International Conference on Pattern Recognition, Cambridge, England, August 23-26, 2004

- Alexei Gritai, Yaser Sheikh and Mubarak Shah, On the Invariant Analysis of Human Actions, 17th conference of the International Conference on Pattern Recognition, 2004.
- Imran Junejo, Omar Javed, Mubarak Shah, Multi Feature Path Modeling for Video Surveillance, 17th conference of the International Conference on Pattern Recognition, 2004.
- Asaad Hakeem and Mubarak Shah, Ontology and Taxonomy Collaborated Framework for Meeting Classification, 17th conference of the International Conference on Pattern Recognition, 2004.
- Orkun Alatas, Omar Javed, and Mubarak Shah, Compressed Spatio-temporal Descriptors for Video Matching and Retrieval, 17th conference of the International Conference on Pattern Recognition, 2004.
- Yun Zhai, Zeeshan Rasheed, Mubarak Shah, Conversation Detection in Feature Films Using Finite State Machines, 17th conference of the International Conference on Pattern Recognition, 2004. 17th conference of the International Conference on Pattern Recognition

CAP 6411 Computer Vision Systems

- Instructor: Dr. Mubarak Shah, shah@cs.ucf.edu, 238 CSB, http://www.cs.ucf.edu/courses/cap6411
- Office Hours:
  - 2PM to 3PM Tues and Thurs, 3PM-4PM Monday, and by appointment
- Grading
  - Mid term 20%, Final 25%, Programs 45% , Homework 10%
- Recommended Book, but not required.
  - Digital Video Processing, A. M. Tekalp, Prentice Hall.

Contents

- Lecture-1: Introduction of Video Computing
- Lecture-2: Image Motion Models
- Lecture-3: Optical Flow
- Lecture-4: Pyramids
- Lecture-5: Global affine (Anandan)
- Lecture-6: Global Projective (Szeliski, Mann)
- Lecture-7: Feature-based Registration
- Lecture-8: Structure from Motion
- Lecture-9: Model-Based Video Compression -I

Contents

Thursday's Class

- Xiao will explain:
  - How to read/write an image in your C program
  - Sequences
  - Routines
- Very important for people not familiar with vision

Computer Vision Story

Mubarak Shah

http://www.cs.ucf.edu/courses/cap6412/2003/Lecture-1.pdf

Computer Vision

- Computer Vision deals with recovery and use of information about objects present in a scene from images of the scene.

Computer Vision

- Computer Vision emerged from:
  - Image Processing
  - Pattern Recognition

Computer Vision

- Computer Vision started as an AI problem.

AI

- Artificial Intelligence is the study of mental faculties through the use of computational models.
  - Search
  - NLU
  - Speech Recognition
  - Games
  - Computer Vision
  - Expert Systems

Image Understanding

- To understand a single image of a scene, locate and identify objects, their structure, and spatial arrangements, and relationships with other objects.

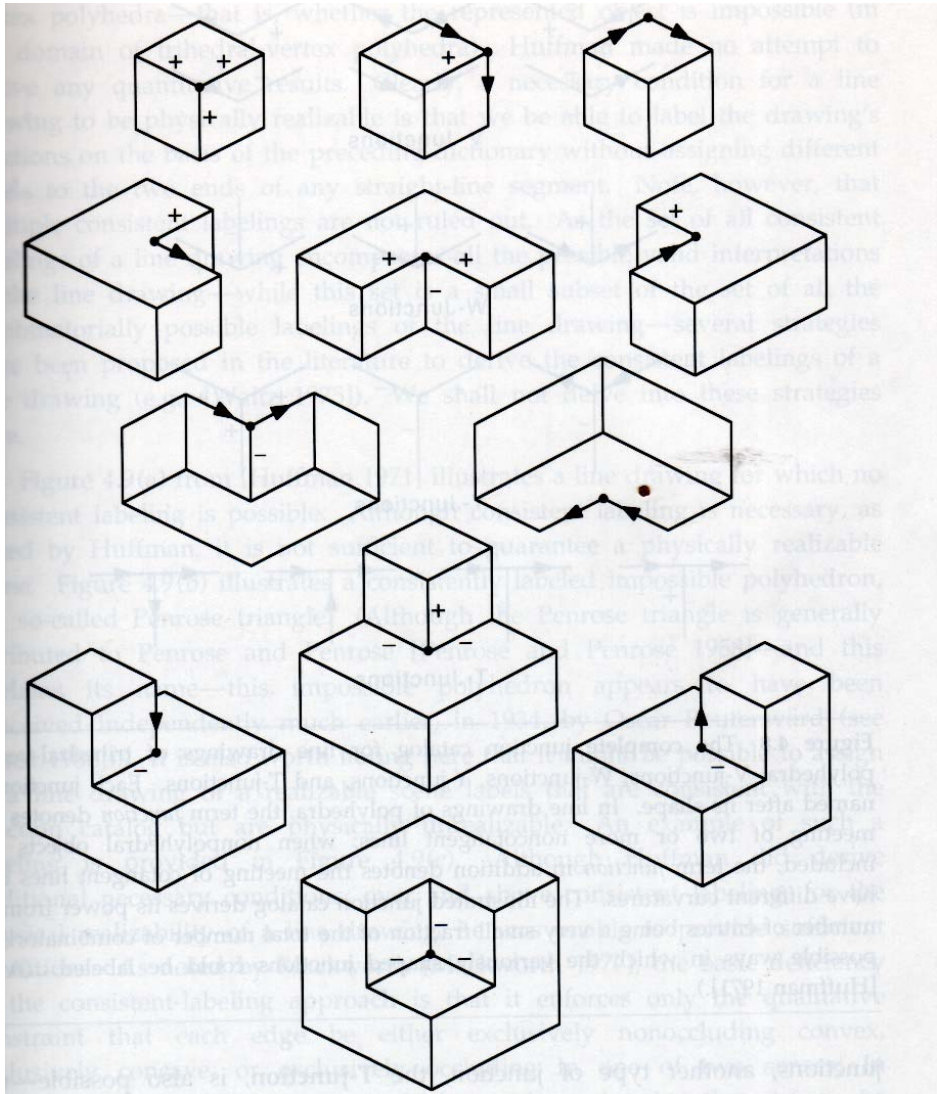
Different Levels

- Low Level: Extraction of symbolic information
- Intermediate Level
- High Level: Interpretation

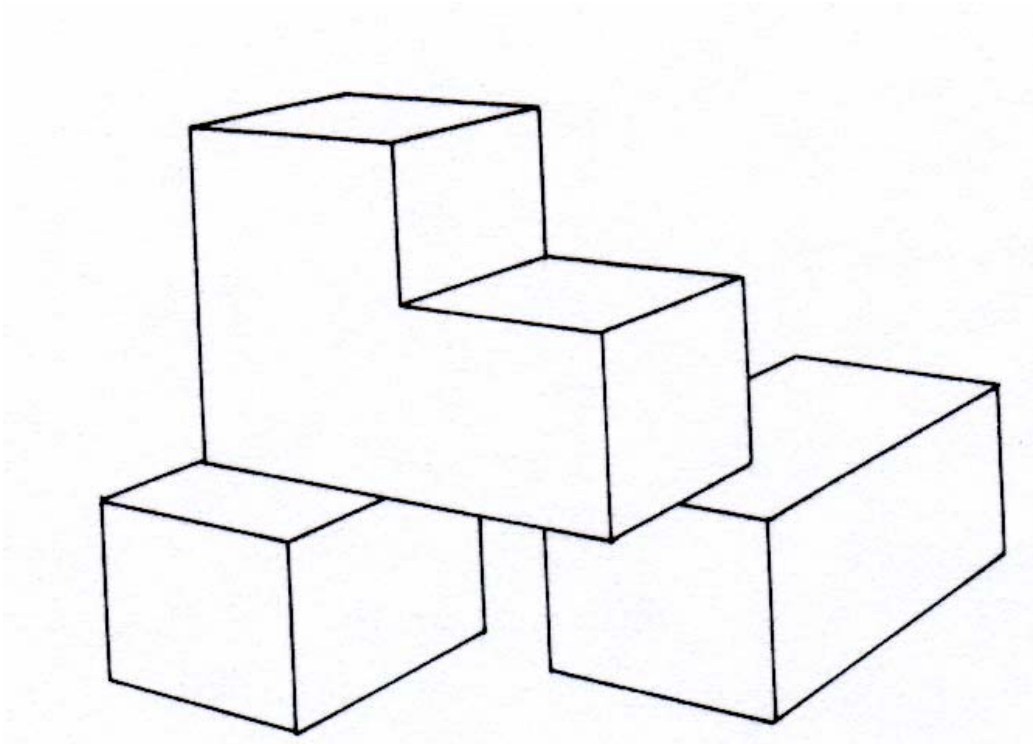
High Level Vision

- Image Understanding
- Scene Interpretation
- Line Drawings

Interpretation of Line Drawing



MIT Copy Demo

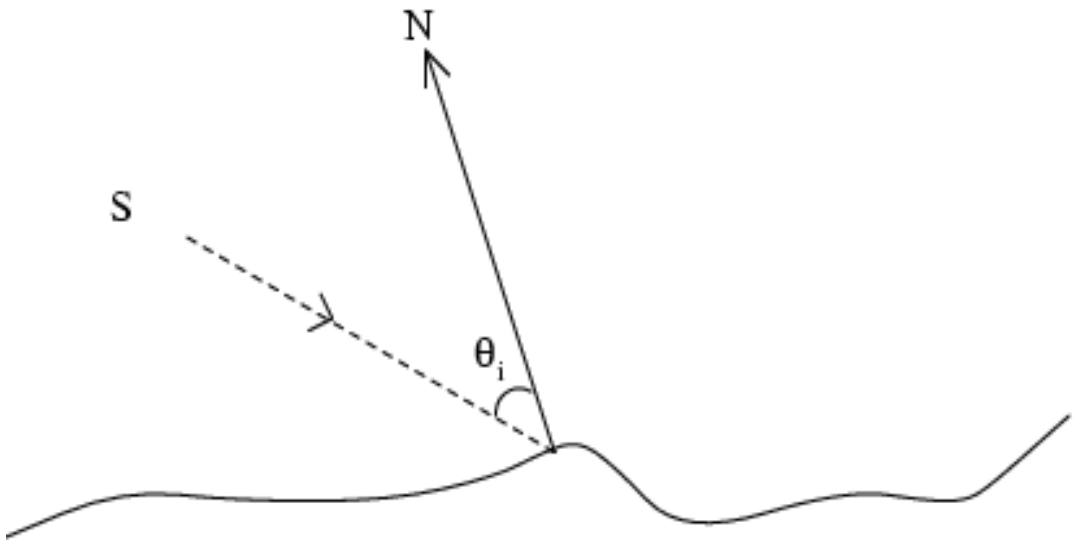


What happened?

- In order to do line interpretation, need to extract lines from images
  - Horn-Binford line finder
  - Solve low level problems before high level problems can be solved.

Horn: Physics Based Vision

- Optics
- Reflectance
- Illumination



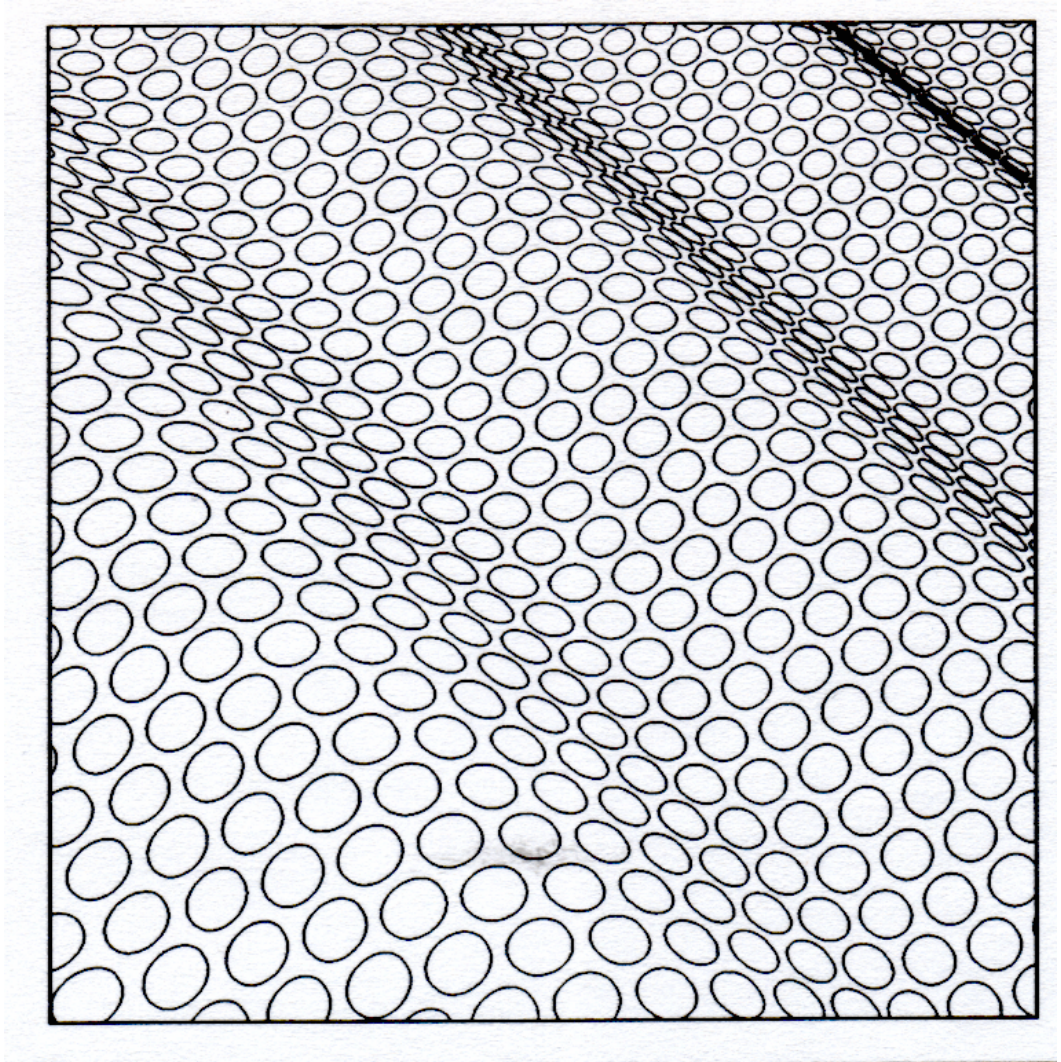
Marr Approach

- **Human vision system**
- **Shape from X: Recover 3-D from 2-D**
- **Quantitative vs Qualitative**

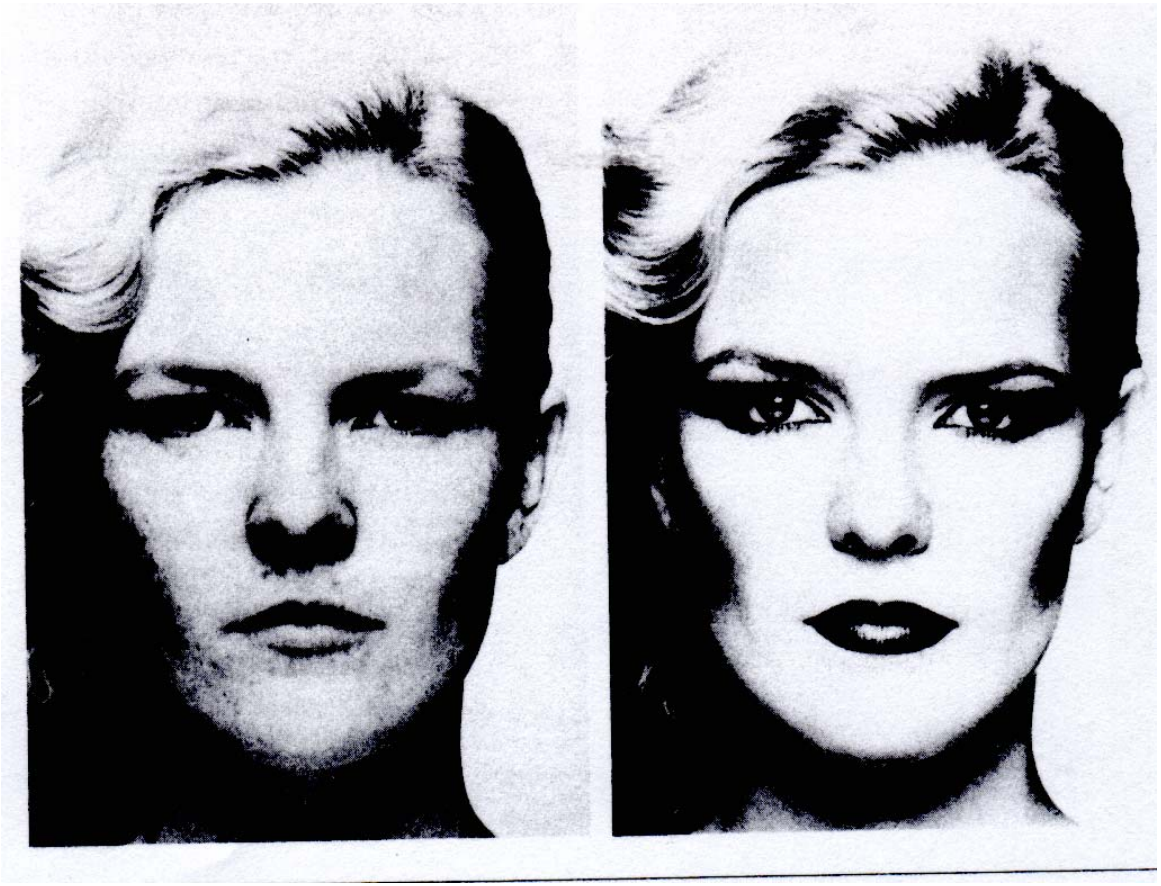
Shape from X

- Shading
- Stereo
- Texture
- Motion
- Contours

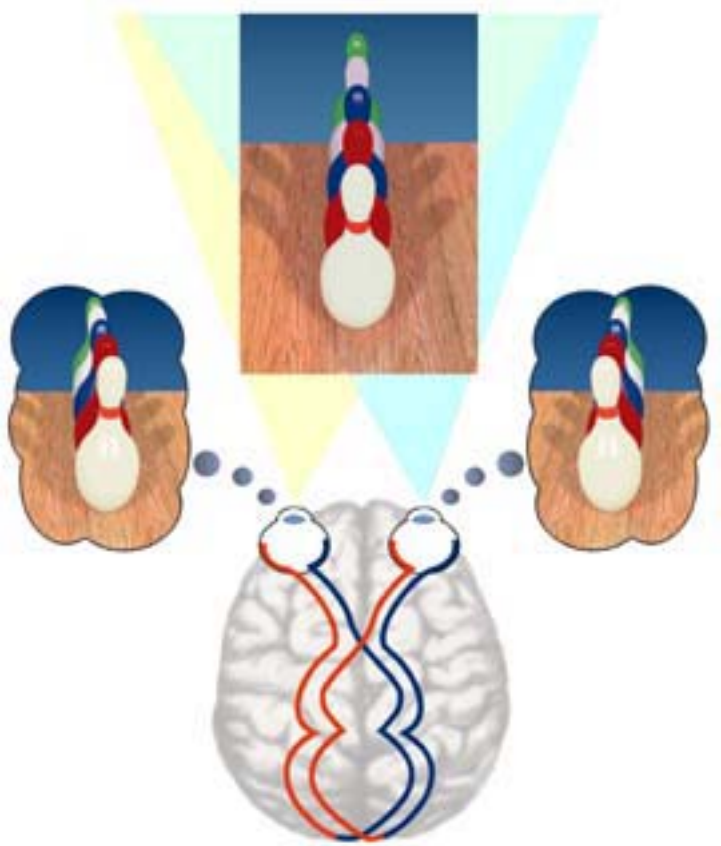
Shape from Texture



Shape from Shading



Shape from Stereo



Marr's Three Levels

- Primal Sketch
  - Marr-Hildreth edge detector
- 2.5 Sketch
  - Marr-Poggio stereo algorithm
  - Grimson's stereo algorithm
  - Ullman's structure from motion
  - Pentland, Witkin, Kass,
  - Terzopoulos: surface reconstruction
- 3-D
  - Generalized Cylinders: Nishihara

After 30 Years of Research

- Stereo is almost a solved problem
- Structure from motion is very hard
- Shape from shading is not interesting/applicable
- Range images did not help much
- Not much progress in understanding/recognition/interpretation

Motion-Based Recognition

- A longer sequence leads to recognition of higher level motions, like walking or running,which consist of a complex and coordinated series of events that cannot be understood by looking at only a few frames.
  - 3-D is not necessary for recognition
  - Use motion directly for recognition vs
    - Recognition followed by reconstruction

Video Understanding

- Gestures
- Activities
- Facial expressions
- Visual Speech

- Applications
  - Video Surveillance and Monitoring
  - Perceptual User Interface
  - Model-based Video Compression
  - Augmented Reality and Video Games
  - Synthesis of Video Sequences

Copy Demo Using A Video Sequence:

Making a Sandwich

[bread, lettuce, ham, bread]

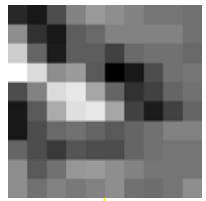
A picture is worth a thousand words.

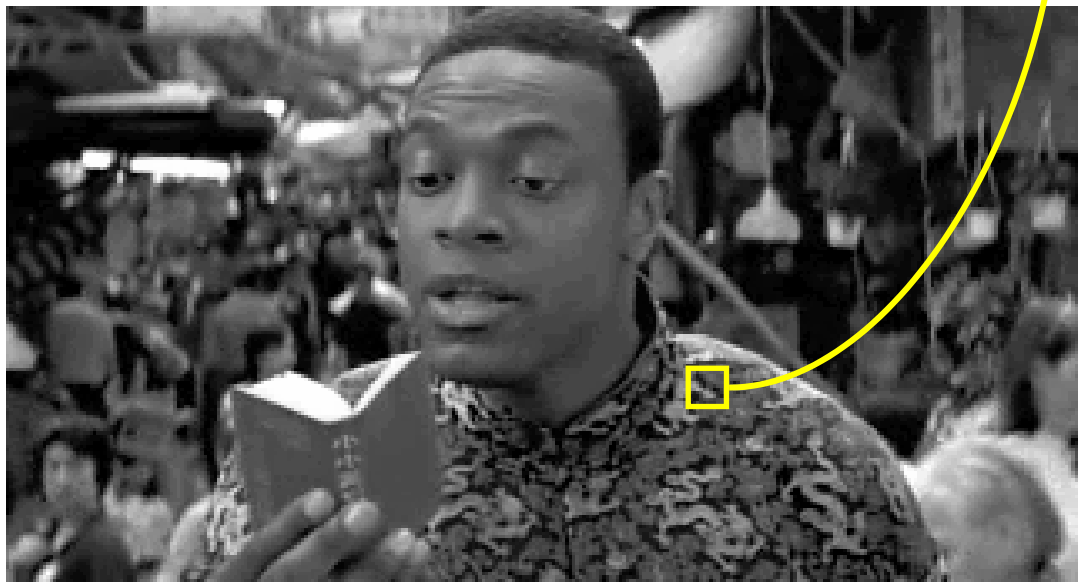
A word is worth a thousand pictures.

A H UNT

What is an Image?

34	23	58	89	106	97	89	83	83	81
97	39	23	67	75	89	89	89	89	81
139	73	26	67	67	50	75	81	81	75
171	147	97	106	64	7	23	58	81	83
56	89	147	155	114	73	40	50	73	81
23	64	115	148	155	114	48	26	48	73
23	56	74	81	73	64	73	81	89	89
73	56	45	62	57	56	73	81	82	82
97	64	81	103	106	97	89	82	82	82
97	81	89	86	89	97	81	78	82	97





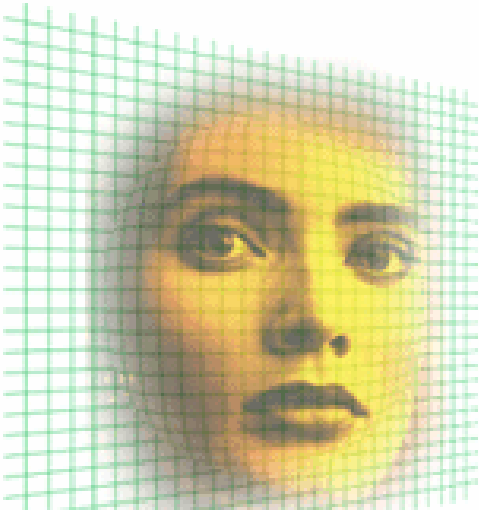
Video Clip

Sequence of Images

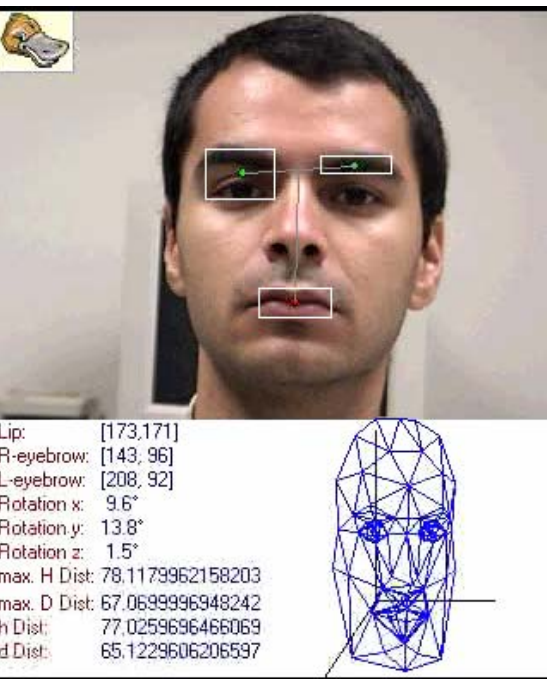
Applications

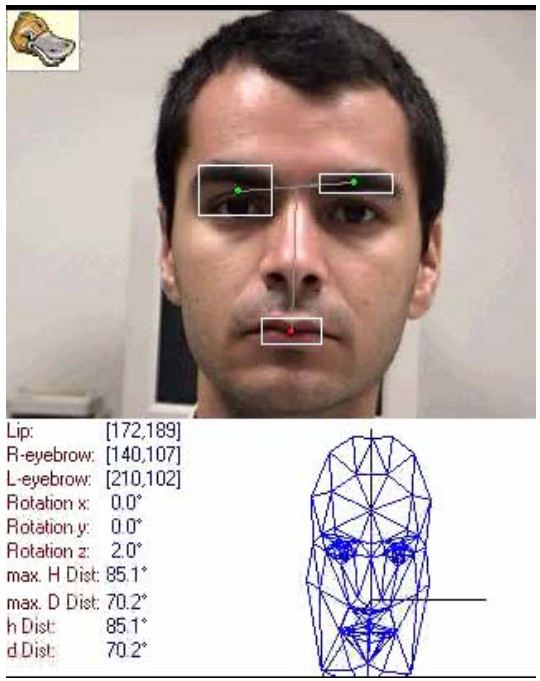
- Face Recognition
- Robotics
- Remote Sensing: UAVs
- Computer Graphics
- Video Surveillance and Monitoring
- Video Data Mining

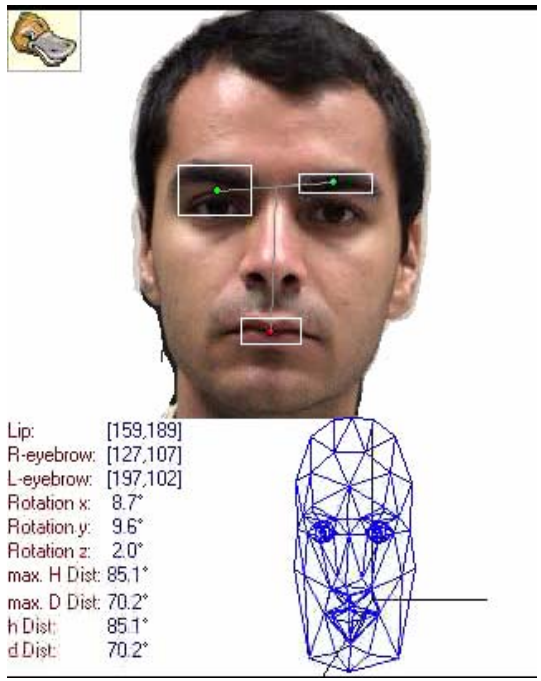
Face Recognition



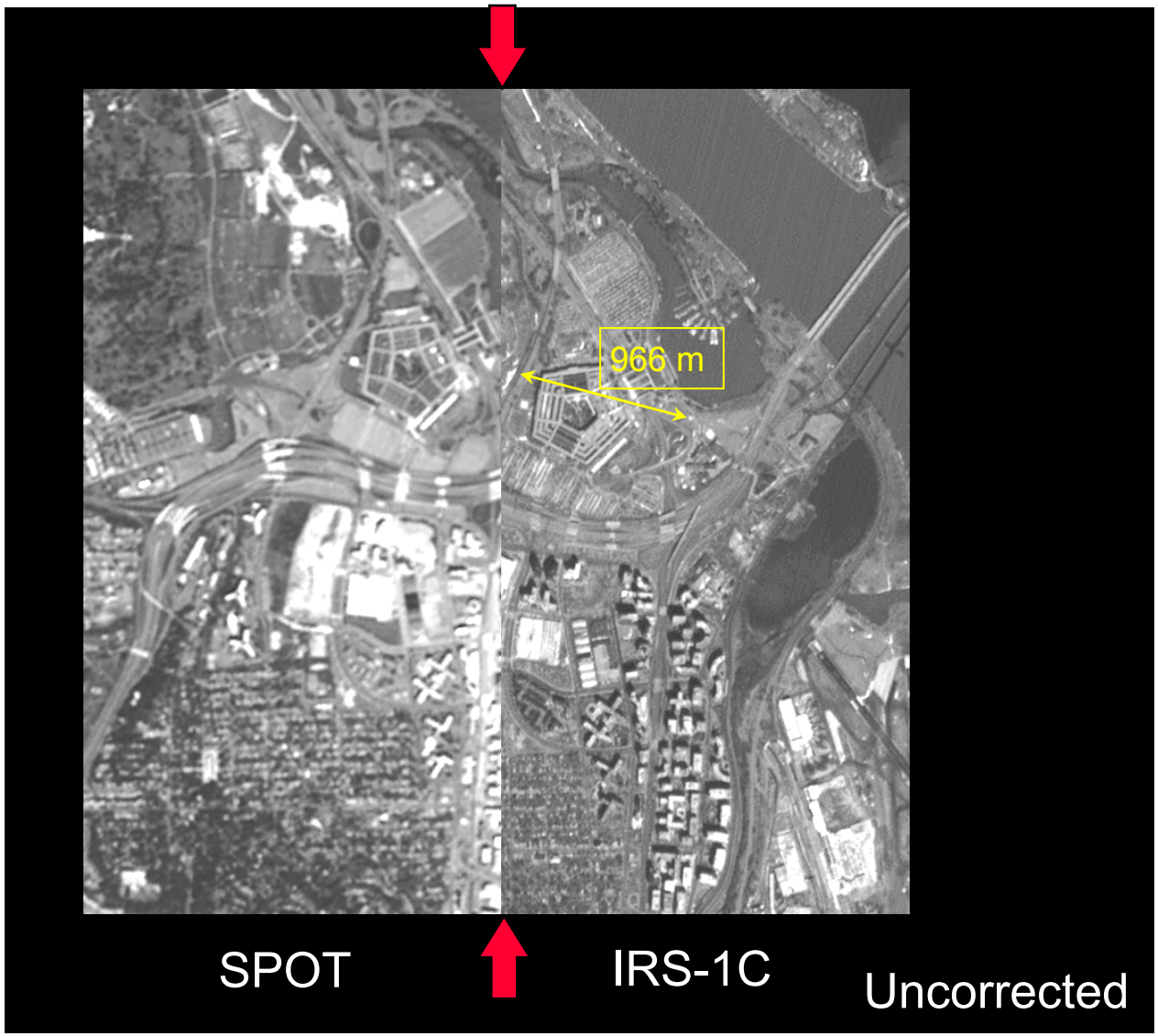
Determining Face Orientation



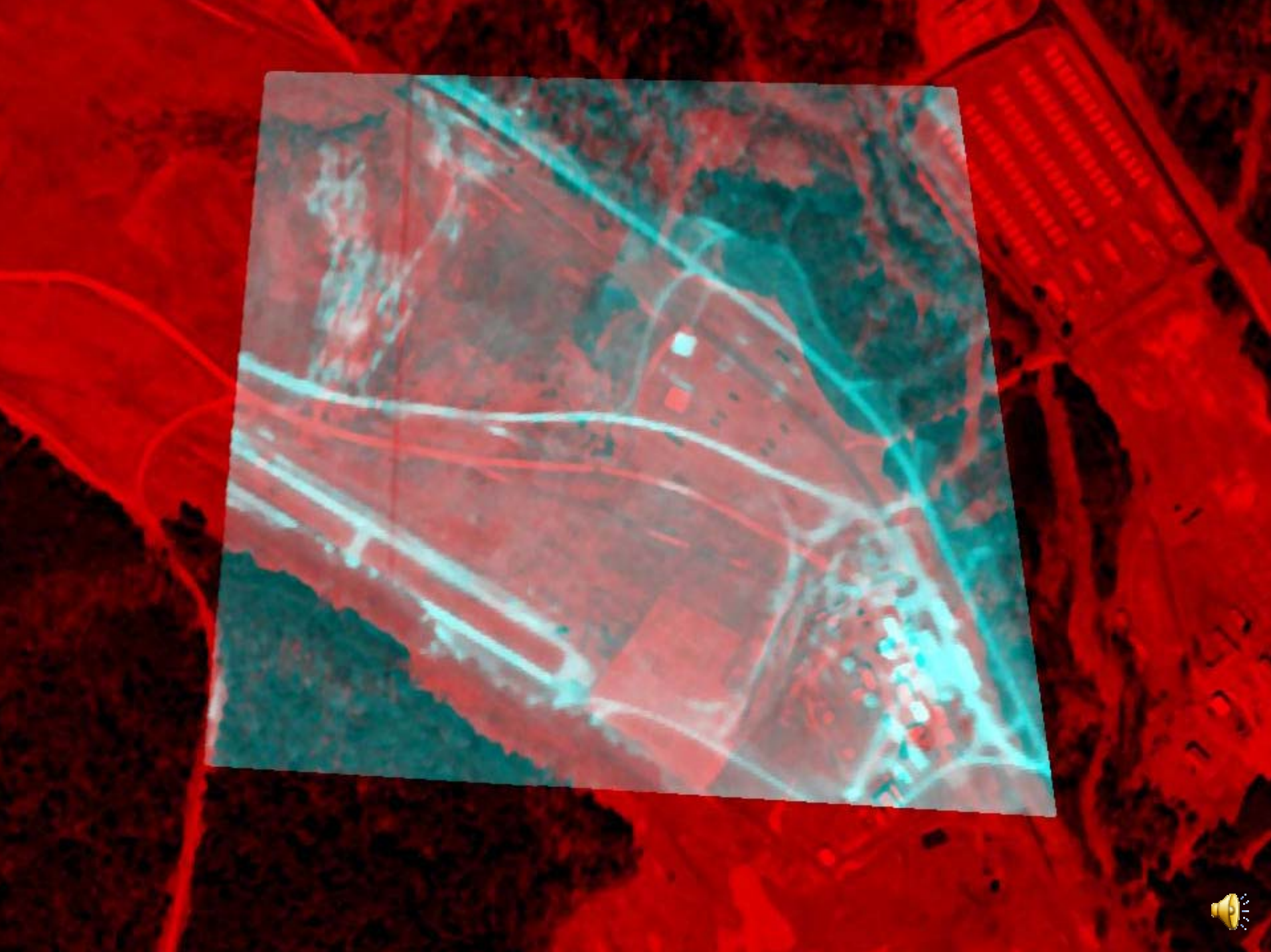




Geo-registration



Registered IRS-1C to SPOT



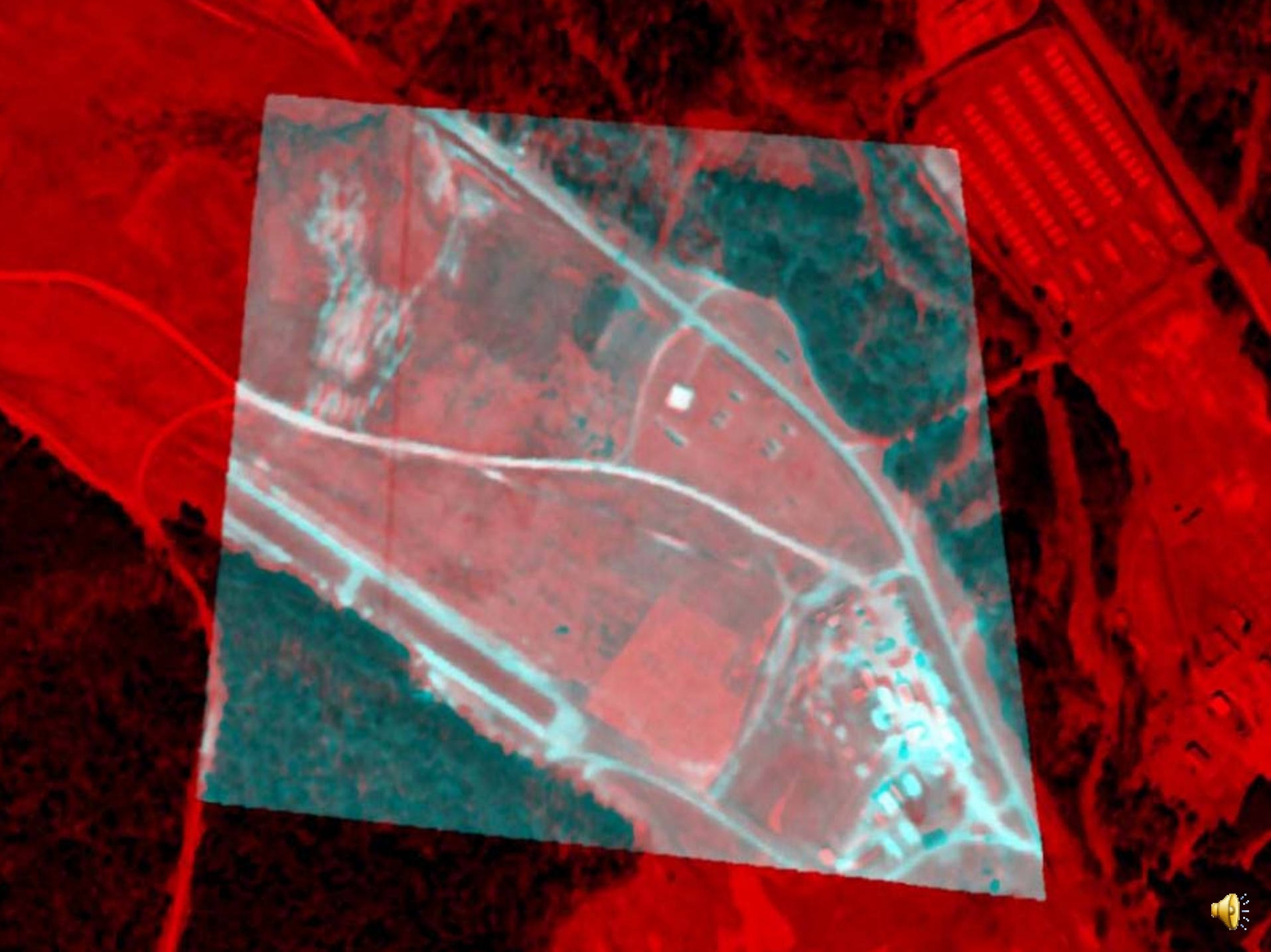


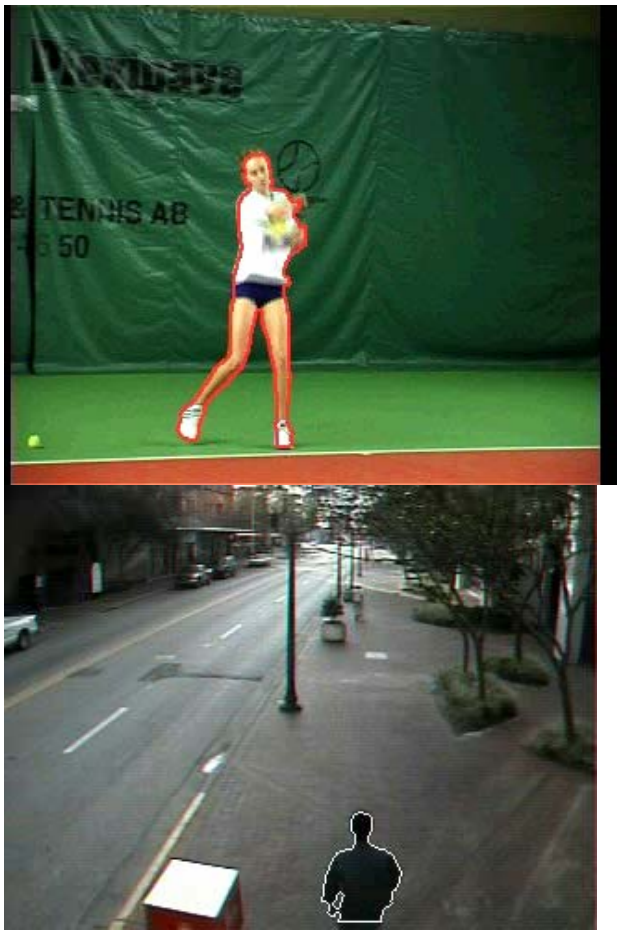
Image-Based Rendering

KNIGHT
Crime Scene Detection System
for The Orlando Police Department

Cameras

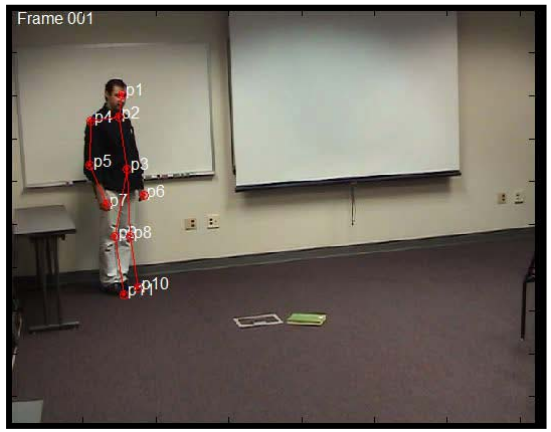
Tracking

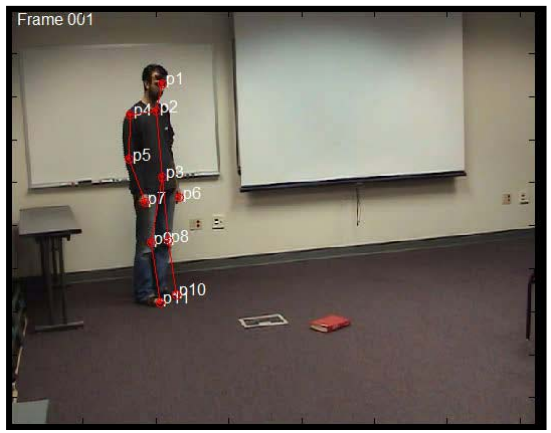
Contour-based Object Tracking Using Level Sets

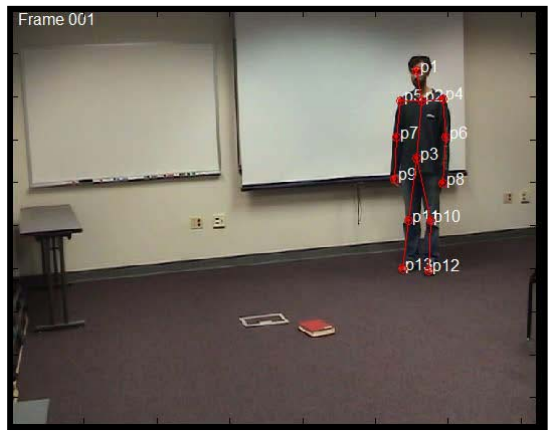


Action Detection: Different approaches, different people, the same action

ReferencePattern

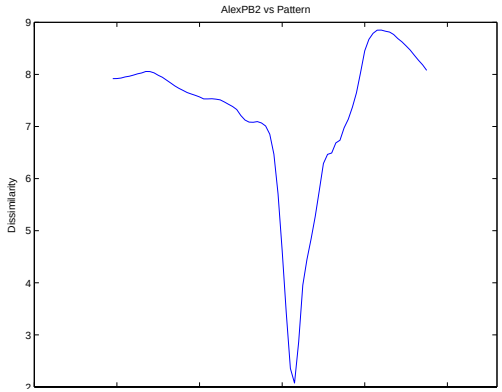


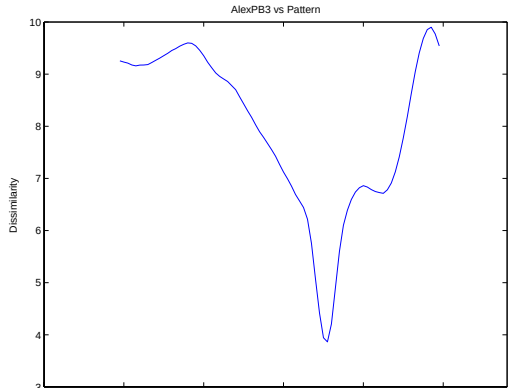


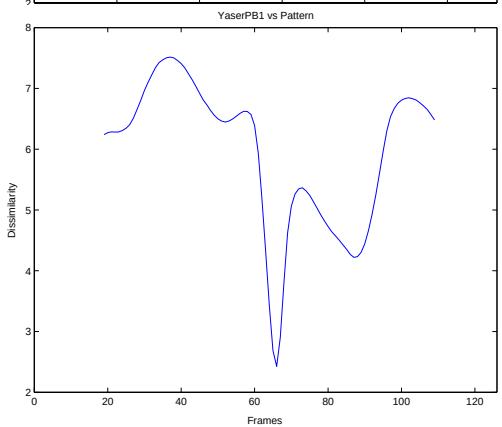


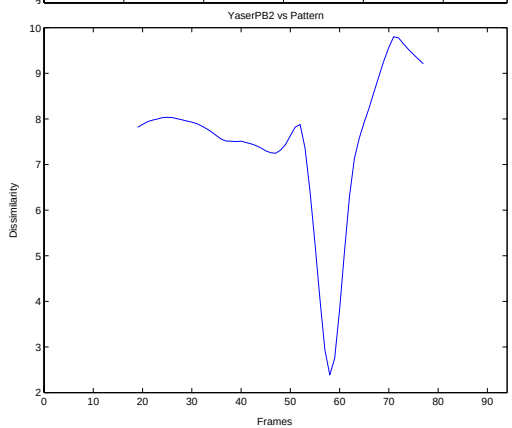
Test Sequences

Action Detection: Different approaches, different people, the same action



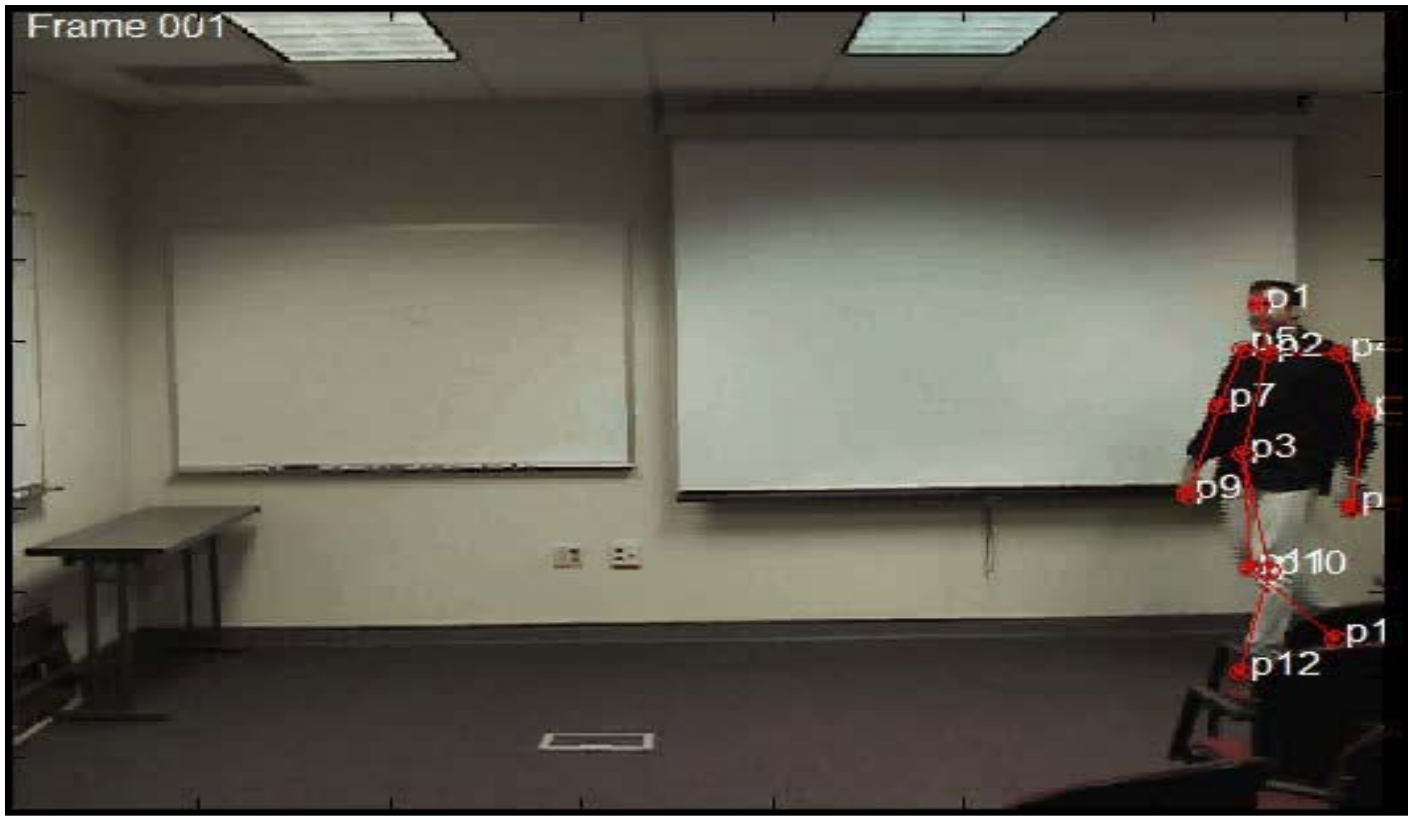




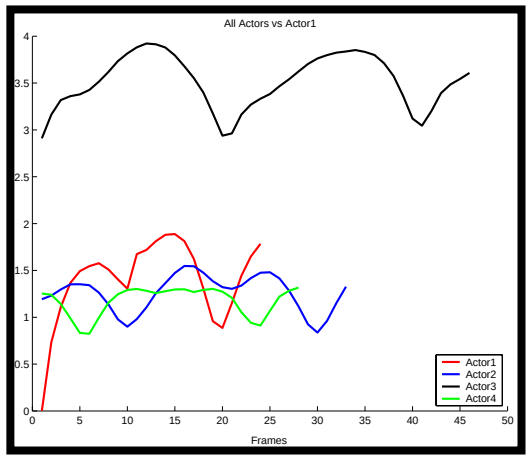


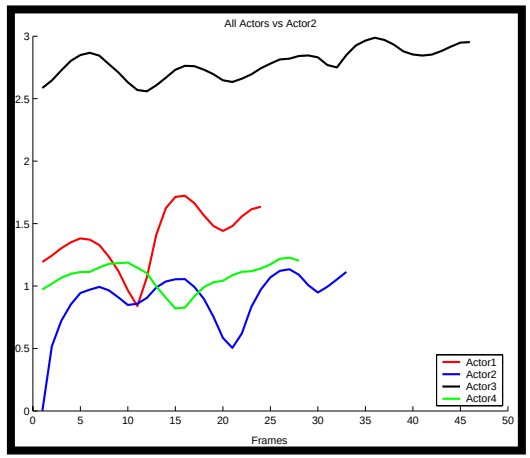
Analyzing Actions

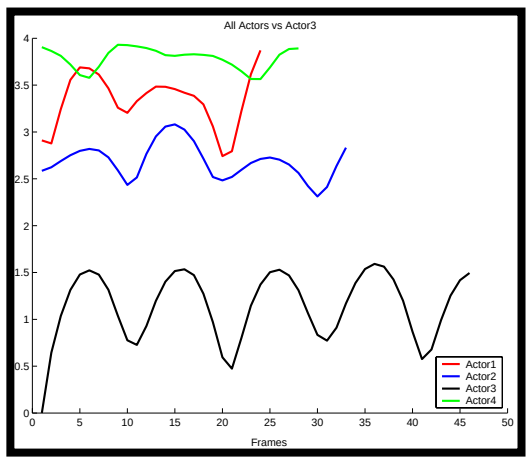
Odd One Out

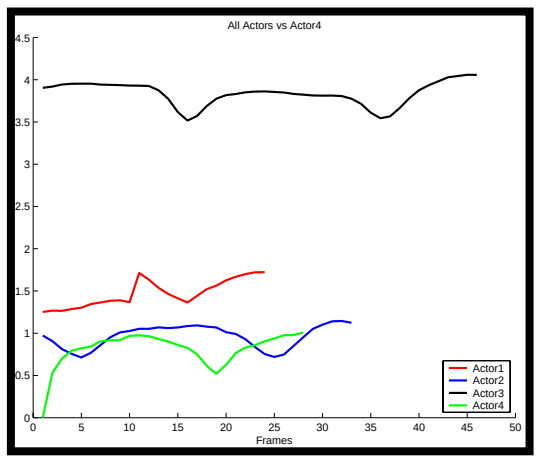


‘Odd One Out’


All Actors vs Actor1
Actor1
Actor2
Actor3
Actor4
Frames


All Actors vs Actor2
Actor1
Actor2
Actor3
Actor4
Frames


All Actors vs Actor3
Actor1
Actor2
Actor3
Actor4
Frames

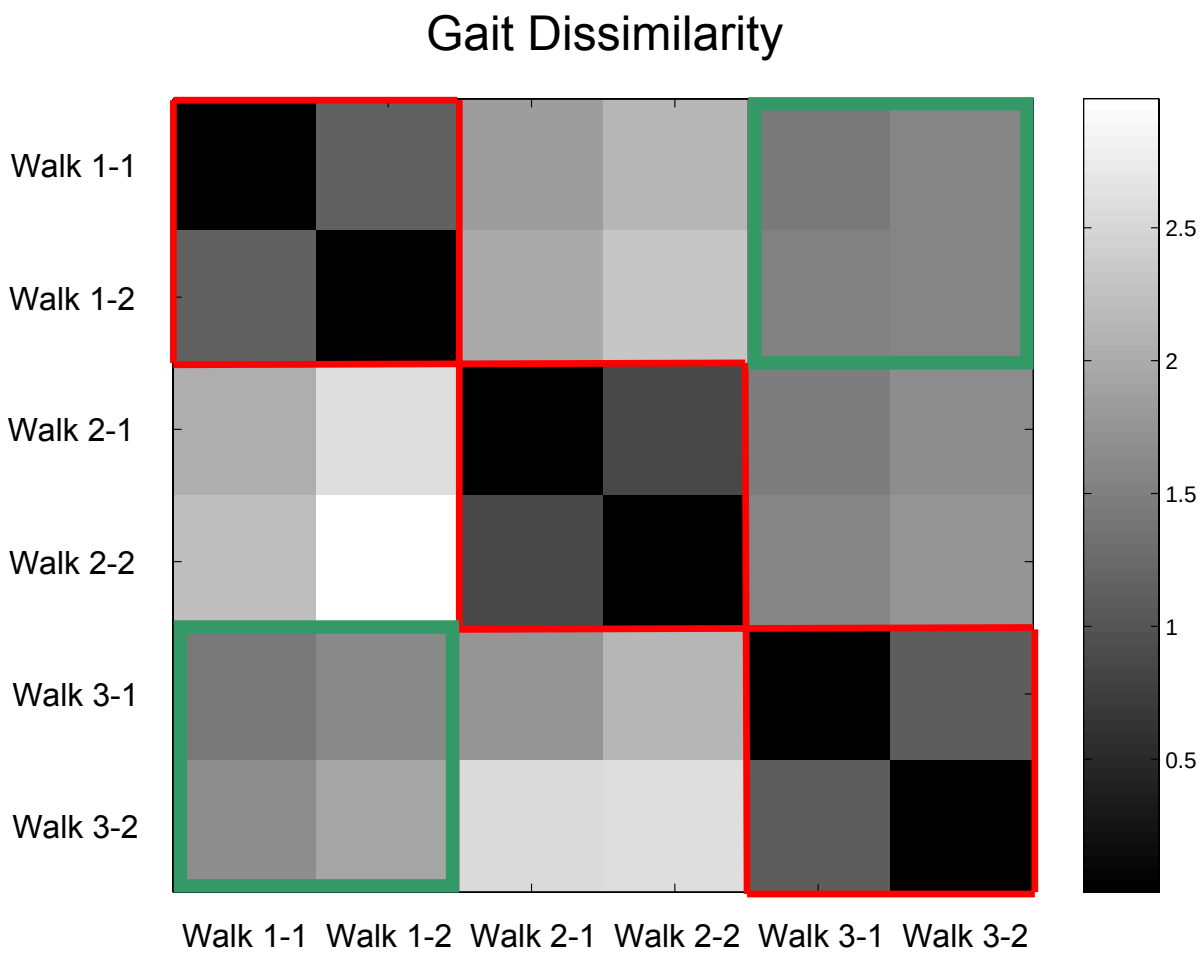

All Actors vs Actor4
Actor1
Actor2
Actor3
Actor4
Frames

Gait Analysis

- Three Actors viewed from two views each

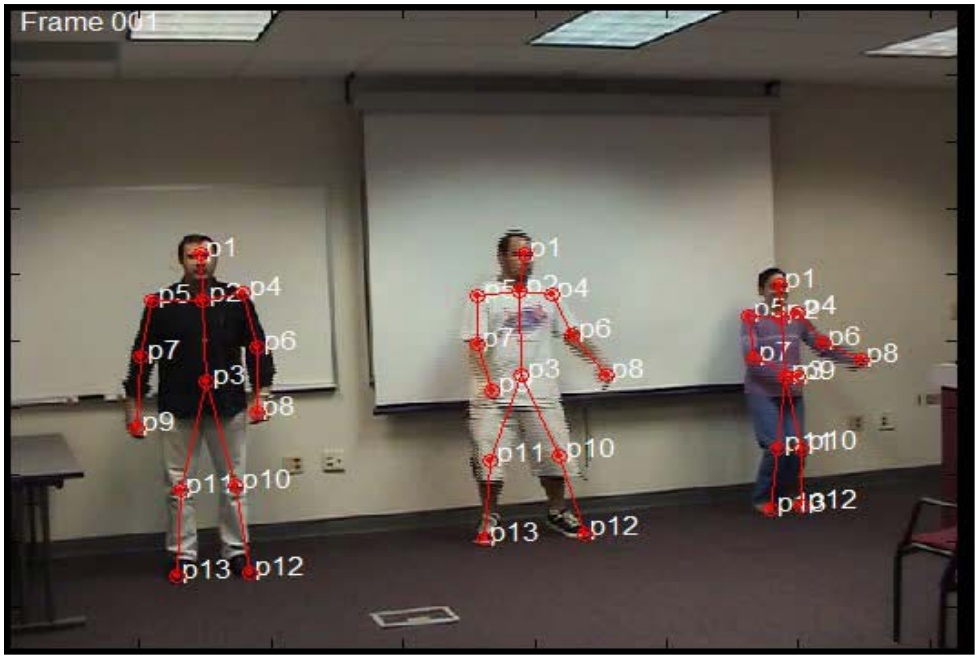
Gait Analysis: Human ID Dataset

Gait Analysis



Action Synchronization

Following the Leader



Action Synchronization

Following the Leader

Outdoor Activities

Scene Representation (Terminator II)

Obtained from the DVD

Chapter 21: Syringe Point

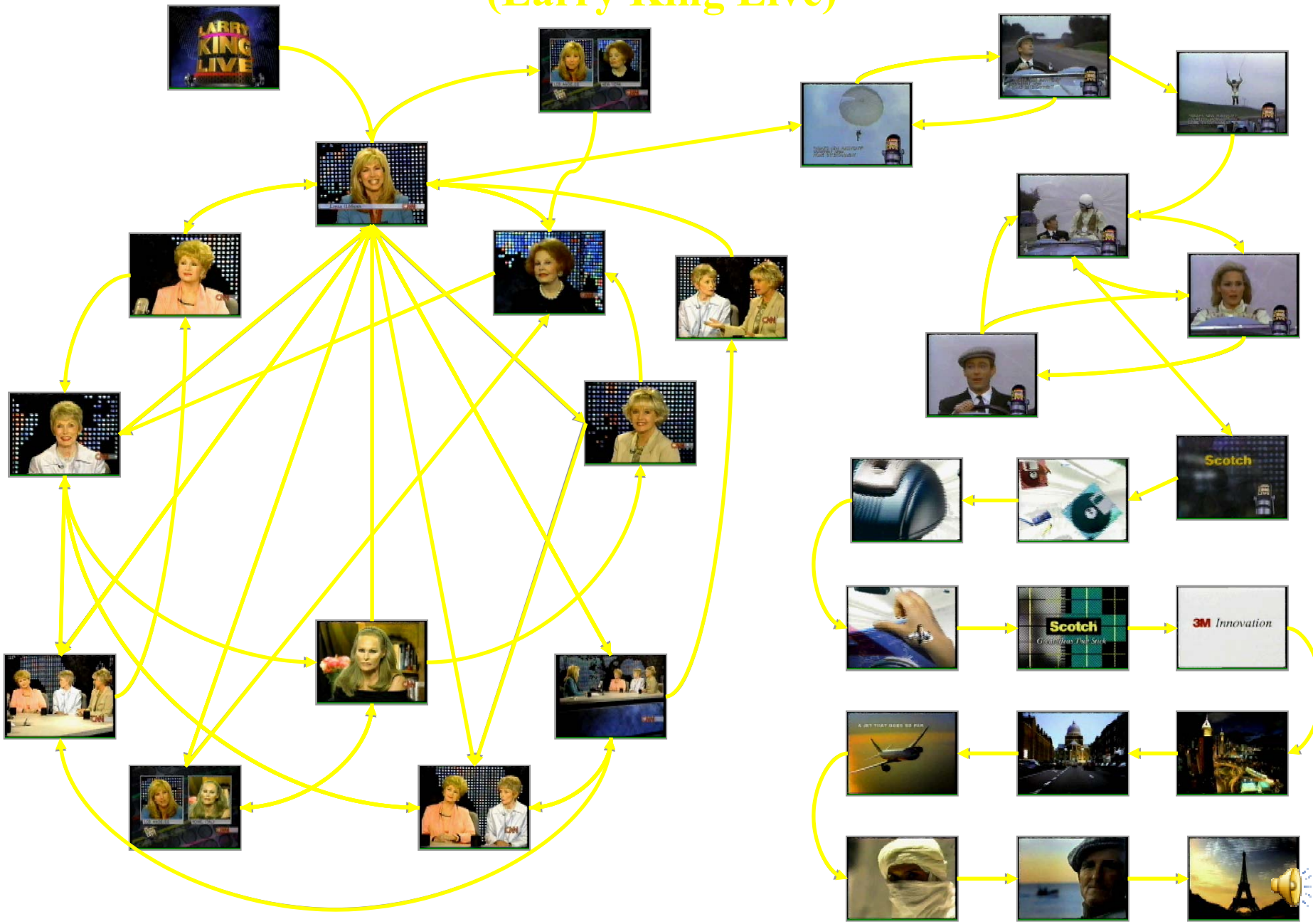

Detected by our algorithm

Chapter 26: Night Repairs


Chapter 29: Detailed Files


Chapter 30: Scalcedas Camp


A Shot Connectivity Graph (Larry King Live)



Video Google

NIST TRECVID Competition

Face Detection

Training Clinton Detector

Some statistics

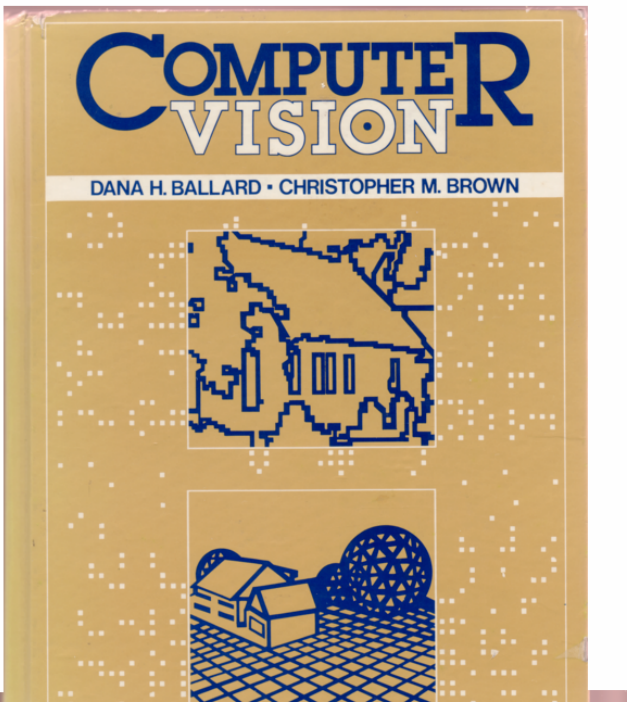
- Given:
  - Totally 128 videos (30 minutes each)
  - Totally 48,893 key frames (9,918 faces)

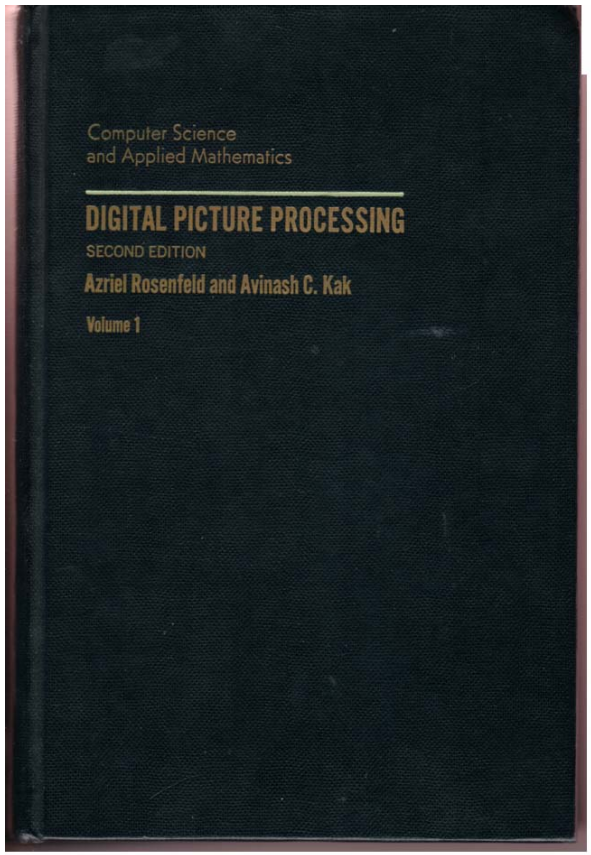
The difficult case: Albright

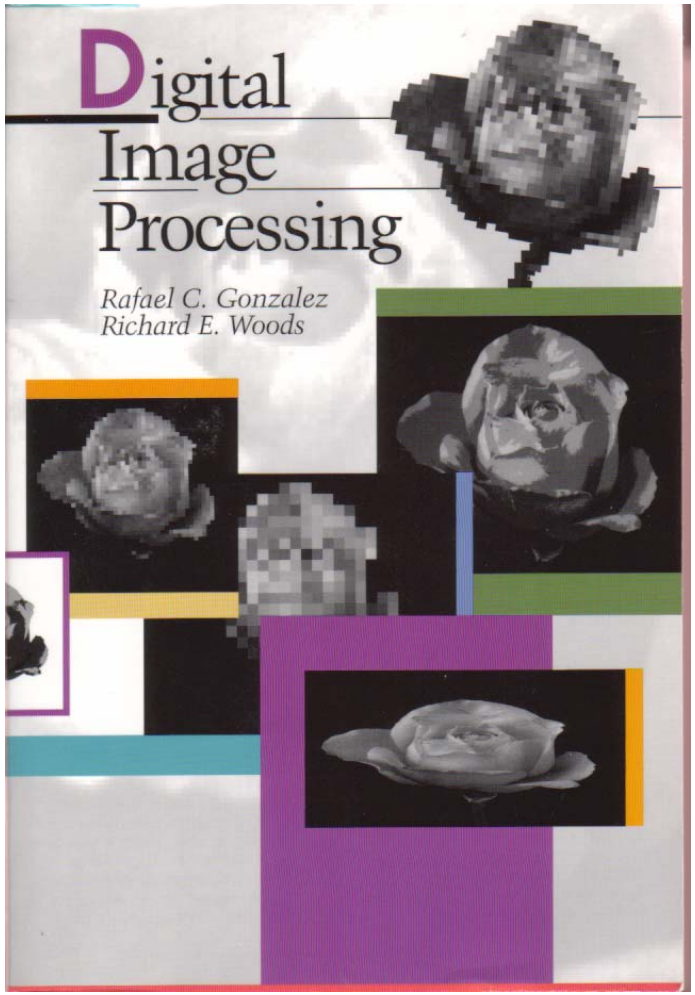
?

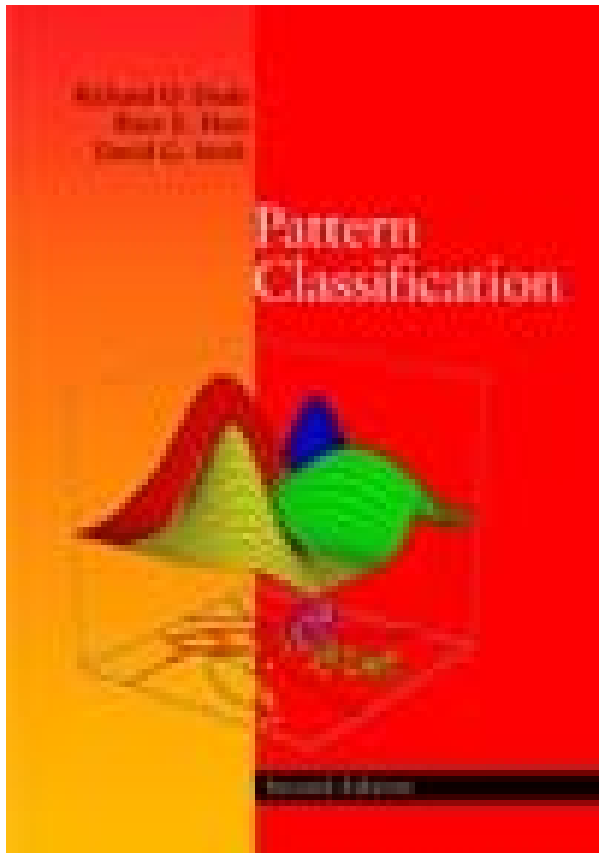
Computer Vision Text Books

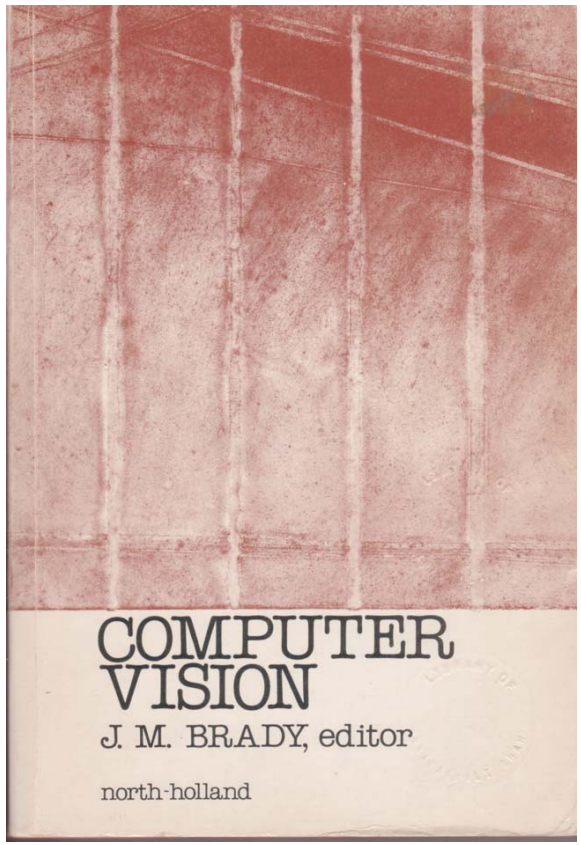
History

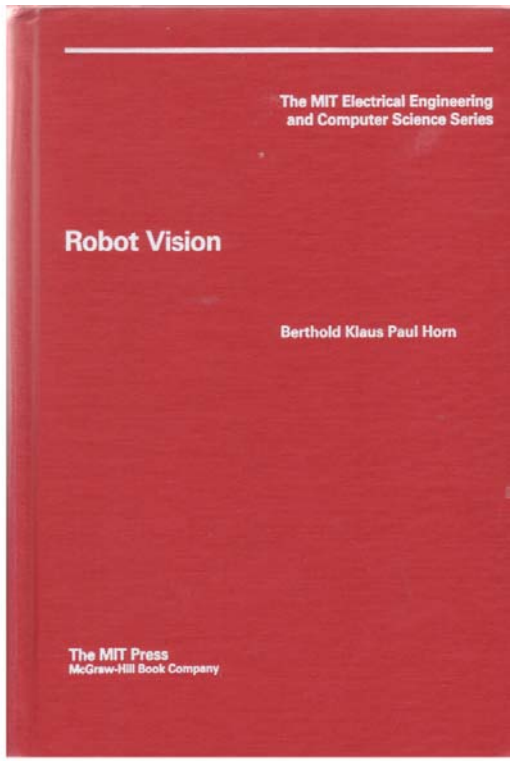

COMPUTER VISION
DANA H. BALLARD • CHRISTOPHER M. BROWN

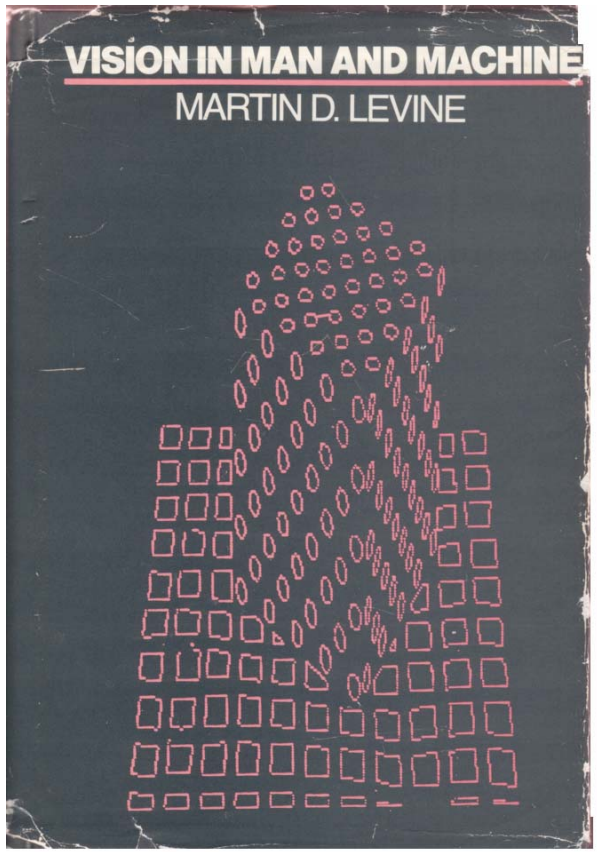

Computer Science
and Applied Mathematics
DIGITAL PICTURE PROCESSING
SECOND EDITION
Azriel Rosenfeld and Avinash C. Kak
Volume 1

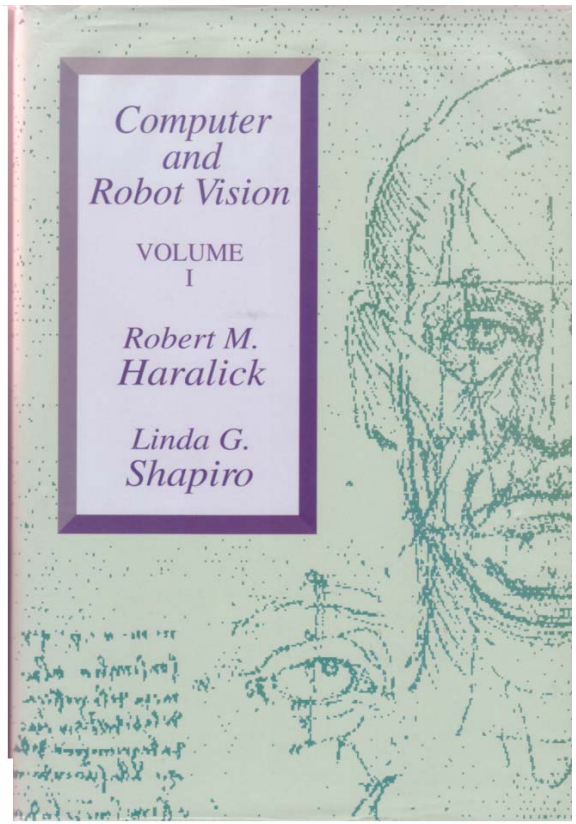

Digital
Image
Processing
Rafael C. Gonzalez
Richard E. Woods

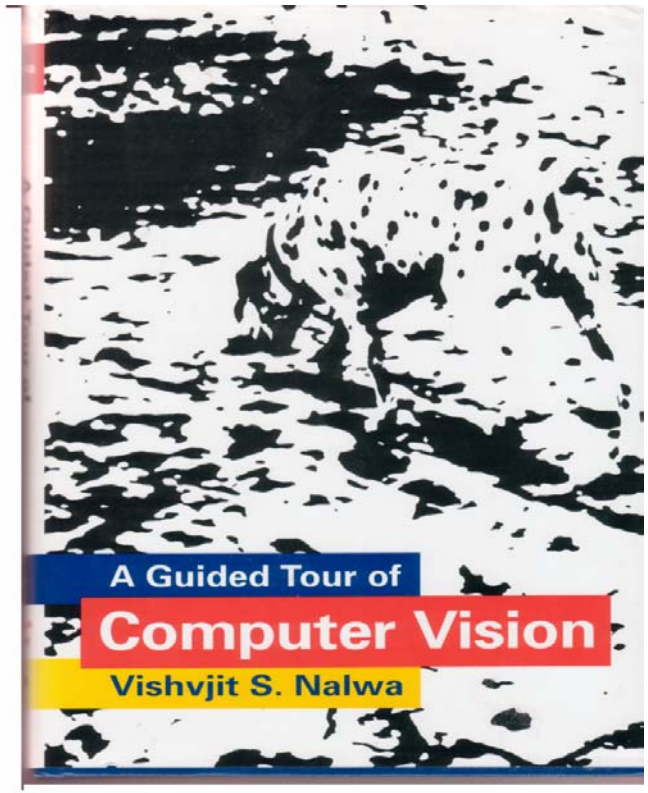

Pattern
Classification

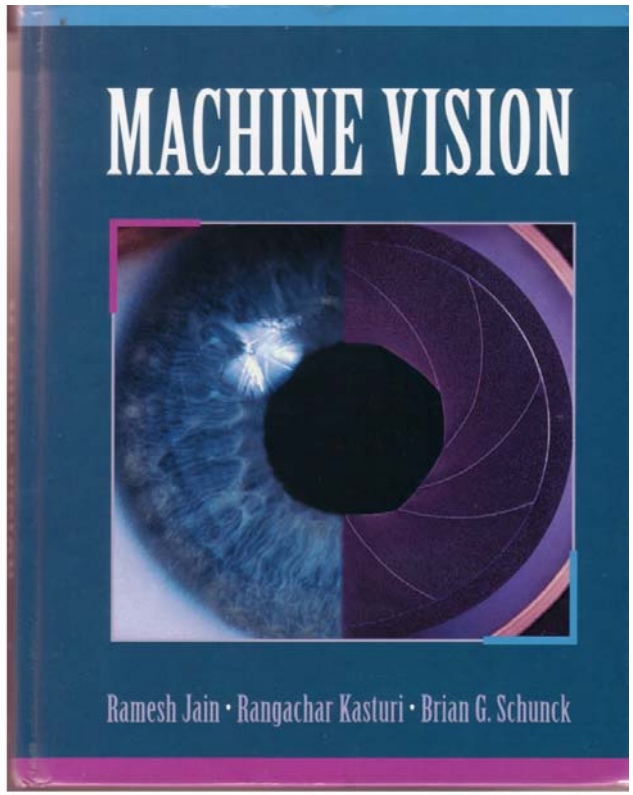

COMPUTER
VISION
J. M. BRADY, editor
north-holland

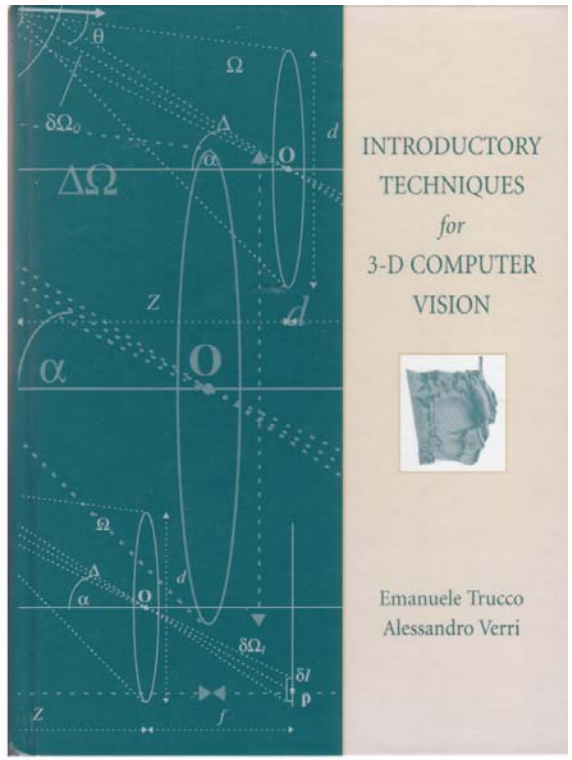

The MIT Electrical Engineering
and Computer Science Series
Robot Vision
Berthold Klaus Paul Horn
The MIT Press
McGraw-Hill Book Company

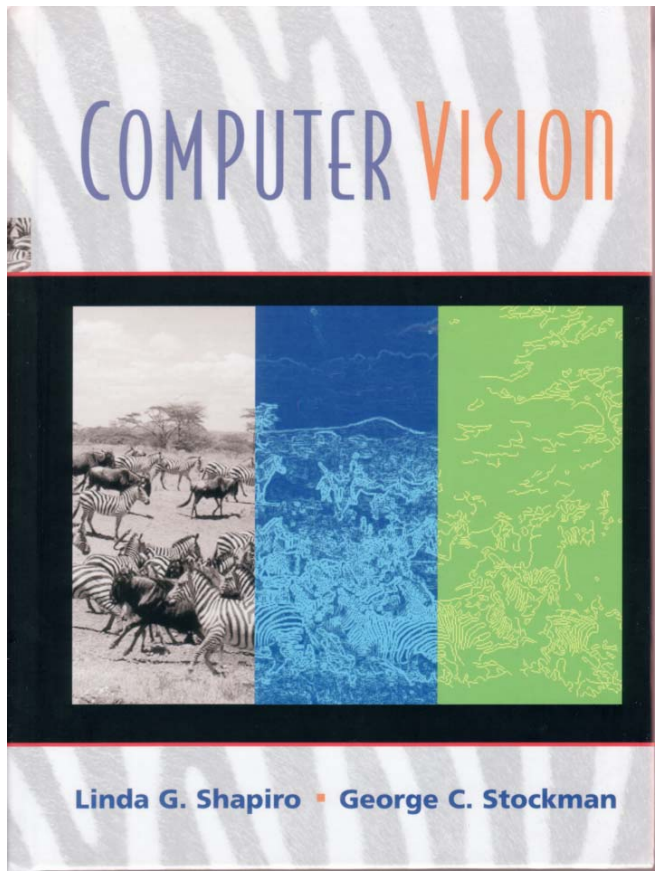

VISION IN MAN AND MACHINE
MARTIN D. LEVINE

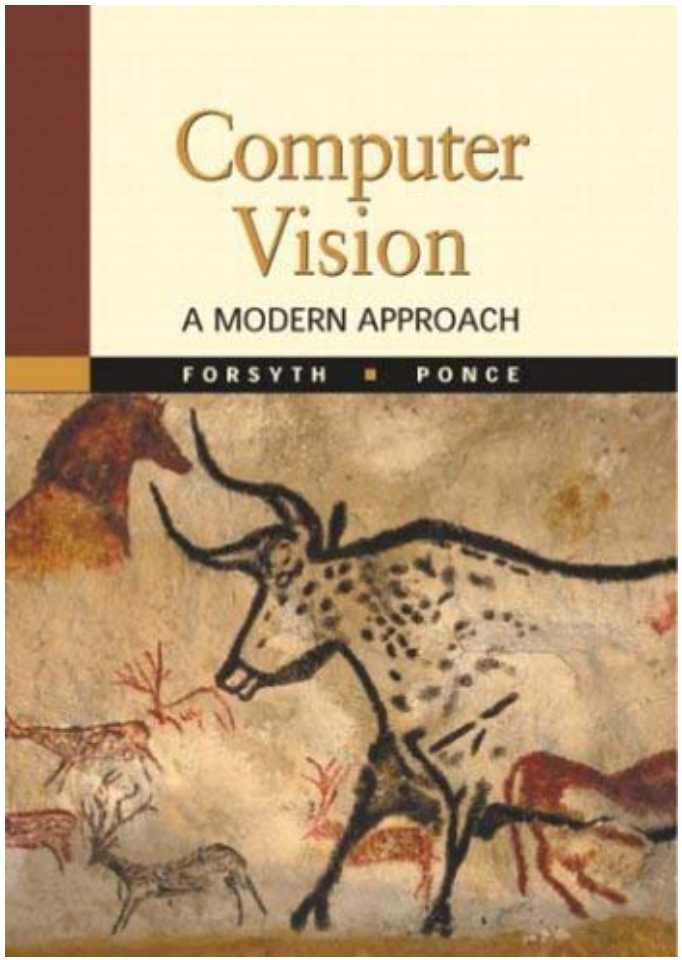

Computer
and
Robot Vision
VOLUME
I
Robert M.
Haralick
Linda G.
Shapiro


A Guided Tour of
Computer Vision
Vishvjit S. Nalwa


MACHINE VISION
Ramesh Jain • Rangachar Kasturi • Brian G. Schunck


INTRODUCTORY
TECHNIQUES
for
3-D COMPUTER
VISION
Emanuele Trucco
Alessandro Verri


COMPUTER VISION
Linda G. Shapiro ▪ George C. Stockman


Computer
Vision
A MODERN APPROACH
FORSYTH ■ PONCE

Computer Vision Researchers

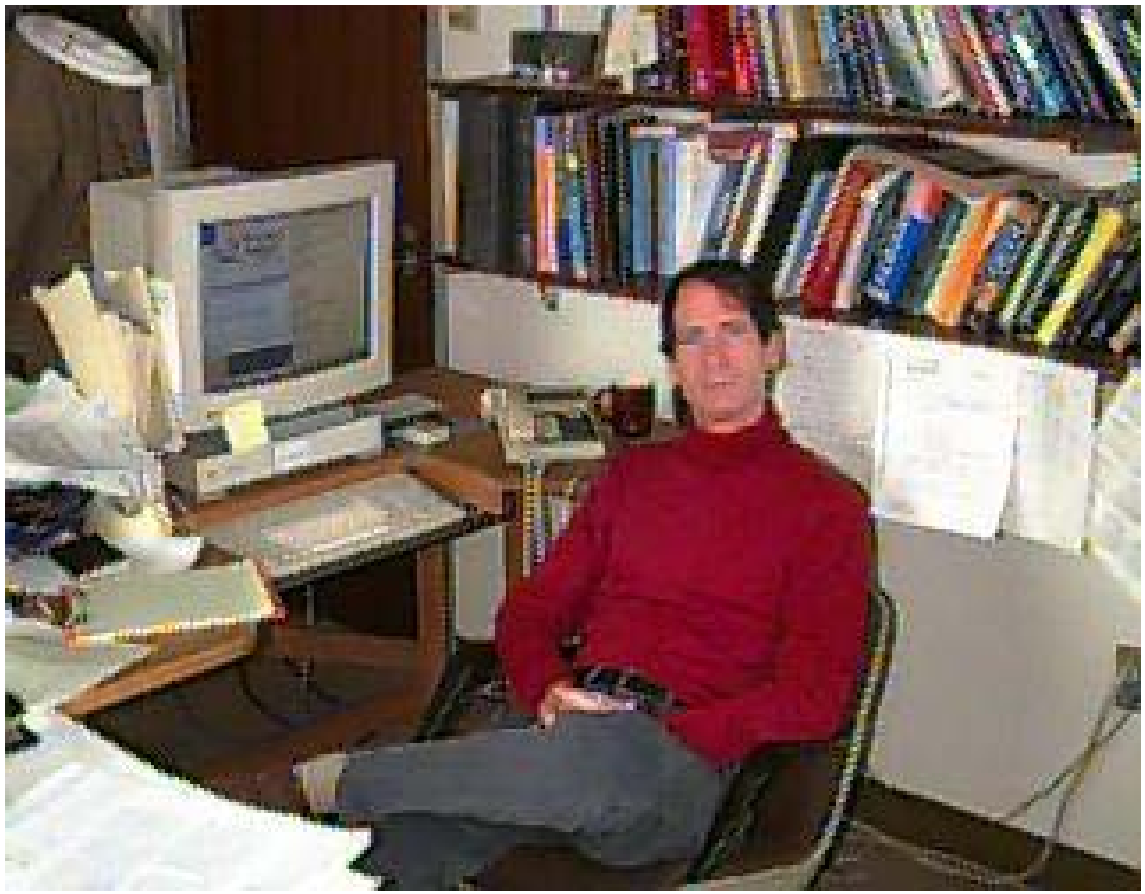
Azriel Rosenfeld

Berthold Horn

Thomas Huang

Jake Aggarwal

Chris Brown



Bob Haralick

Olivier Faugeras

Takeo Kanade

Sandy Pentland

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John Canny

Demetri Terzopoulos

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Computer Vision Journals

IEEE TRANSACTIONS ON

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JUNE 1993 VOLUME 15 NUMBER 6 ITPIDJ (ISSN 0162-8828)

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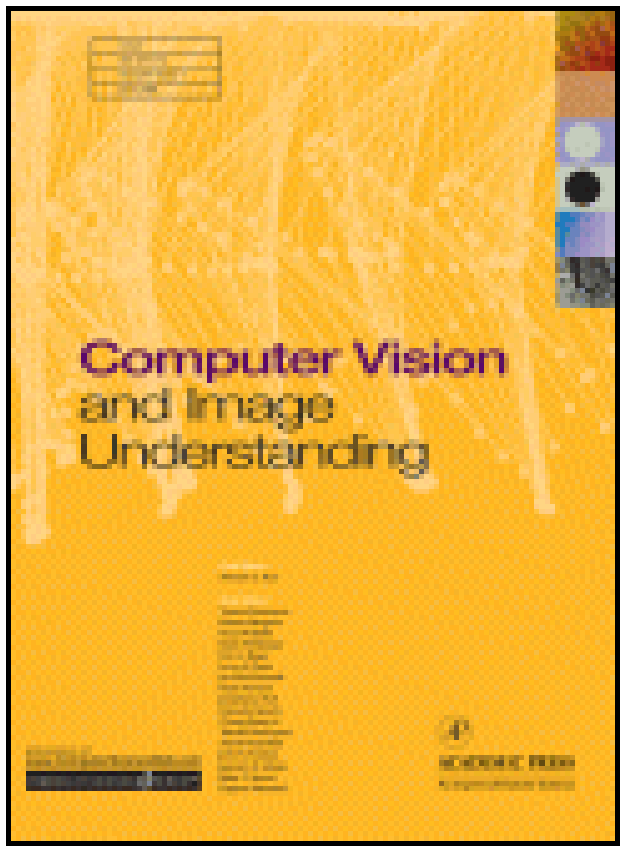
Computer Vision
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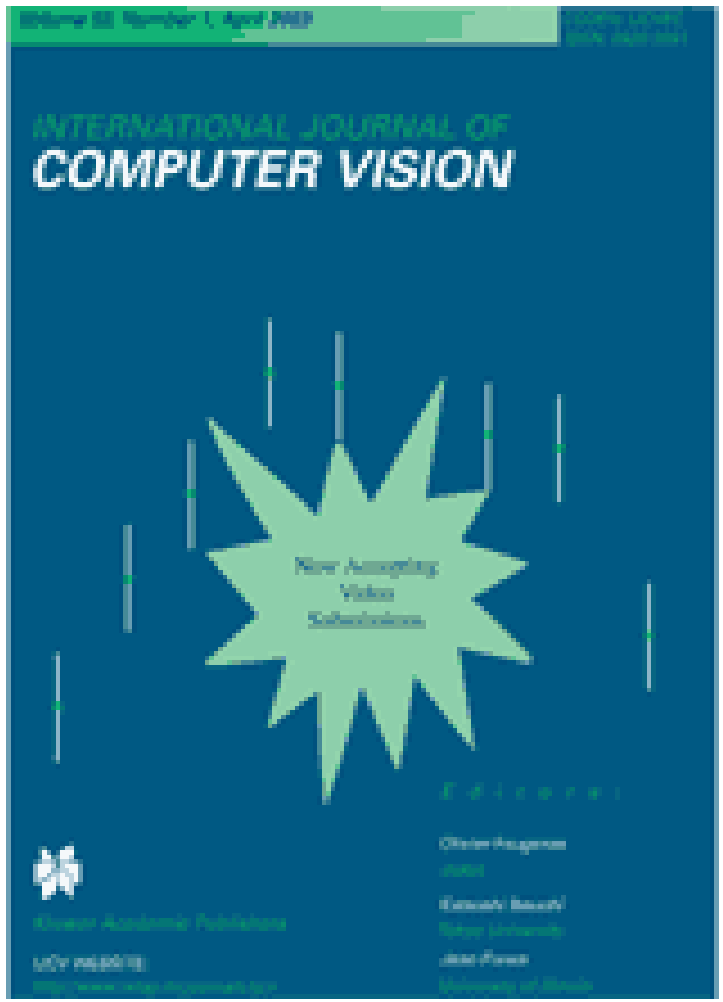
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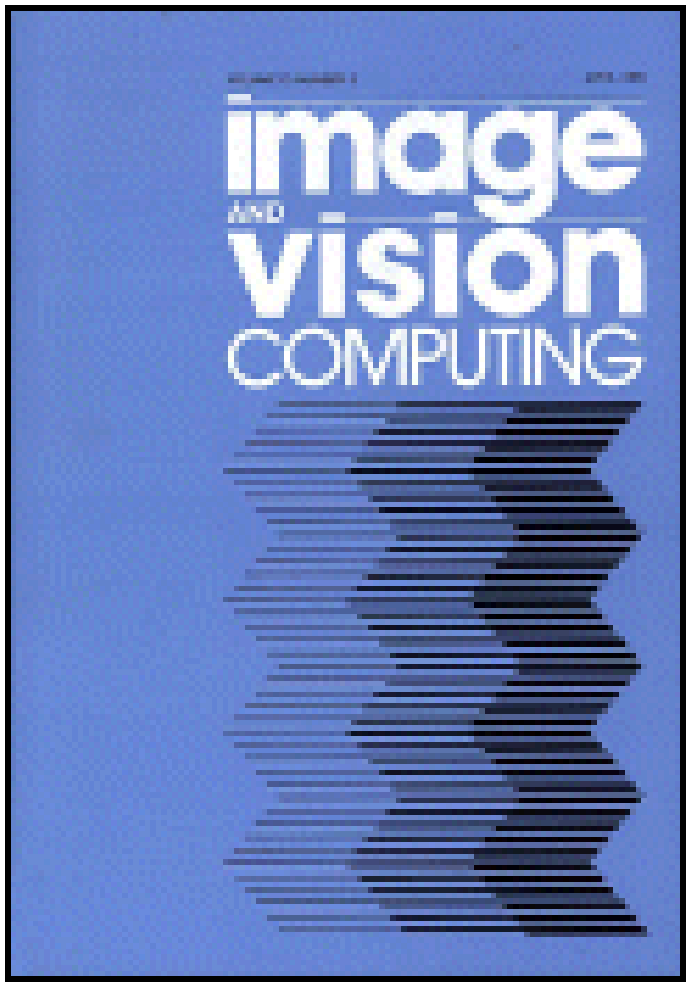
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An International Journal

Computer Vision Conferences

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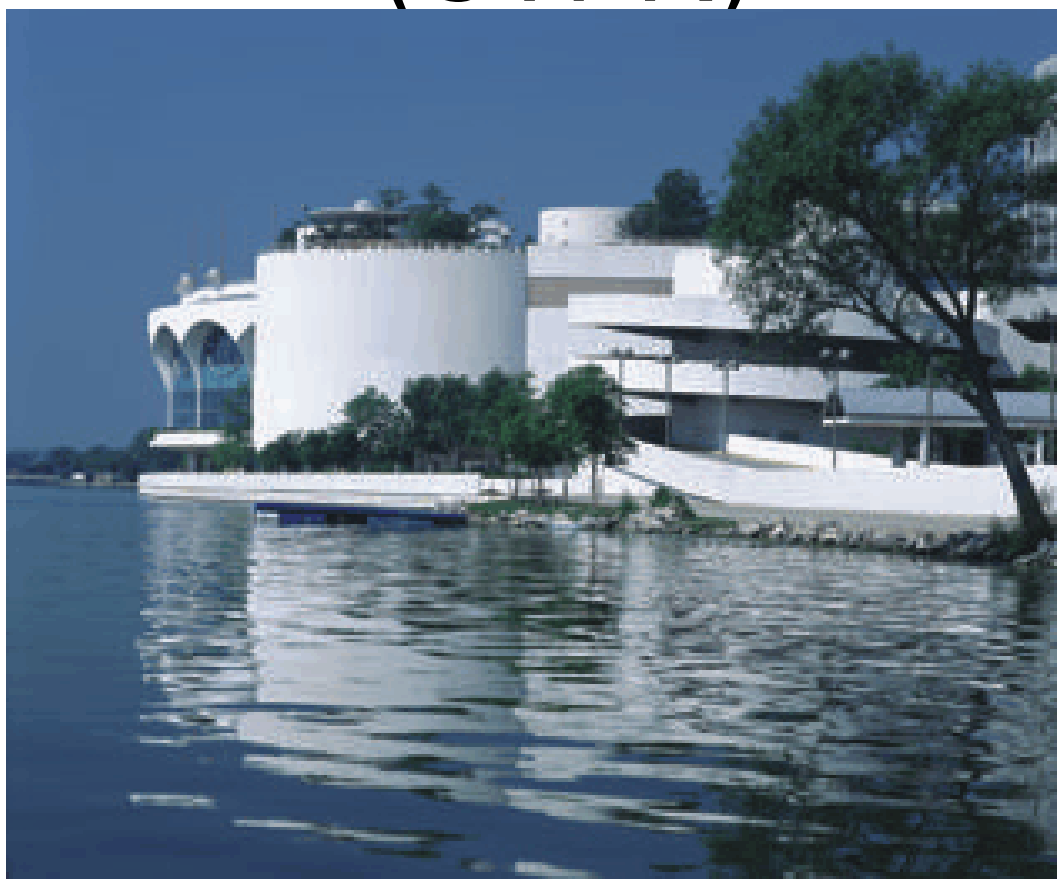
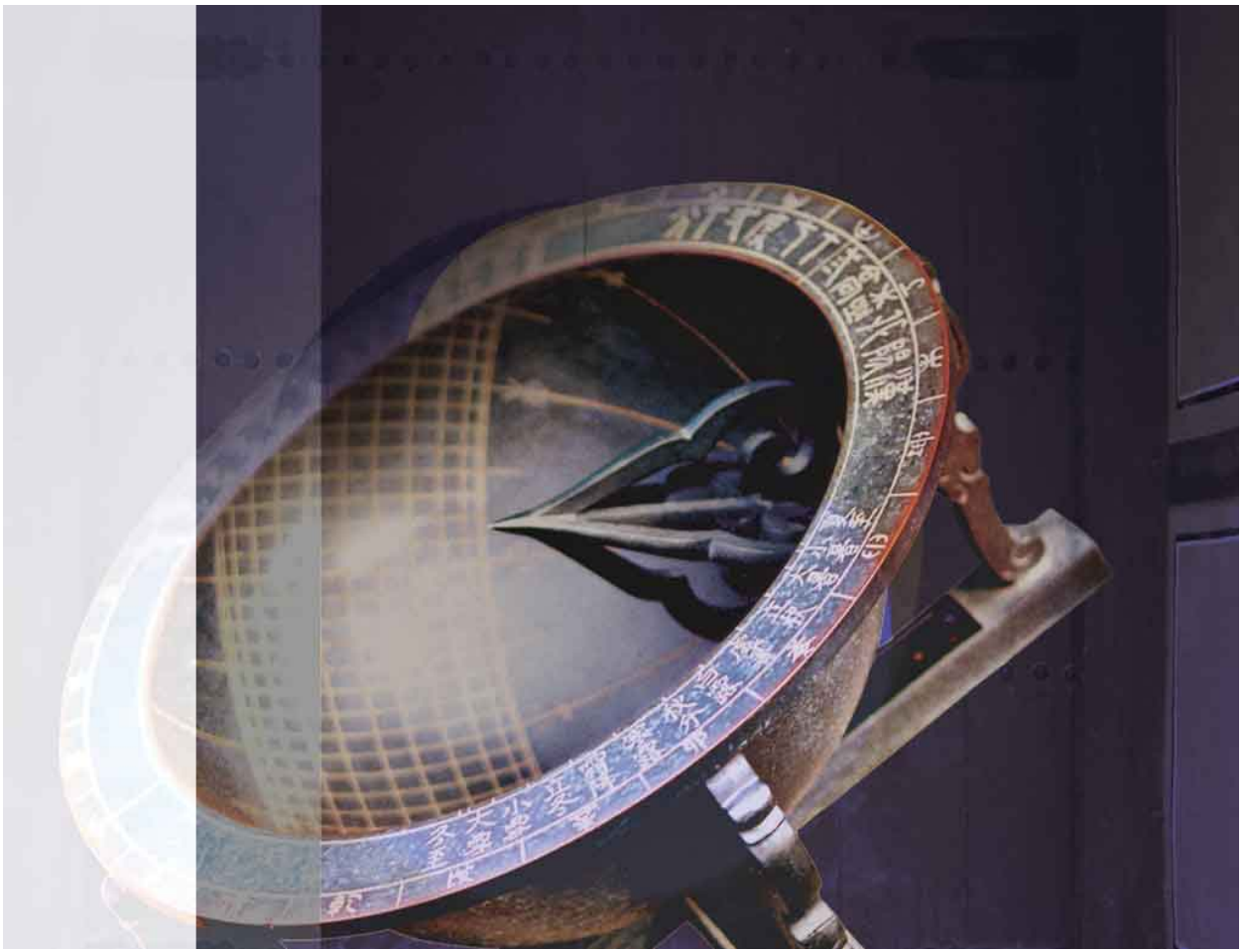
IEEE Conference on Computer Vision and Pattern Recognition (CVPR)



European Conference on Computer Vision (ECCV)

International Conference on Pattern Recognition (ICPR)

Asian Conference on Computer Vision (ACCV)



International Conference on Image Processing

Computer Vision at UCF

- Started in August 1986
- Developed four courses
  - Intro to Robot Vision
  - Computer Vision
  - Computer Vision Systems
  - Advanced Computer Vision

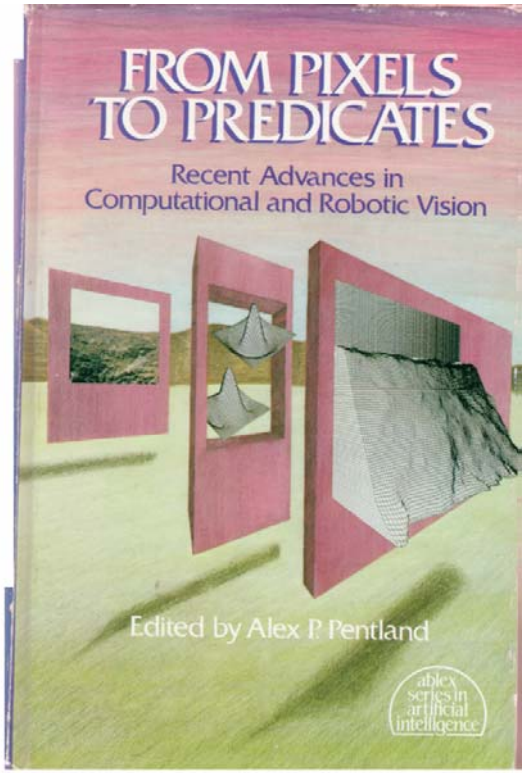
- Graduated first Ph.D. student in 1989
- Dr. Lobo joined in 1992
- Dr. Foroosh joined in 2002

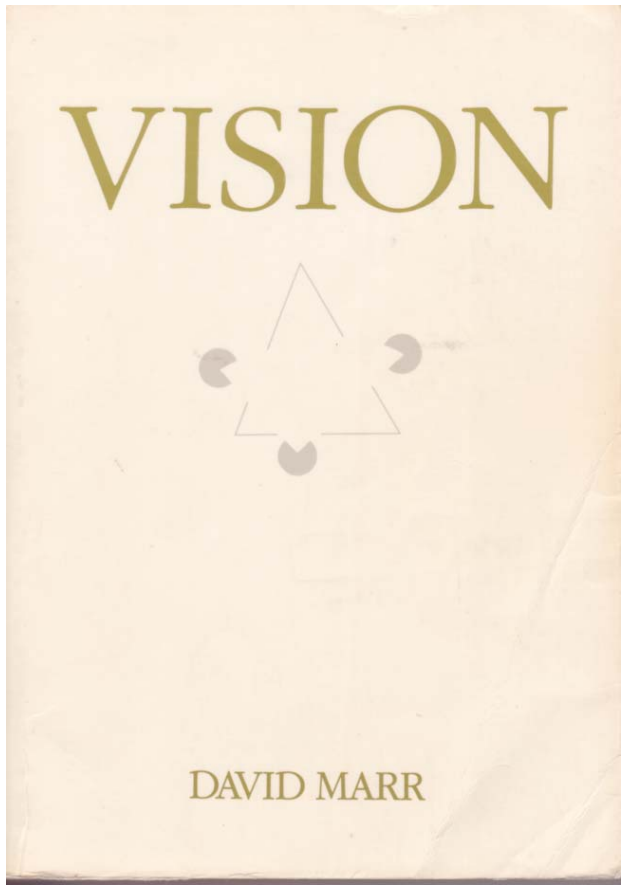
Vision Books Used at UCF

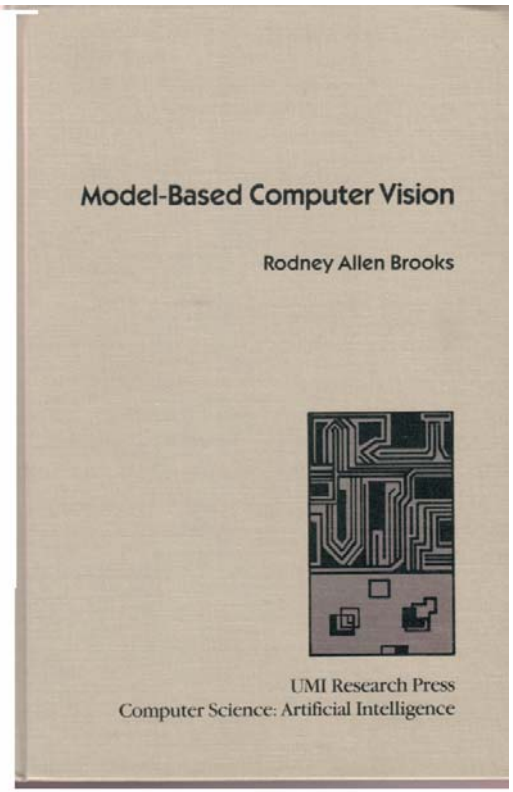
FUNDAMENTALS OF COMPUTER VISION[1]

Mubarak Shah
Computer Science Department
University of Central Florida
Orlando, FL 32816

December 7, 1997


FROM PIXELS TO PREDICATES
Recent Advances in Computational and Robotic Vision
Edited by Alex P. Pentland
ablex series in artificial intelligence


VISION
DAVID MARR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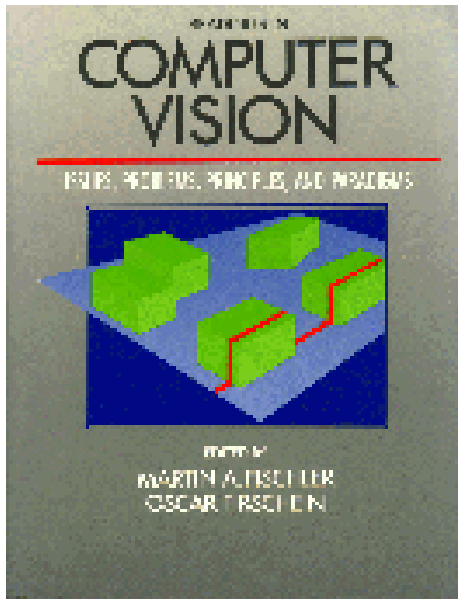
Rodney Allen Brooks
UMI Research Press
Computer Science: Artificial Intelligence

Perceptual Organization and Visual Recognition

David Lowe

Kluwer Academic Publishers, 1985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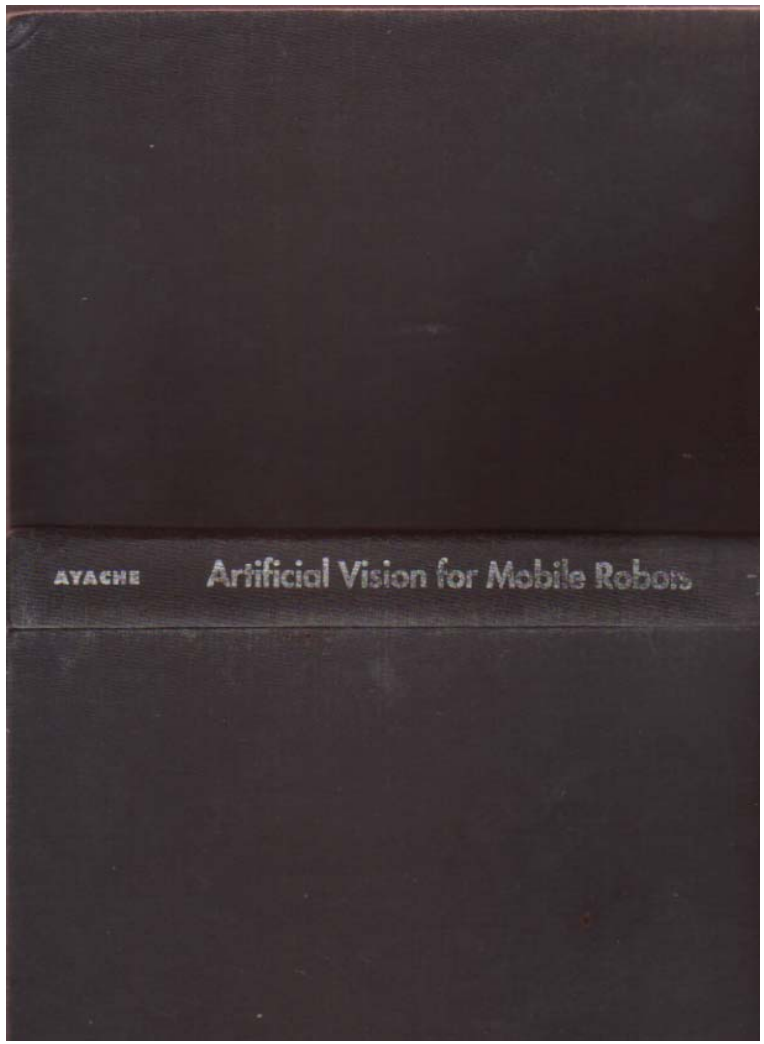
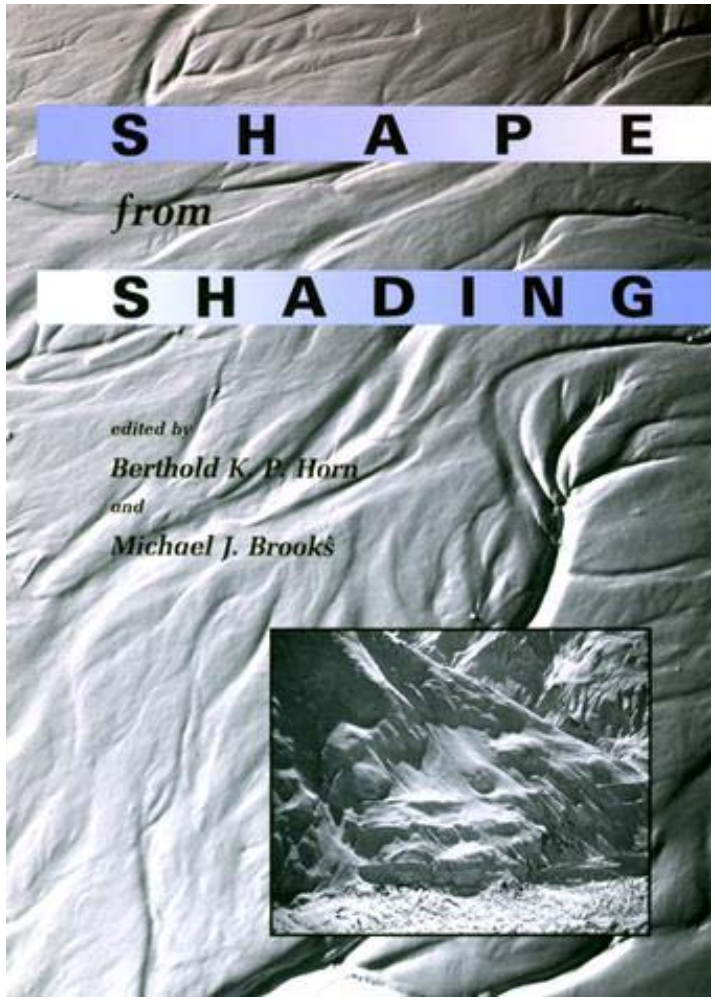

AYACHE
Artificial Vision for Mobile Robots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Berthold K. P. Horn
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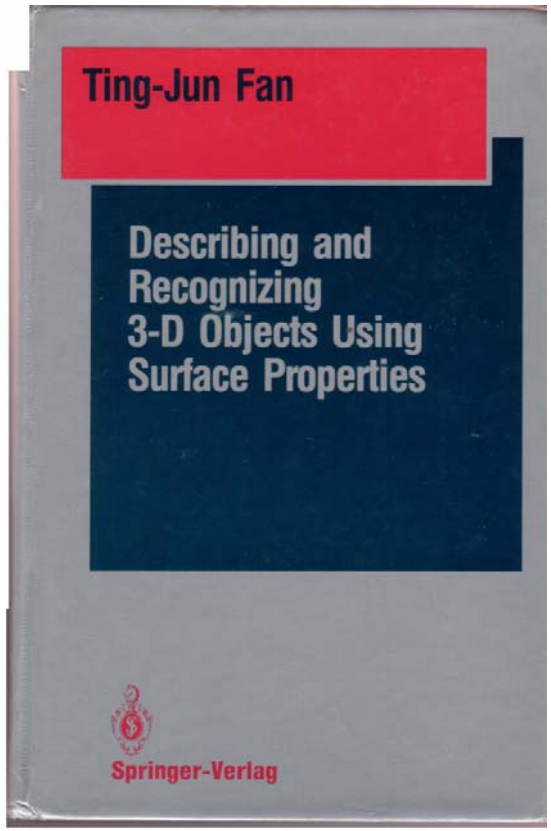
Michael J. Brooks


Ting-Jun Fan
Describing and Recognizing 3-D Objects Using Surface Properties
Springer-Verlag

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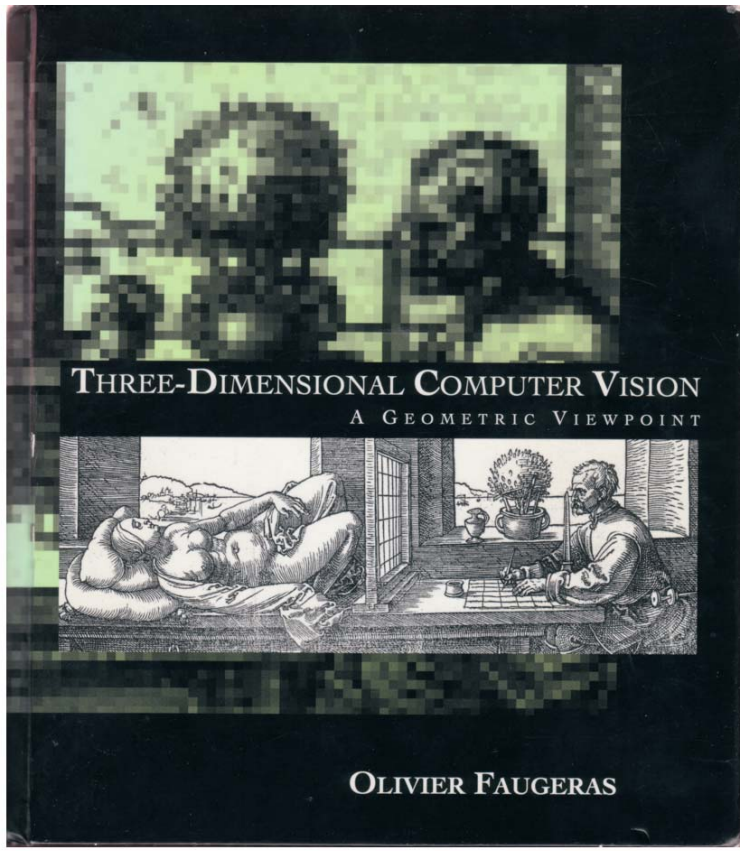
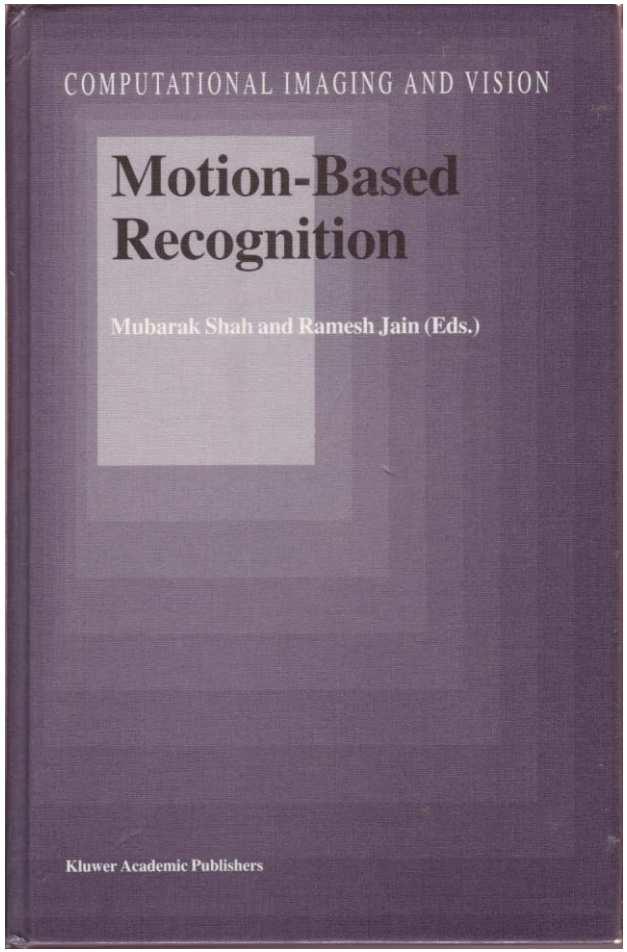
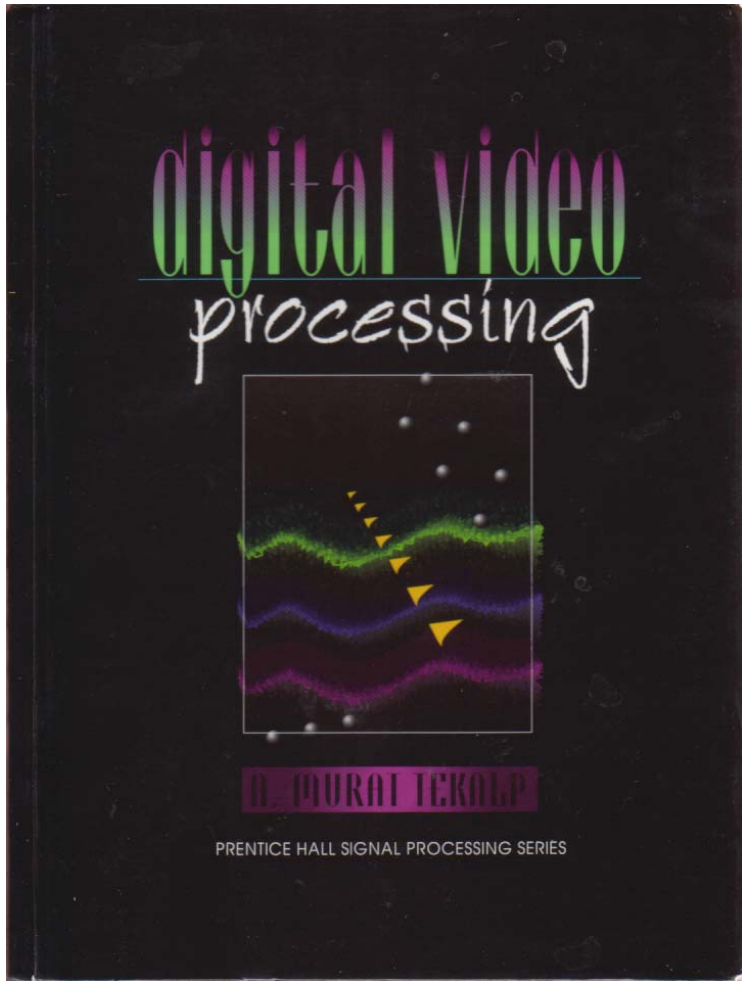

THREE-DIMENSIONAL COMPUTER VISION
A GEOMETRIC VIEWPOINT
OLIVIER FAUGERAS


COMPUTATIONAL IMAGING AND VISION
Motion-Based Recognition
Mubarak Shah and Ramesh Jain (Eds.)
Kluwer Academic Publishers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Current Ph.D. Students

- Omar Javed
- Alper Yilmaz
- Orkun Alatas
- Lisa Spencer
- Yaser Shaikh
- Jiangjian Xiao
- Yun Zhai
- Asad Hakeem
- Yunjun Zhang
- Alexei Gritai
- Paul Smith
- Imran Junejo
- Lisa Spencer
- Saad Ali
- Xiochun Cao
- Fahad Rafi

End of Story