

COMPUTER VISION

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COMPUTER VISION

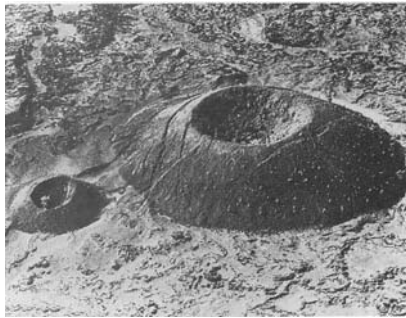
Goal: Inferring the properties of the world from one or more images

- Photographs
- Video Sequences
- Medical images
- Microscopy

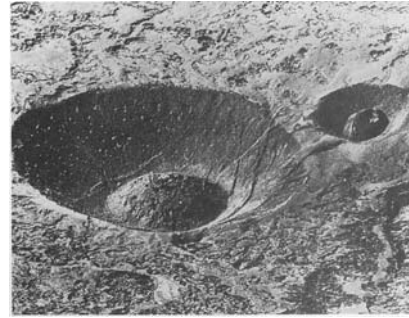


→ Image Understanding

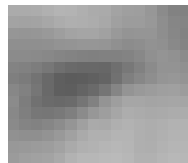
WHAT DO YOU SEE?



AND NOW?



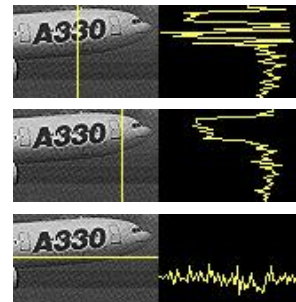
A POWERFUL MECHANISM



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A POWERFUL MECHANISM



CONTEXT & MODELS



CHALLENGES

Vision involves dealing with:

- Noisy images
- Many-to-one mapping
- Aperture problem

→ Requires:

- Assumptions about the world
- Object models

COMPUTERS vs HUMANS

True image understanding seems to involve a great deal of human intelligence:

- Automated systems are still very far from achieving human performances;
- But can be very effective in a sufficiently constrained context.

→ **Good Interfaces key to effective systems**

APPLICATIONS

Cartography:

- Maps from aerial and satellite images

Robotics:

- Autonomous navigation
- Visual servoing

Industrial inspection

- Quality control

Security applications

- Access control
- Surveillance

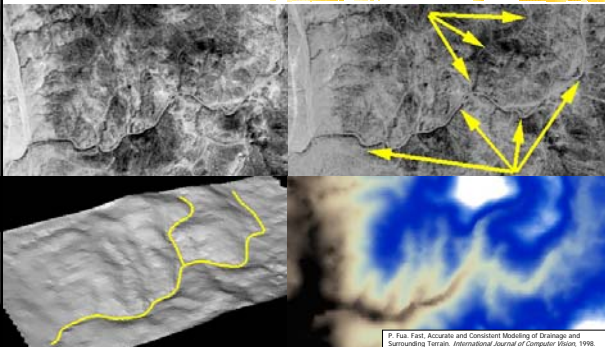
Databases

- Automated retrieval

Medical Imagery

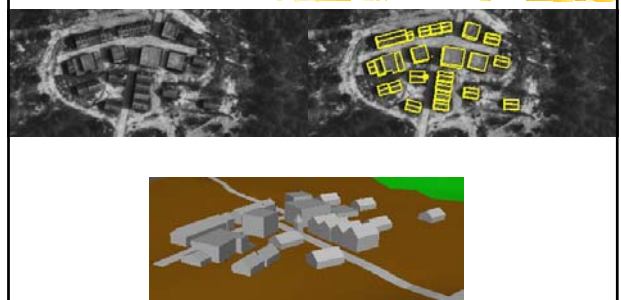
- Microscopy

CARTOGRAPHIC MODELING: RIVERS



P. Fua, Fast, Accurate and Consistent Modeling of Drainage and Cartographic Terrains, International Journal of Computer Vision, 1998.

CARTOGRAPHIC MODELING: BUILDINGS AND ROADS



MARS TERRAIN



APPLICATIONS

- Cartography:**
 - Maps from aerial and satellite images
- Robotics:**
 - **Autonomous navigation**
 - Visual servoing
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MARS ROVER



APPLICATIONS

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VISUAL INSPECTION OF ASSEMBLED DEVICES



Software embedded in the camera to find and read serial numbers

- Localization
- Illumination changes
- Generality

AKAmedix. www.taeym.be

APPLICATIONS

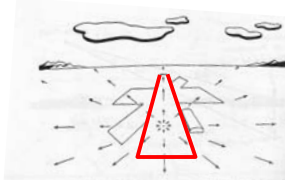
- Cartography:**
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VISUAL SERVOING



<http://mi.eng.cam.ac.uk/~twd20/Research/robotics.html>

SELF-LANDING PLANE



EU Pegasus project:

- Runway detection
 - Tracking
 - Servoing
- Working on it!



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TRACKING PEOPLE



J. Berclaz, F. Fleuret, and P. Fua CVPR'06

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Industrial inspection

- Quality control

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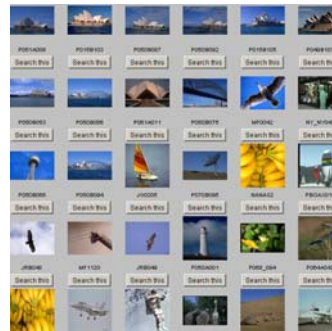
Databases

- Automated retrieval

Medical Imagery

- Microscopy

AUTOMATED RETRIEVAL



Find pictures of the Sydney opera house

- in a large database,
- on the web.

APPLICATIONS

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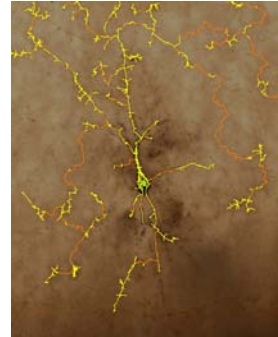
Databases

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Medical Imagery

- **Microscopy**

CONFOCAL MICROSCOPY



HUMAN MODELING FROM VIDEO



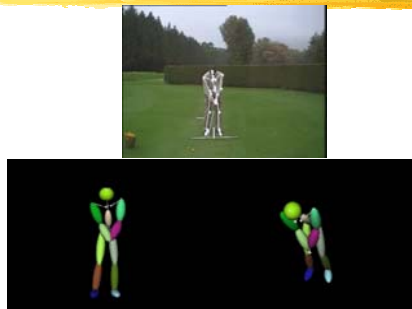
M. Dimitrijevic, S. Ilic, and P. Fua CVPR'04, S. Ilic, and P. Fua PAMI'06

HUMAN MOTION CAPTURE MULTIPLE CAMERAS



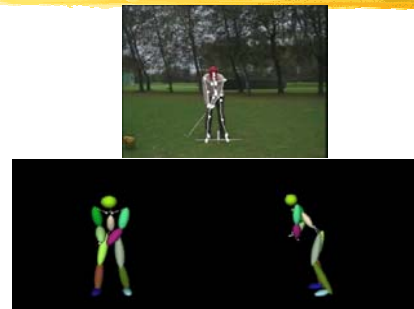
E. Boyer & J.S. Franco CVPR'03, M. Niskanen & E. Boyer & R. Horaud BMVC'05

HUMAN MOTION CAPTURE SINGLE CAMERA



R. Urtasun, D. Fleet, and P. Fua ICCV'05, R. Urtasun, D. Fleet, and P. Fua CVPR'06

HUMAN MOTION CAPTURE

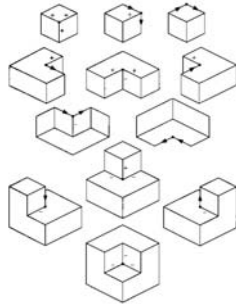


THE BLOCKS WORLD

- Computer Vision started in 1965 at MIT as a short term project.

- Perfect data and strong assumptions.

→ The real world is not like that!



RELATED FIELDS

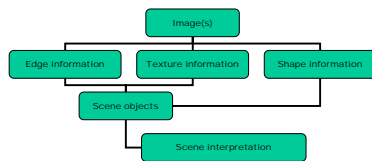
Image processing

- Image enhancement: improve image appearance
 - Image restoration: restore degraded images.
 - Image compression: code images using as few bits as possible
- Can be done without explicit understanding of the scene

Pattern recognition

- Statistical pattern classification
 - Optical character recognition
- Effective with "clean" data.

A PLAUSIBLE SCHEME



Decomposition of the vision process into smaller manageable and implementable steps.

--> Paradigm followed in this course

--> May not be the one humans use

COURSE OUTLINE

Introduction:

- Definition
- Human Vision

Image formation:

- Optics
- Radiometry

Extracting features:

- Edge detection and linking
- Region segmentation

Shape recovery:

- From one image
- Using additional images

COURSE MATERIAL

Textbooks:

- V. S. Nalwa, A Guided Tour of Computer Vision, Addison- Wesley, 1993.
- D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002.
- A. Zisserman and R. Hartley, Multiple View Geometry in Computer Vision, Cambridge University Press, 2003.
- R. Horaud and O. Monga, Vision par ordinateur, Editions Hermes, 1995.

Web page:

<http://cvlab.epfl.ch/~fua/courses/vision/intro>

COURSE ORGANIZATION

- Formal lectures
- Exercises every other week
- Written examination