

# Extraction of MPEG-4 Facial Animation Parameters with Active Appearance Models

IMM

DTU



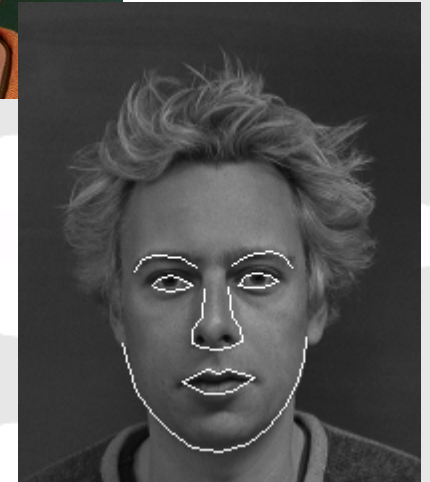
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52425 Digital Video Technology

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# Aim & Method

- To extract MPEG-4 Facial Animation Parameters (FAPs) from a detailed map of facial features in an unknown image
- Active Appearance Models (AAMs):
  - A deformable template model introduced by Cootes, Edwards and Taylor (1998).
  - A priori knowledge is learned through statistical analysis of a training set



# Presentation outline

- Active Appearance Models
- Segmentation of faces in the IMM face database
  - Building the Active Appearance Model
  - Example results

[face database provided by Janusz Sierakowski, Michael M. Nordstrøm & Mads Larsen]
- Real-time tracking using an AAM
- Near real-time extraction of MPEG-4 facial parameters
  - MPEG-4 AAM
  - Results

[presentation based on work by Jörgen Ahlberg, Linköbing University]

# Active Appearance Models

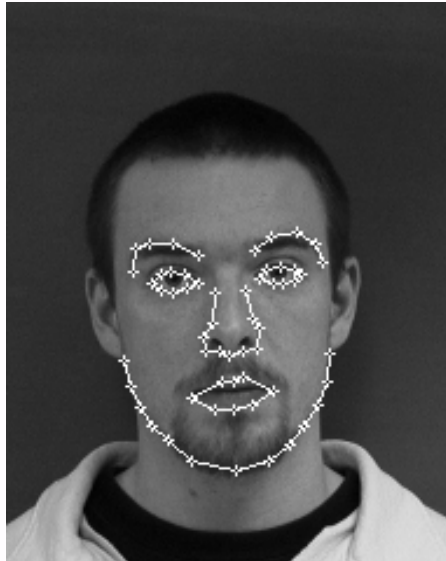
- Aim: To locate non-rigid objects with large variability – but distinct features – in digital images
- Method: A generative deformable model providing a photo-realistic model representation
- Characteristics of the object class is learned through statistical analysis of shape and grey-level variation in a training set
- A compact object class description is derived and used to rapidly search images for new object instances
- Properties: general, specific, robust, parameter-less and fast

# Face training set

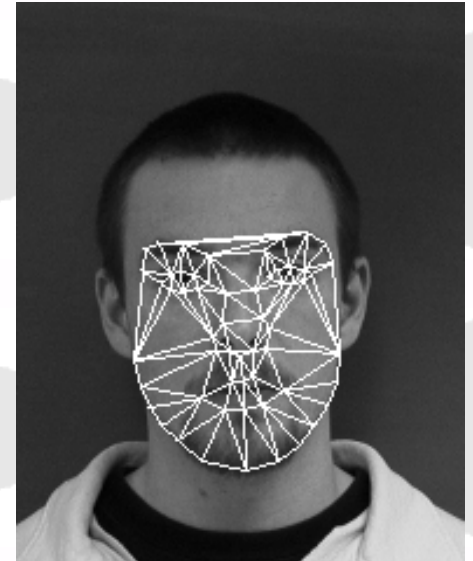
- 35 frontal images of 35 different human faces  
(the total database consists of 240 face images)
- Each face is annotated with 58 corresponding points



Training example



Annotated training example



AAM mesh model

# Face AAM

- Shape and texture variation are extracted by a principal component analysis of the shape points and pixel intensities
- Resulting model:  $\sim 7600$  pixels, 26 combined parameters



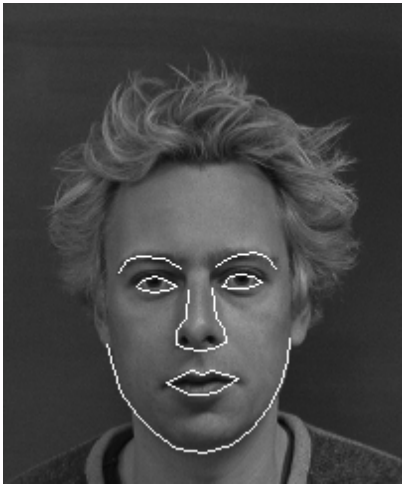
Registration

1st shape mode

1st texture mode

1st combined mode

# AAM Search

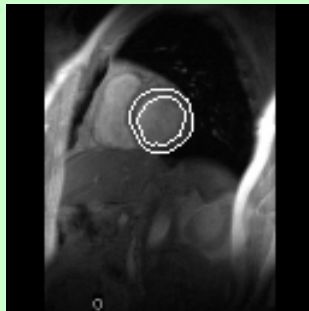


# Multi-resolution AAMs

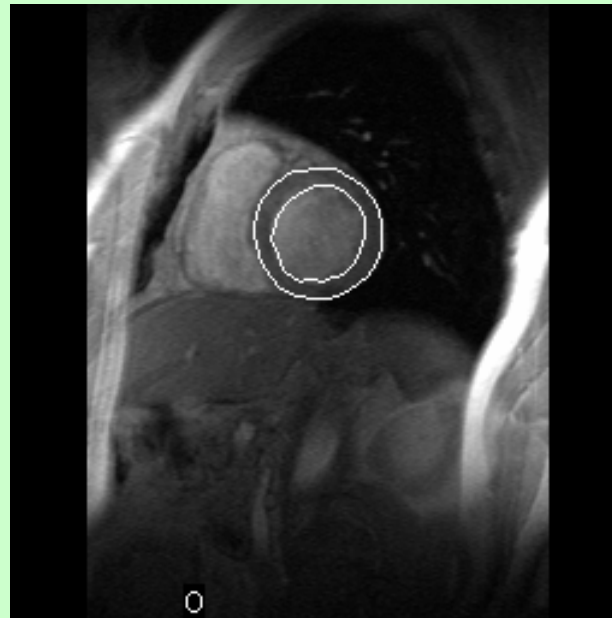
- Normal AAMs are built at each level of a scale-pyramid
- Search-based initialization at top level
- AAM search results propagates down the pyramid



64x64



128x128



256x256

## 3 level Cardiac AAM

Segmentation time:

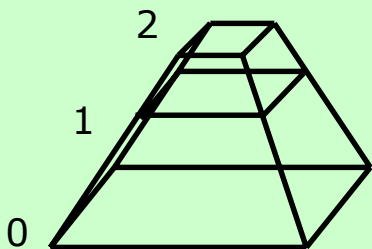
~200 ms

Texture model:

Level 0: 2196 pixels

Level 1: 549 pixels

Level 2: 136 pixels



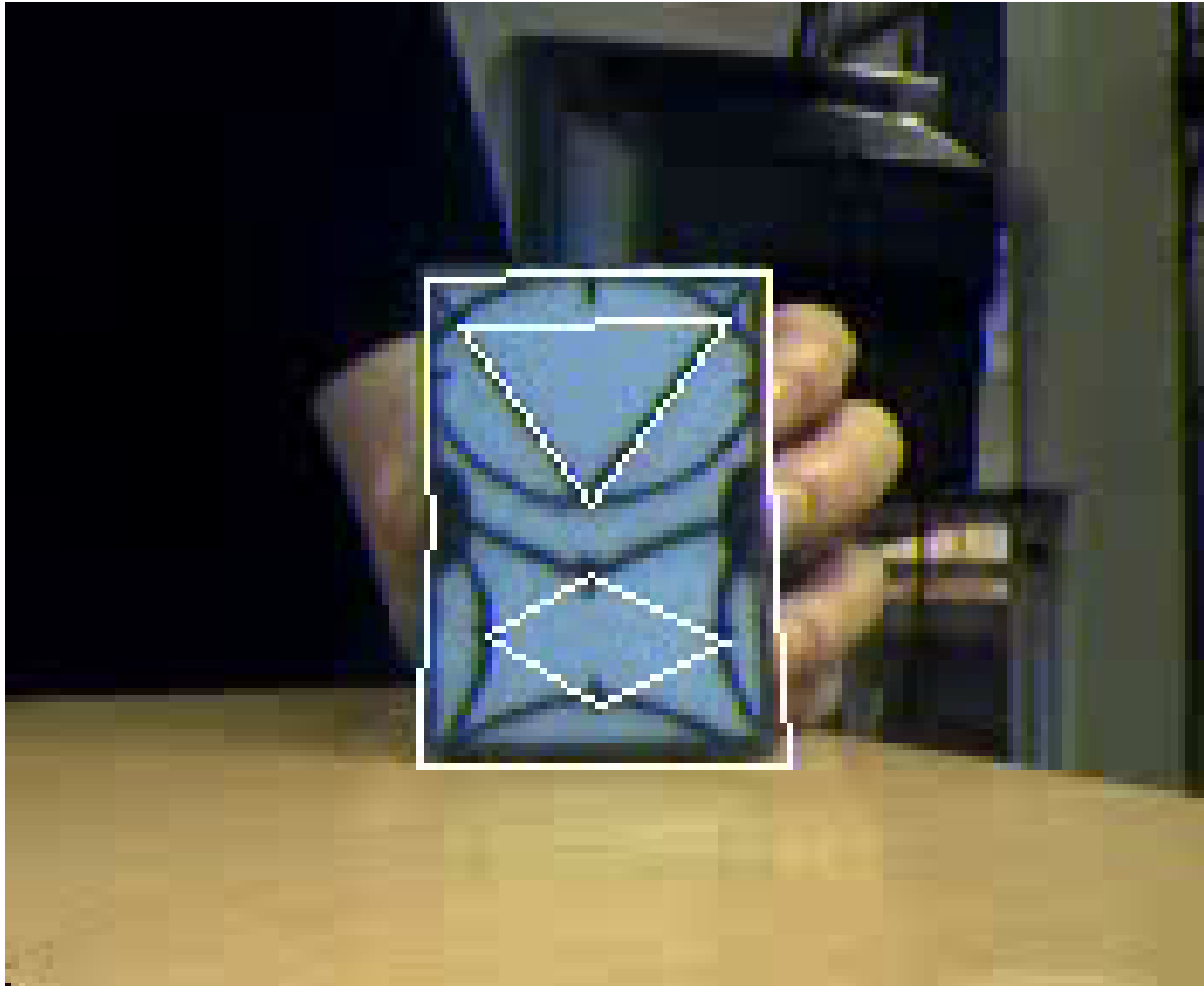


# Real-time AAMs

- Purpose
  - To demonstrate the general nature and the performance of AAMs
- Equipment
  - PC & 30\$ web-cam
- LQ-AAM
  - 5 images / 12 landmarks
  - Texture model: 9.100 pixels
  - Initialized by a 2 level pyramid
- Performance
  - 7-10 frames/sec.
  - No temporal filtering performed



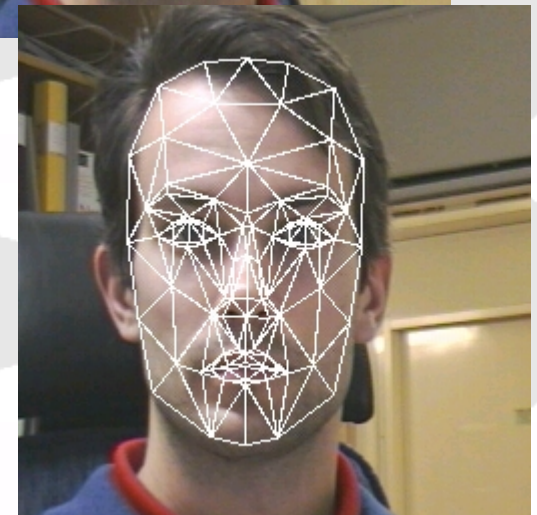
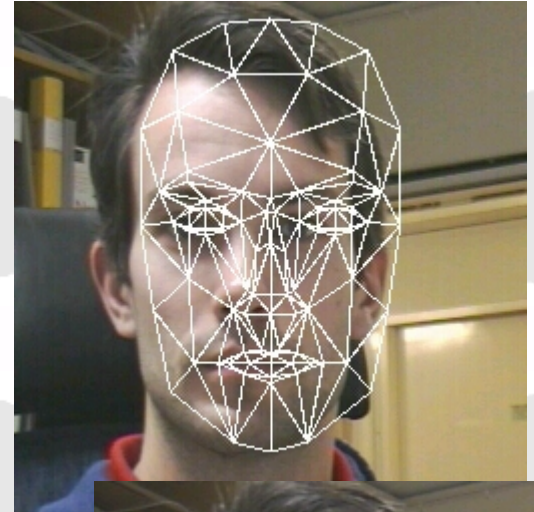
# Near real-time AAMs



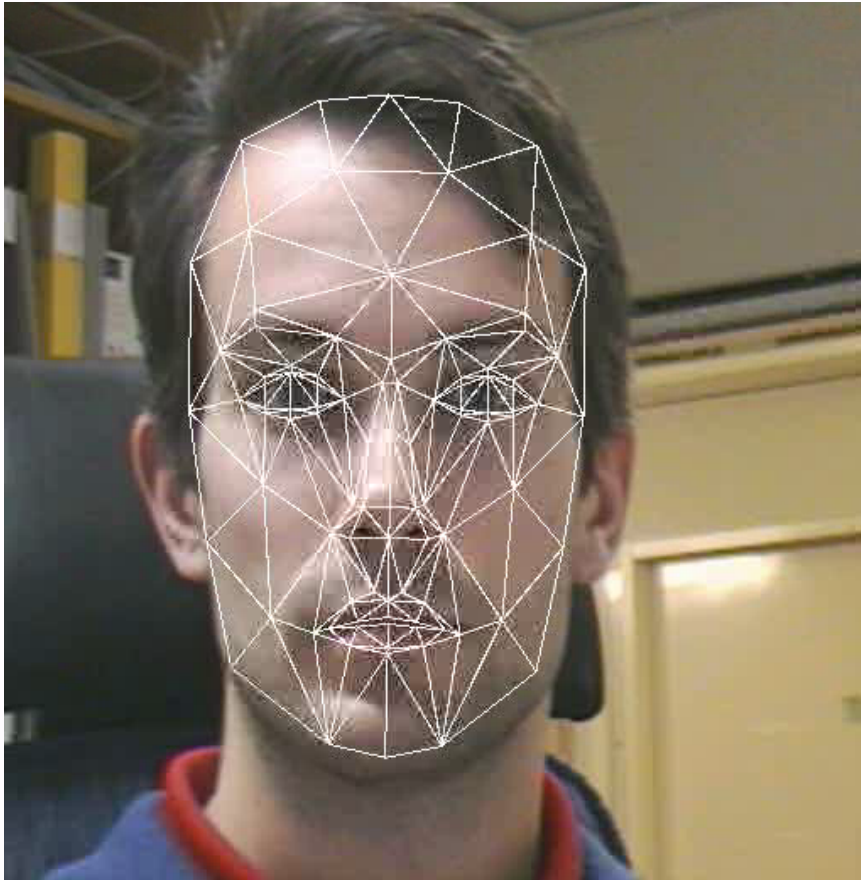
# MPEG-4 AAM

- AAM built on 257 face images of 5 different persons
- AAM mesh corresponds to the MPEG-4 Facial Feature Points, thus making extraction of MPEG-4 Facial Animation Parameters (FAPs) easy
- Processing time: 0.1–1.5 seconds/frame (500 MHz PIII)

Ref: Ahlberg, Jörgen, *An Experiment on 3D Face Model Adaption using the Active Appearance Algorithm*, Linköping University, Image Coding Group, 2001, <http://www.icg.isy.liu.se/~ahlberg>



# Results

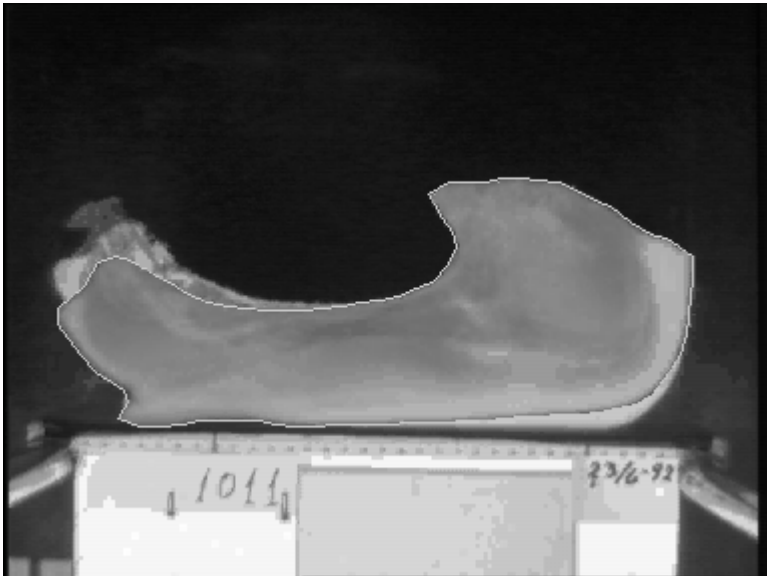
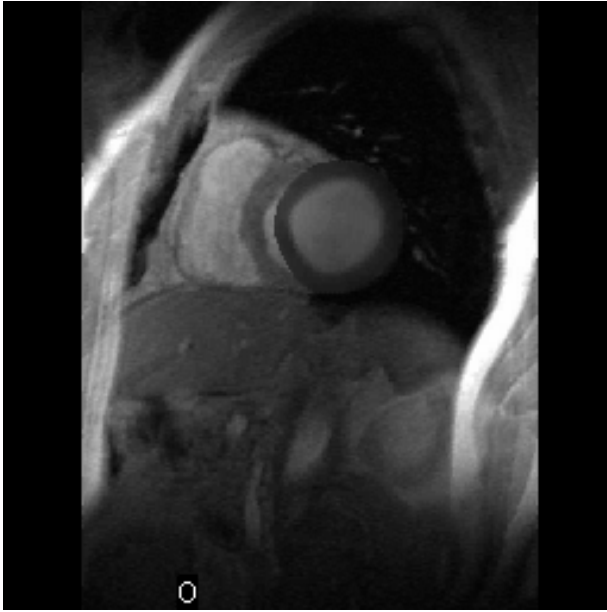


AAM tracking of head movements



Synthesized MPEG-4 FAP movie

# Other AAM Models



# The end

## ■ Acknowledgements

- Face database built by:
  - Janusz Sierakowski, Michael M. Nordstrøm & Mads Larsen
- MPEG-4 facial parameter extraction by:
  - Jörgen Ahlberg, Linköping University - <http://www.icg.isy.liu.se/~ahlberg>

## ■ References

- Tim Cootes (co-inventor of AAM) - <http://www.isbe.man.ac.uk/~bim>
- The AAM-Site - <http://www.imm.dtu.dk/~aam>
- Mikkel B. Stegmann, [mbs@imm.dtu.dk](mailto:mbs@imm.dtu.dk)