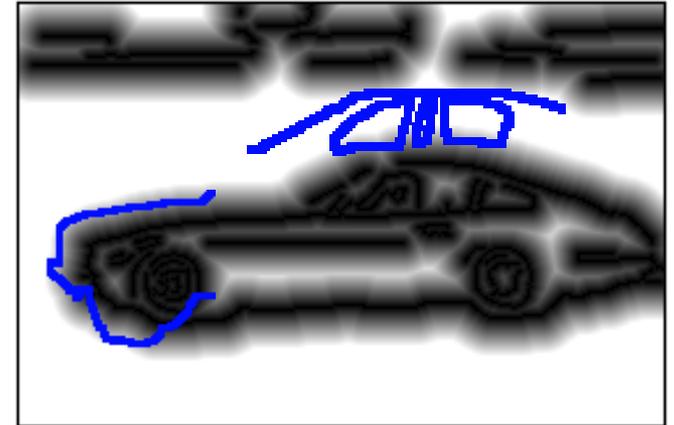
Oriented
Carry
Distance
Edge
Transform
Detector



Matching shape templates



Oriented
Chamfer
Matching



Hand detection system



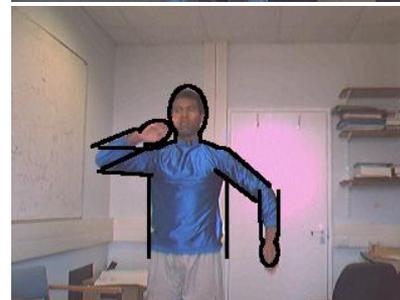
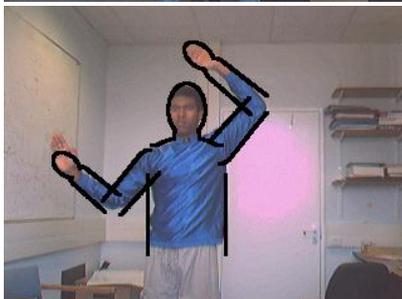
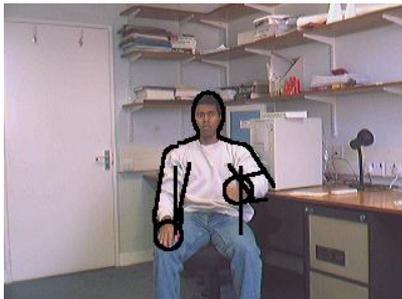
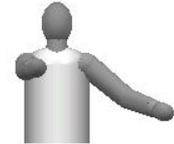
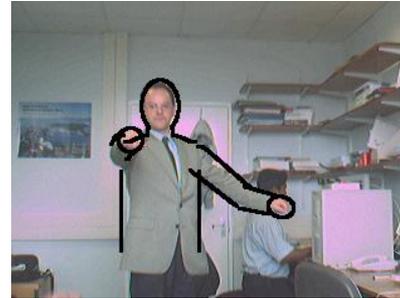
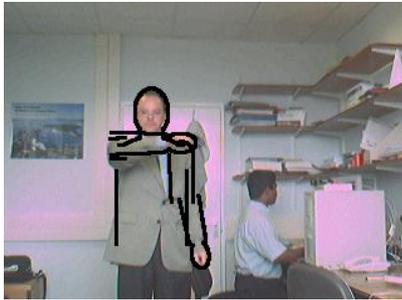
Tracking - 3D mouse



Tracking - 3D mouse



People and pose detection



People and pose detection

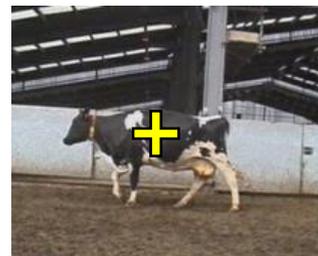
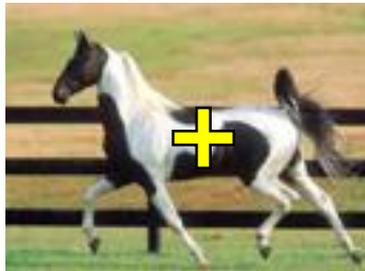


3. Object category detection and machine learning

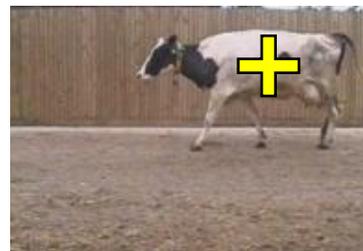
Shotton, Blake and Cipolla 2005

Supervised learning

- Learn to recognise images of a particular class, localised in space and scale
- i.e. find the horse/cow/car etc!



Desired
Results

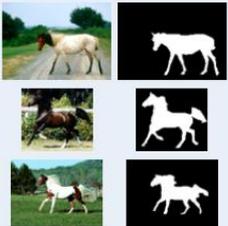


Learning and Adaptability

Training Data

Class

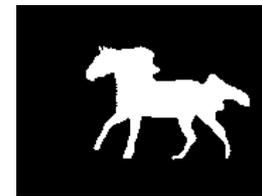
Segmented: D_S



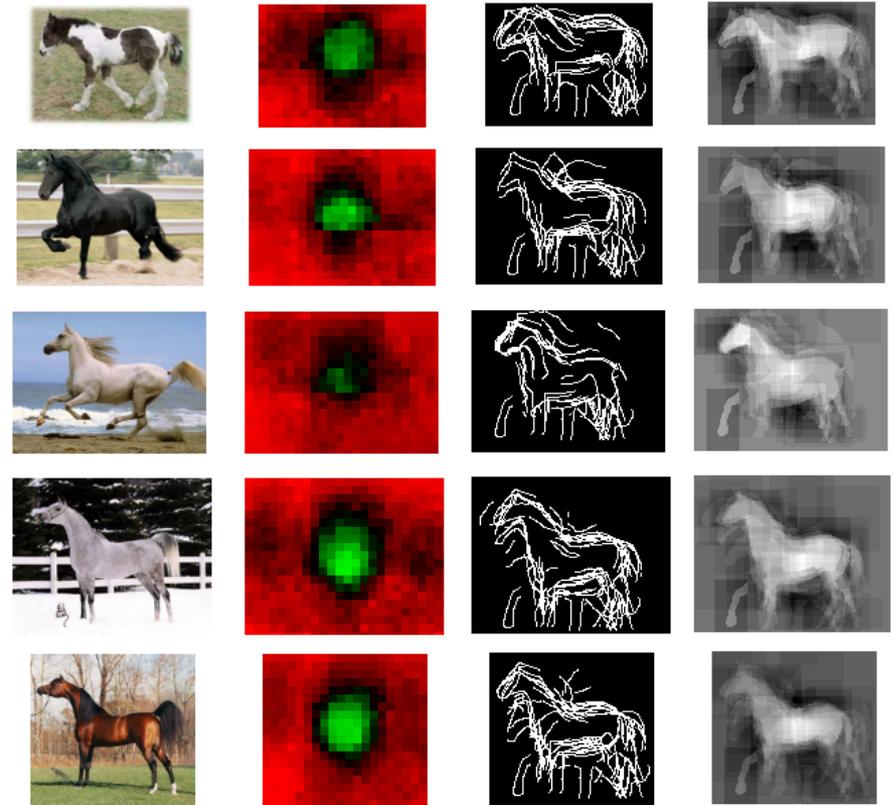
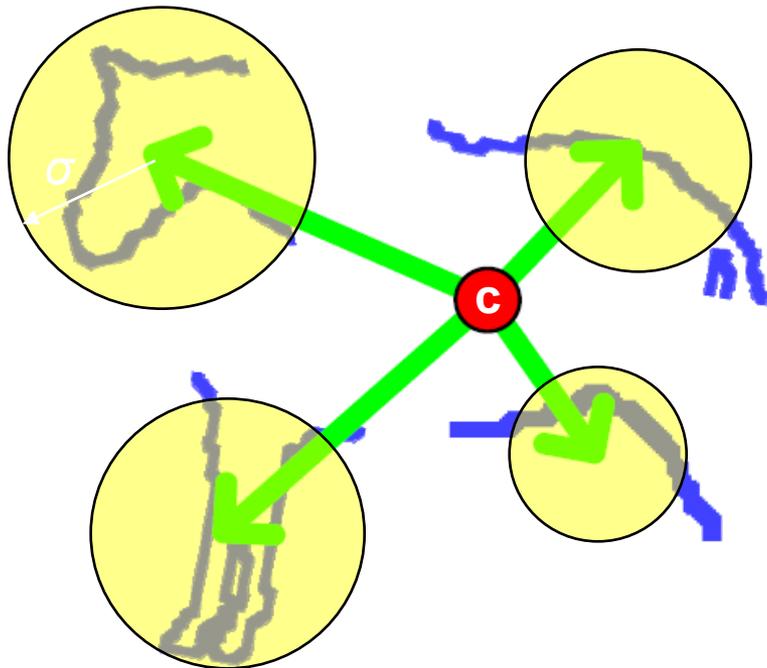
Unsegmented: D_U



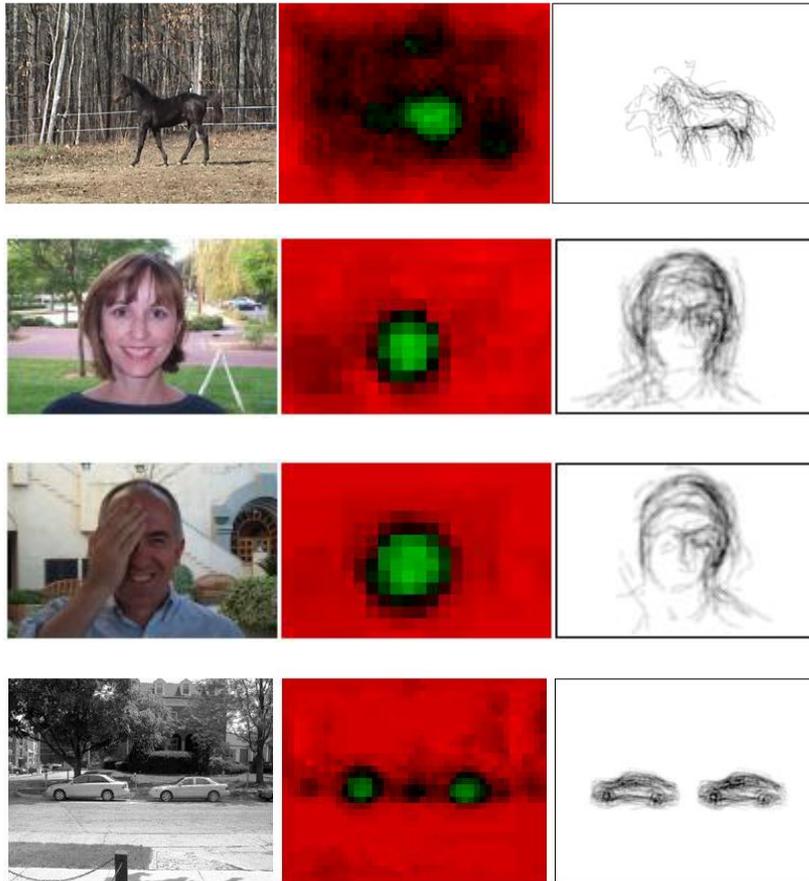
Background: D_B



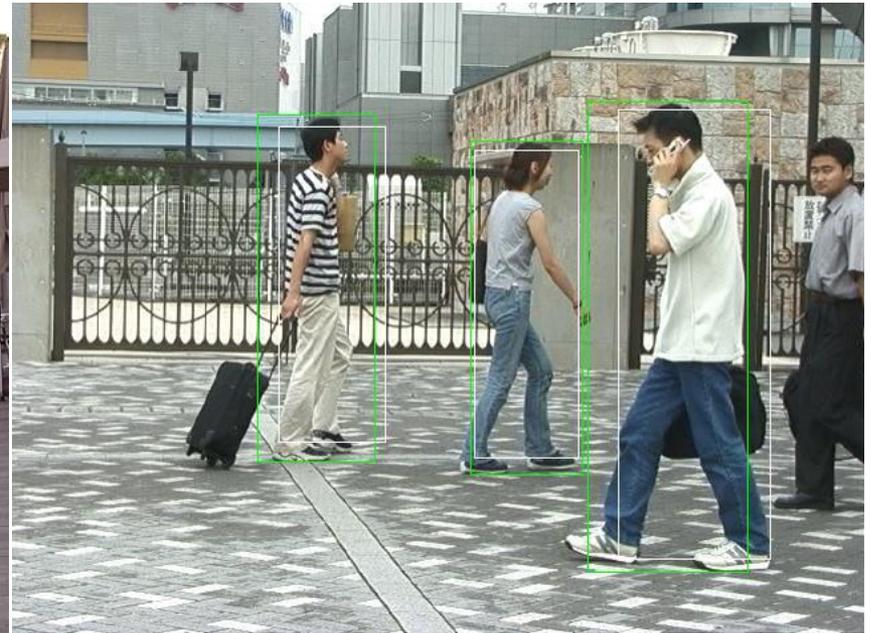
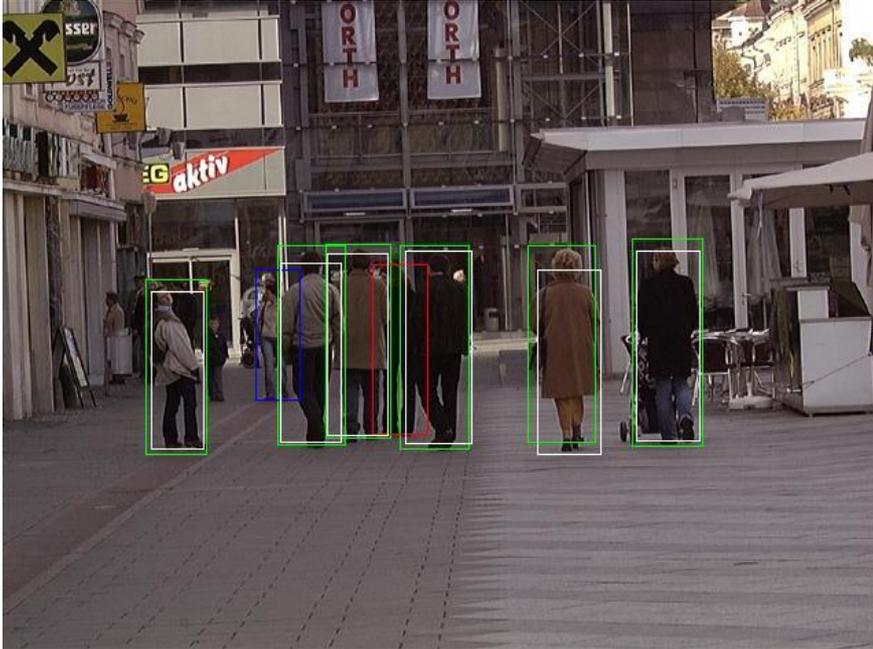
Object Model



Visual Object Categorisation



Pedestrian detection



4. Motion Analysis

Detection and tracking people in crowds

Brostow and Cipolla 2006

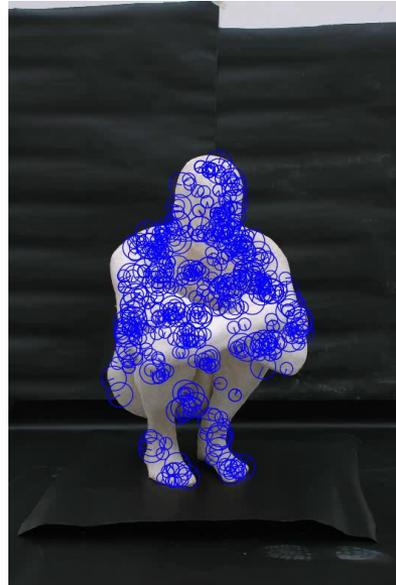
Input Images



Recovery of camera motion



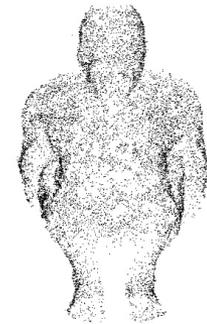
Input images



Feature
extraction



Feature
matching



Bundle
adjustment

Image motion

Tracking people in crowds

Detecting People in
Crowds by Bayesian Clustering

Brostow & Cipolla, 2005

5. Detection and recognition in video

Arandjelovic and Cipolla 2004-2006

Kim, Wong and Cipolla 2005-2006

Face recognition

Appearance variations due to:

Lighting condition



Scale, pose, motion pattern



Face recognition

Face recognition from video for access control

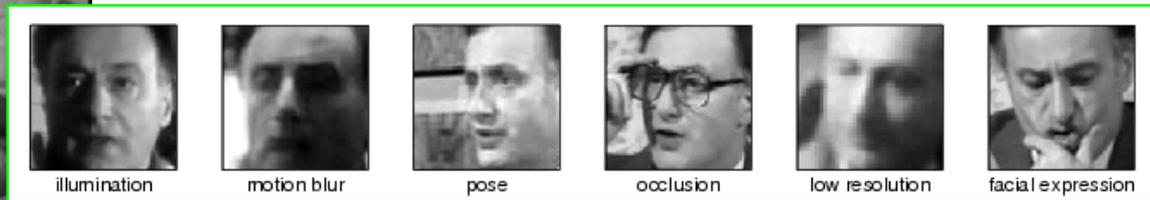
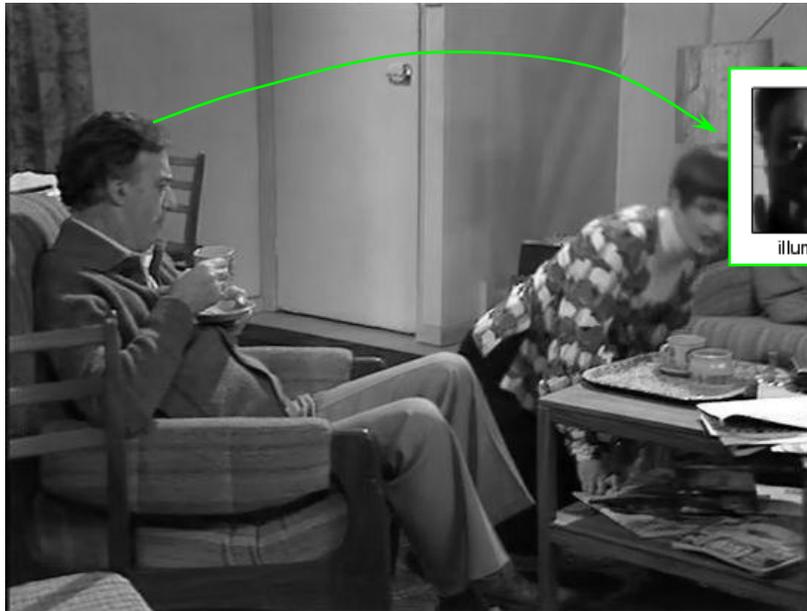
Reference sequence



Input sequence



Automatic cast listing



Problem difficulties

Automatic cast listing

“Simple clustering”
results

Sir Hacker:



Miss Hacker:



Humphrey:



Secretary:



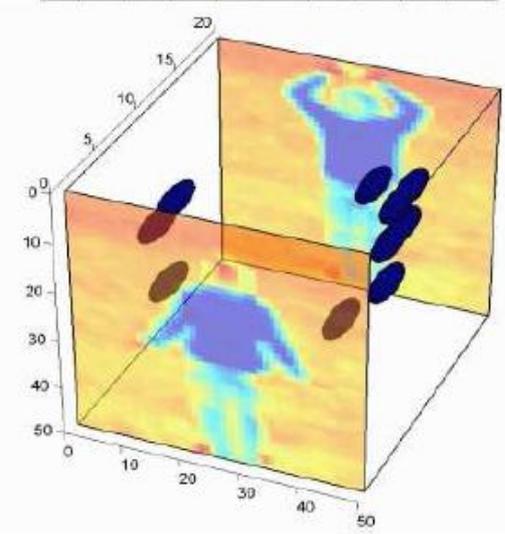
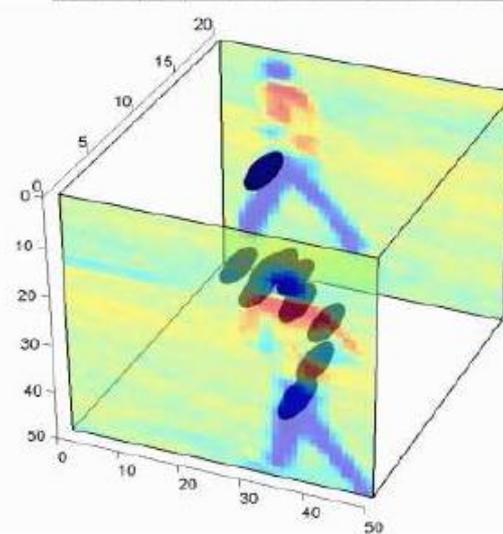
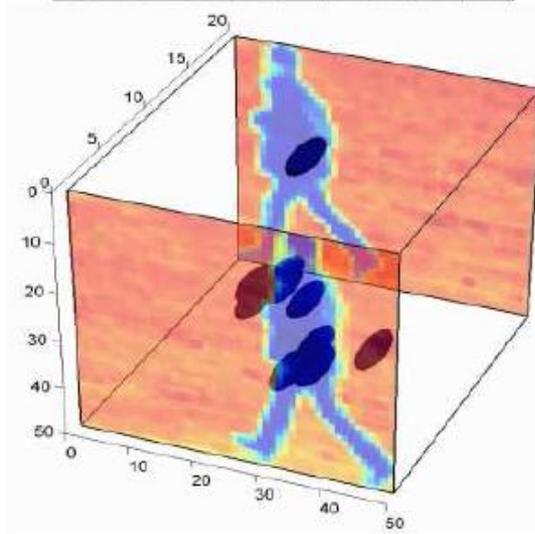
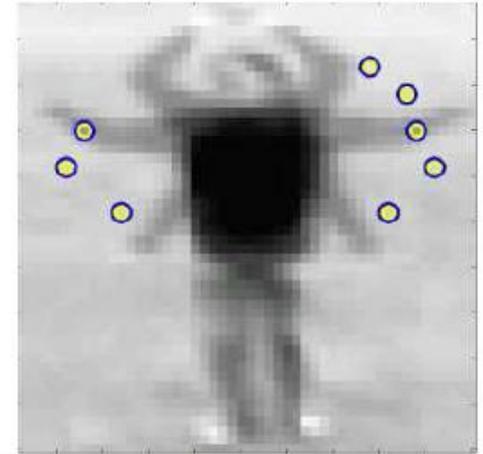
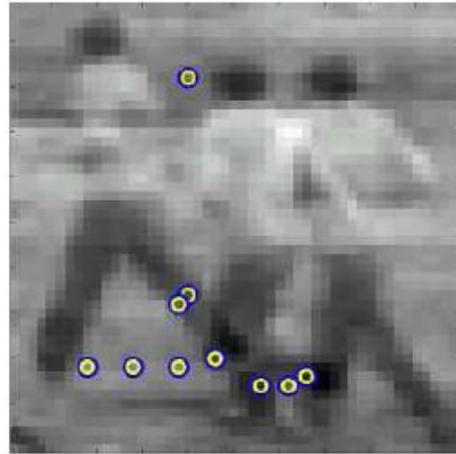
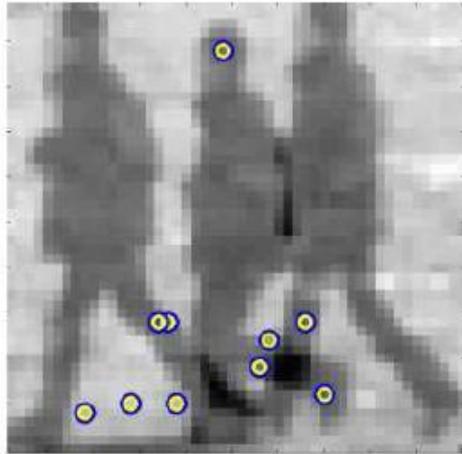
Bernard:



Frank:



Action recognition



Action recognition



Boxing



Hand clapping



Hand waving



Jogging



Running



Walking

Overview

- Object detection – local appearance and shape
- Motion analysis – people in crowds
- Face, event and action recognition