EEE-6512: Image Processing and Computer Vision

August 23, 2018

Lecture #1 Course Overview

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Course Information

- EEE-6512 Image Processing/Computer Vision
- **Instructor:** Damon Woodard (dwoodard@ece.ufl.edu)
- **Office:** 226E Materials Engineering Bldg. (MAE)
- **Lectures:** Tues. (1:55 PM – 2:45 PM), Thurs. (1:55 PM – 3:50 PM) 201 New Engineering Building (NEB)
- **Office Hours:** Tues. (8:00 AM – 10:00 AM), Thurs. (8:00 AM – 9:00 AM), or by appointment.
- Course Materials in CANVAS
  - http://lss.at.ufl.edu

Teaching Assistant

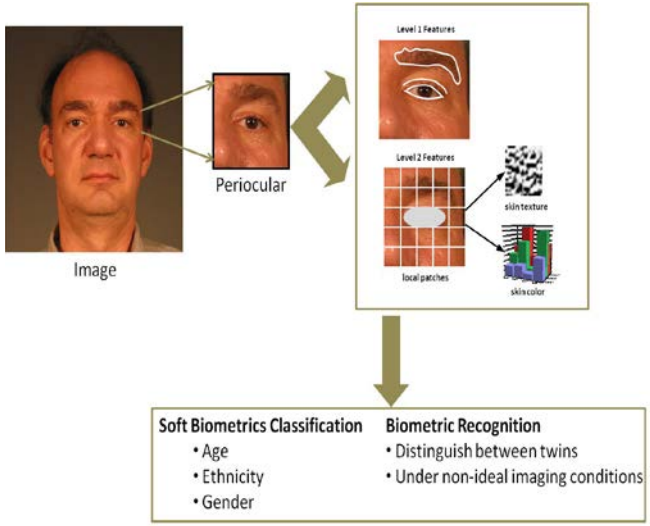
- Ronald Wilson
- Email Address: ronaldwilson@ufl.edu
- Office Hours: TBA

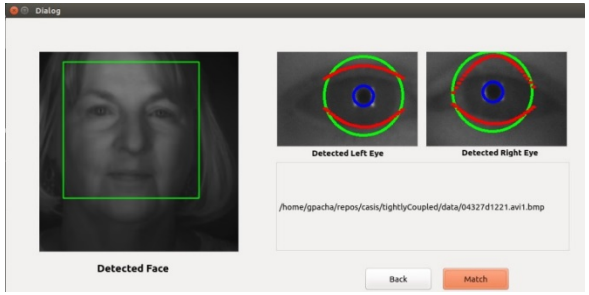
Prior Research (Subset)

Keystroke Dynamics

Periocular Biometrics

Tightly Coupled Face + Iris Biometrics



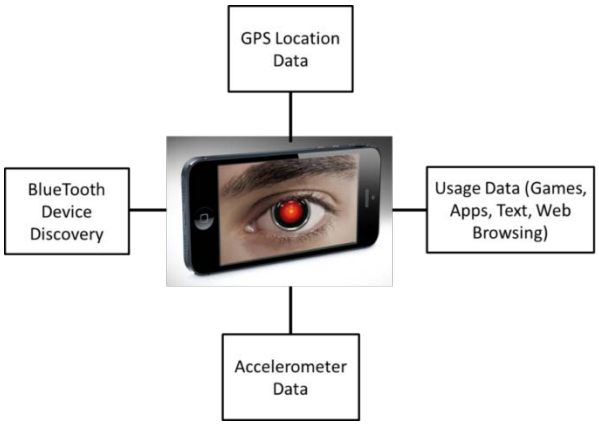


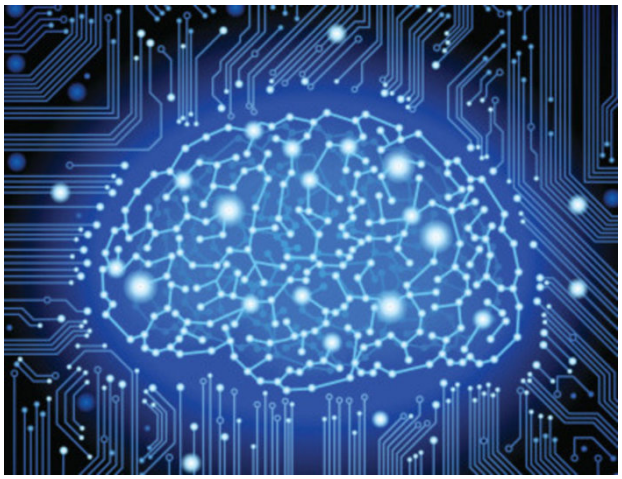
Current Research Projects

Mobile Device Based Biometrics

Stylometry/Author Obfuscation

Machine Learning for Cybersecurity Applications





Course Goal / Objective

Goal:

To understand how to efficiently represent, process, and analyze image signals.

Objective:

To provide students with the scientific foundations needed to implement and apply techniques used to address image processing and analysis related problems.

Course Overview

- **Prerequisites:**
  - EEE-5502 Foundations of Signal Processing
  - Undergraduate-level probability and statistics course
  - Undergraduate-level linear algebra course
  - Programming experience required, preferable experience using the MATLAB programming environment
- **Textbook:** Digital Image Processing, Fourth Edition by Rafael C. Gonzales and Richard E. Woods
- **Recommended:** Computer Vision: Algorithms and Applications, 2011 Edition, Richard Szeliski

Course Overview (cont.)

Evaluation of Grades

Item	Grade Percentage
Homework Sets (6)	50%
Exams (3)	50%

Percent	Grade	Grade Points
94 – 100	A	4.00
90 – 93	A-	3.67
88 – 89	B+	3.33
82 – 87	B	3.00
80 – 81	B-	2.67
78 – 79	C+	2.33
72 – 77	C	2.00
70 – 71	C-	1.67
62 – 69	D	1.00
0 – 61	E	0.00

What is this course all about?

Image Processing:

The processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. (Gonzales & Woods)

Computer Vision:

is an interdisciplinary field that deals with how computers can be made for gaining high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do.

Tentative Course Schedule

- ***Course Schedule***
- Week 1: Course Overview, Introduction
- Week 2: Fundamentals of Imaging / **Homework #1 Due**
- Week 3: Image Transformations and Spatial Filtering Pt. 1
- Week 4: Spatial Filtering Pt. 2 /**Homework #2 Due**
- Week 5: Frequency Domain Filtering Pt. 1/ **Exam #1**
- Week 6: Frequency Domain Processing Pt. 2 / **Homework #3 Due**
- Week 7: Color Image Processing
- Week 8: Morphological Image Processing / **Homework # 4 Due**
- Week 9: Image Segmentation Pt. 1
- Week 10: Image Segmentation Pt. 2/ **Exam #2**
- Week 11: Feature Extraction Pt. 1 / **Homework #5 Due**
- Week 12: Feature Extraction Pt. 2
- Week 13: Model Fitting Pt. 1/ **Homework #6 Due**
- Week 14: Model Fitting Pt. 2
- Week 15: Classification Pt. 1 /**Exam #3**
- Week 16: Classification Pt. 2

Course Policies

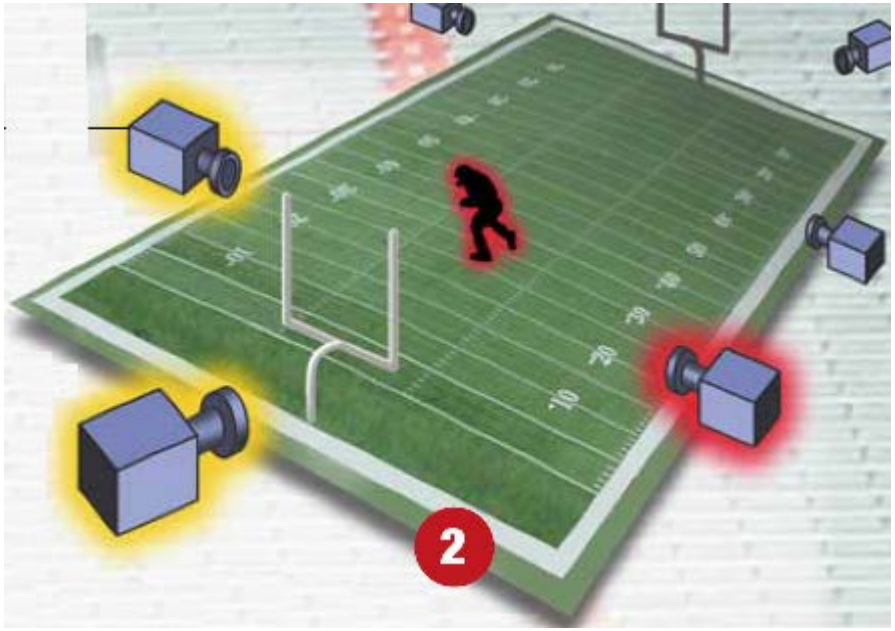
- Grading concerns should be raised within one week after grades have been returned for a course item.
- Final grades will be based solely on the student's performance on the course items
- Questions on the material should be posted as discussions on CANVAS and not sent as email messages.

Tips for Success

- Read the Text (Preferably before lectures)
- Ask questions during class
- Use other sources
- Start homework assignments early

Applications which use Image Processing / Computer Vision

The thin yellow line

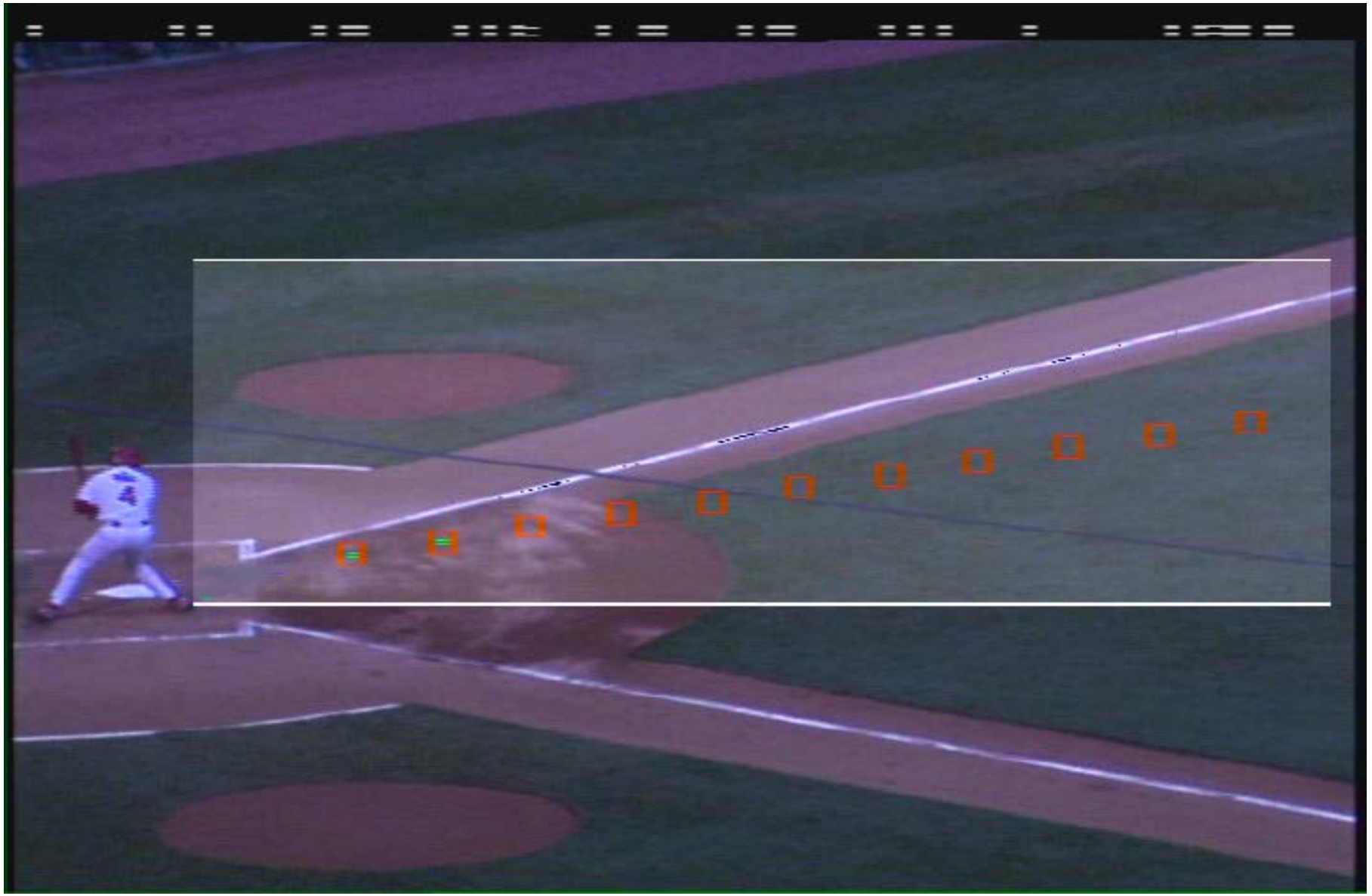


http://www.smartcomputing.com/articles/2001/s1212/17s12/17s12.pdf

Video-based Tracking of a Baseball Pitch

from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

Processed Video

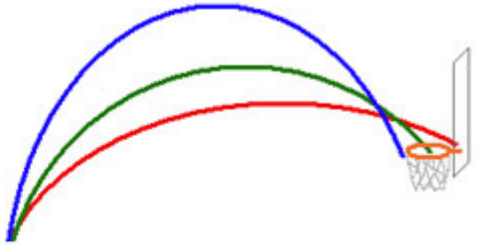


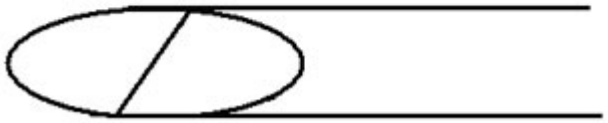
from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

Result of baseball extraction

from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

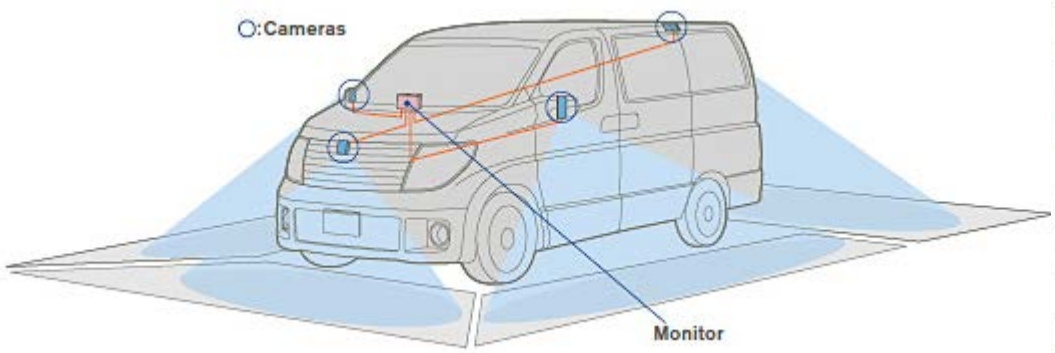
Freethrow shooting





http://www.noahbasketball.com

Automotive applications



Nissan's Around View Mirror

http://www.nissan-global.com/EN/TECHNOLOGY/INTRODUCTION/DETAILS/AVM/

Special Effects in The Matrix

- *Bullet Time* special-effect in The Matrix is an example of the application of SFM ideas.
- Linear array of cameras replaces moving camera.
- Green screen makes segmentation easy.

from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

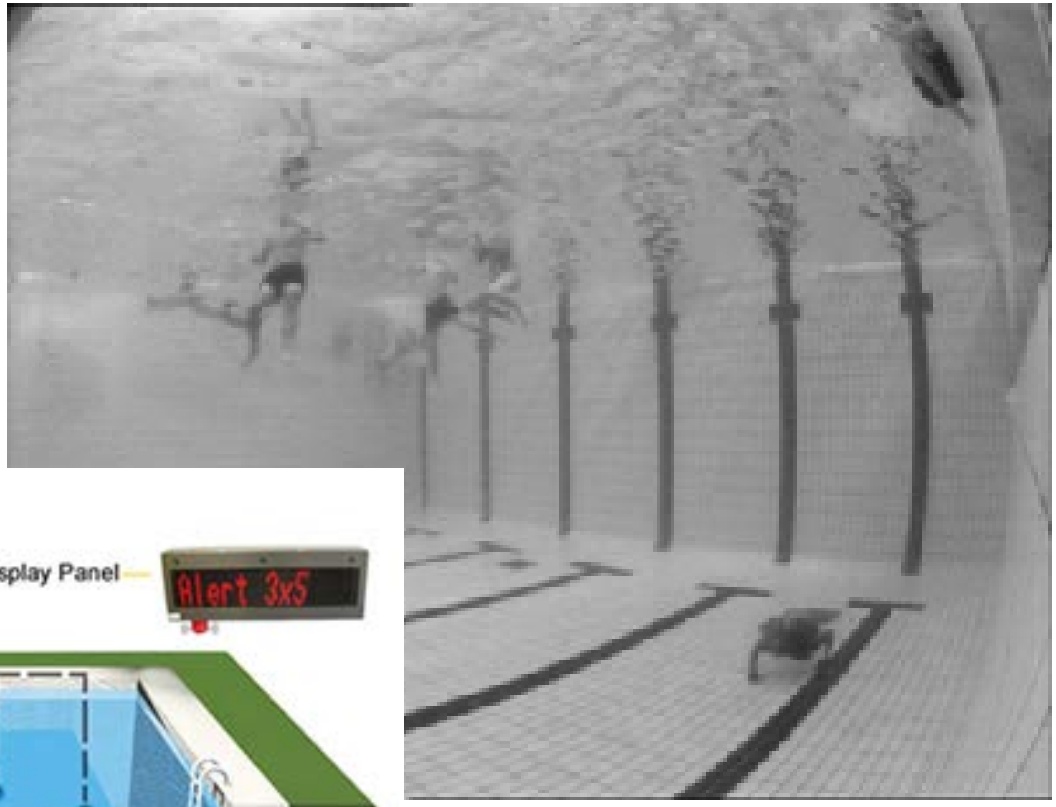
Unstructured Road Following

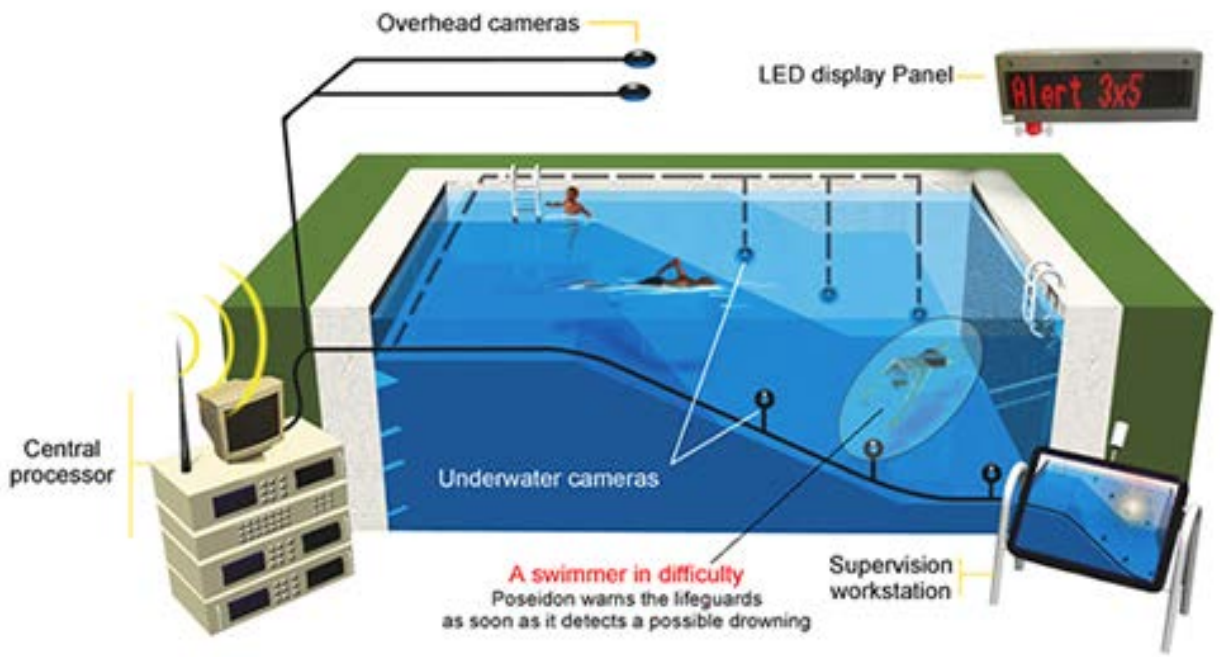
from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

Rescuing drowning victims

Poséidon

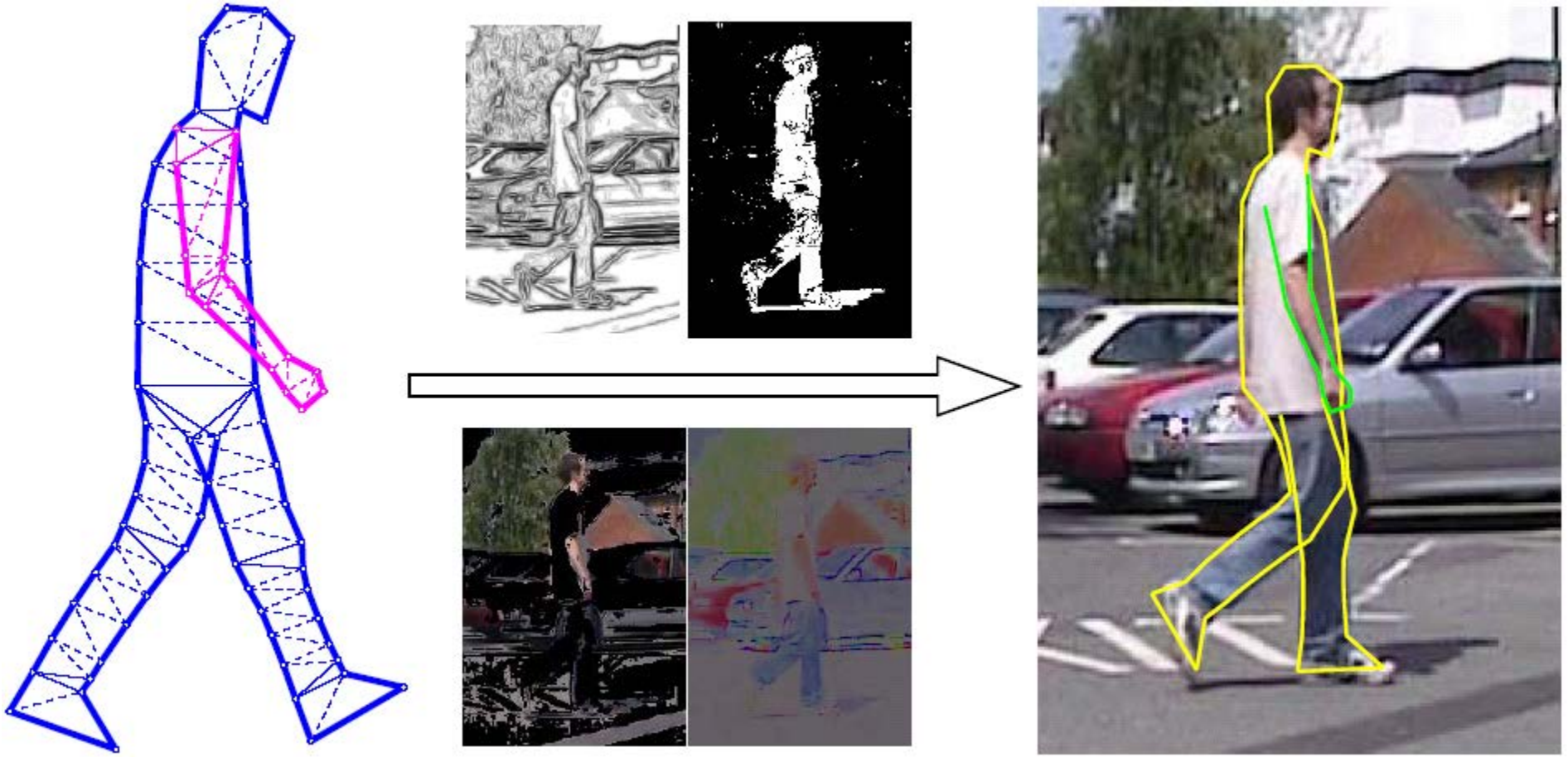
THE LIFEGUARD'S THIRD EYE





http://www.poseidon.fr/us/

Tracking Articulated Shapes

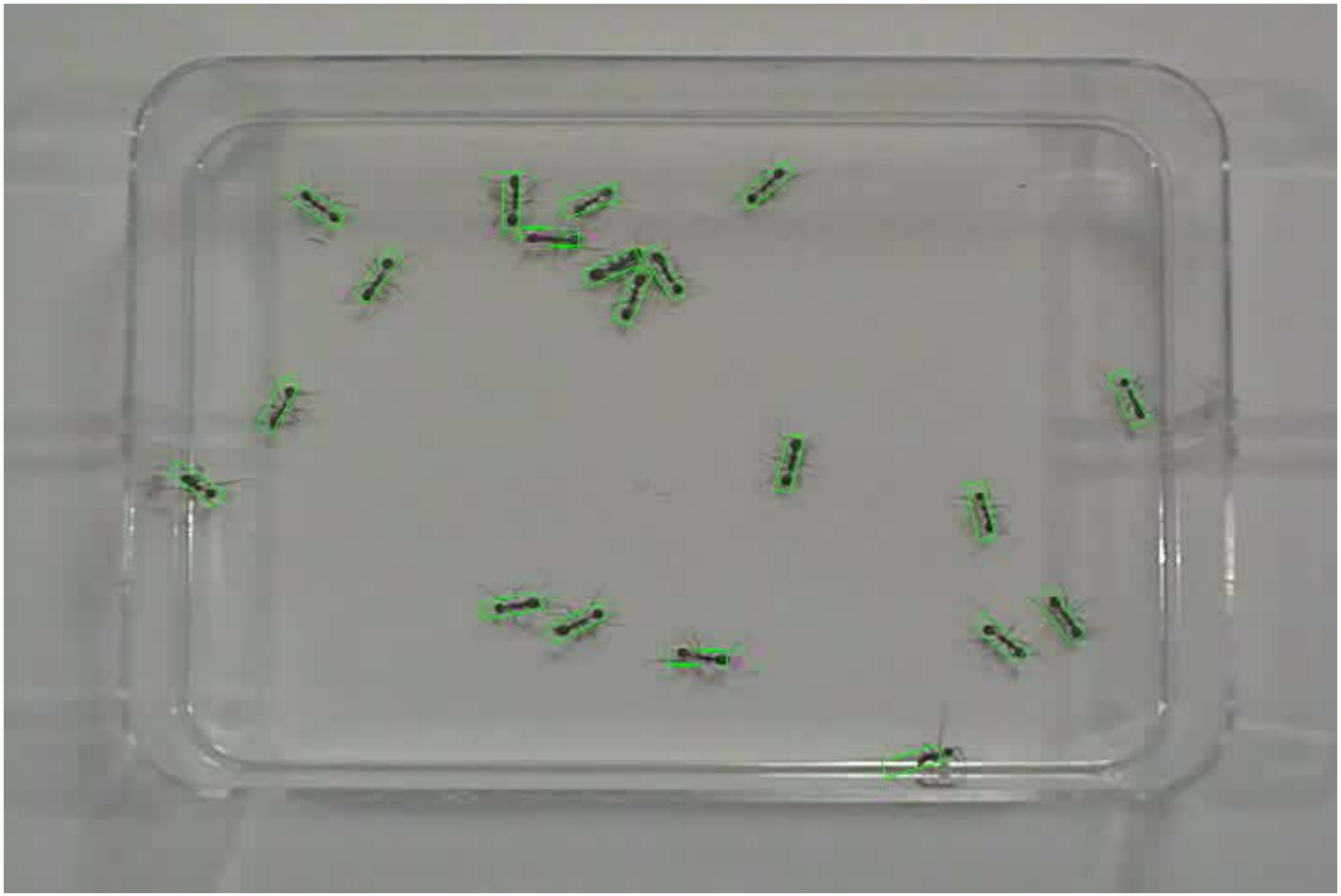


from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

Tracking Multiple Humans

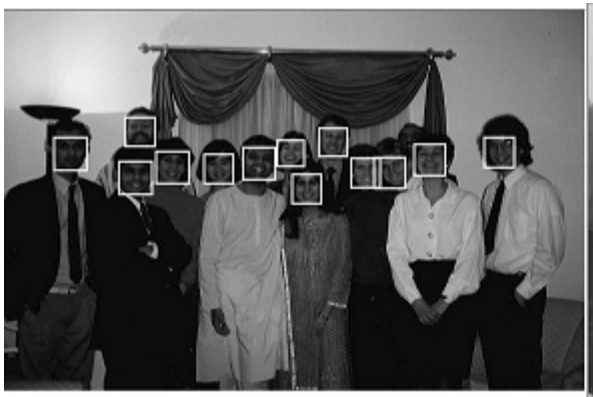
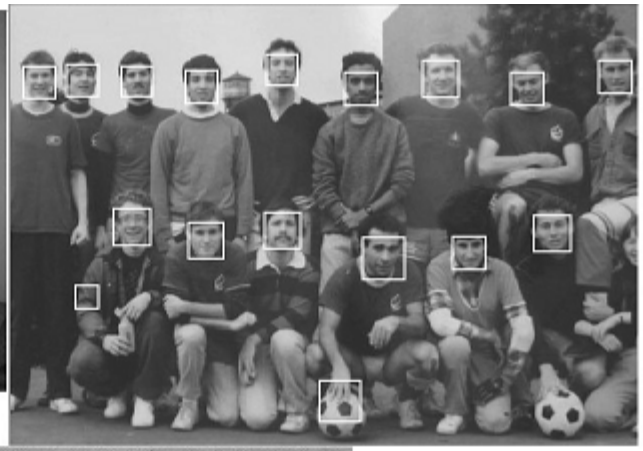
from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

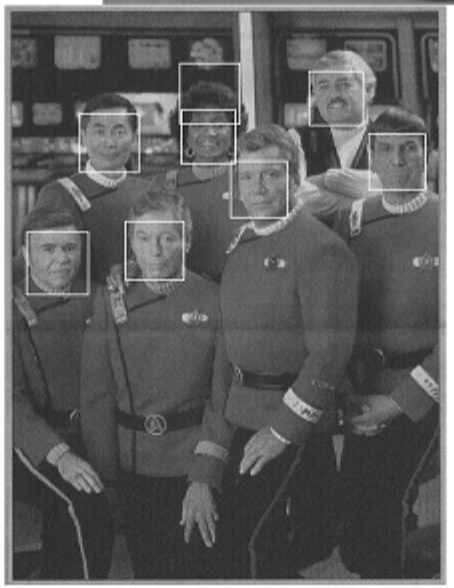
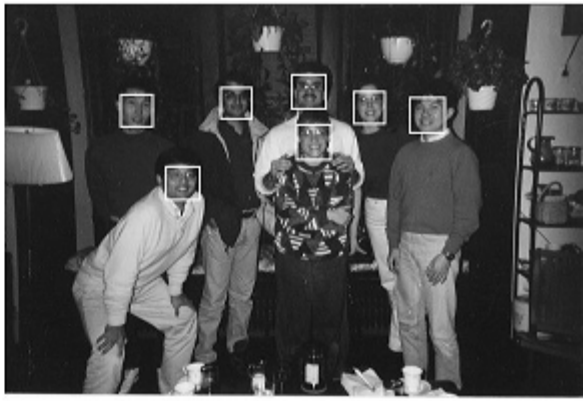
Tracking Ants



from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

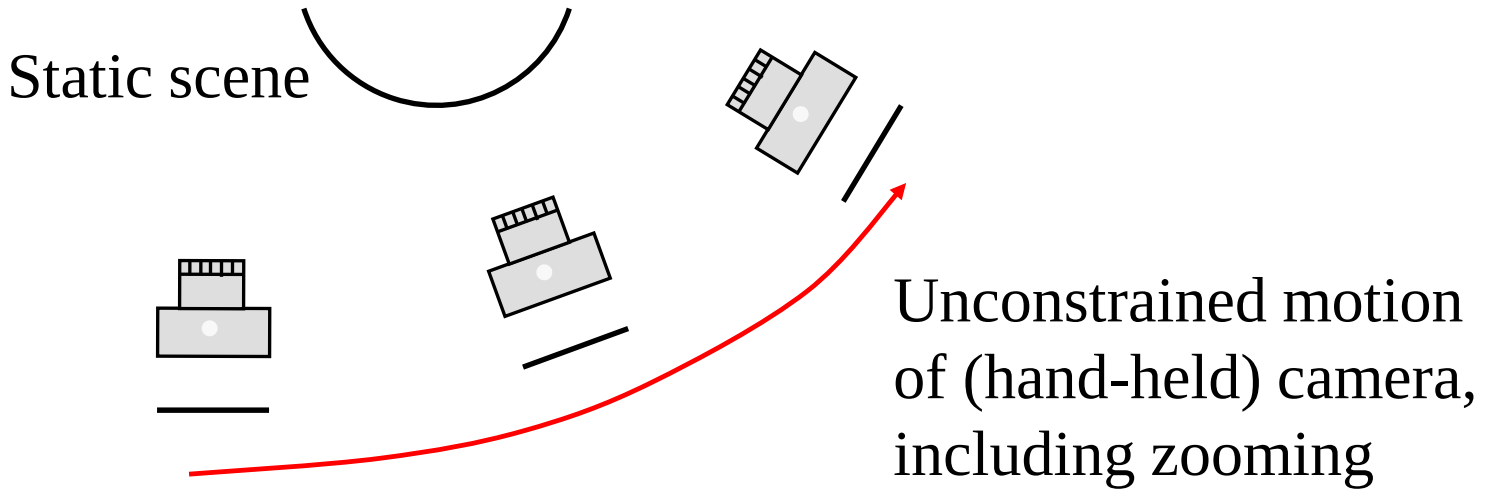
Face Detection

from http://www-static.cc.gatech.edu/classes/AY2007/cs4495_fall/html/materials.html

Structure from Motion



Generalization of stereo framework:

- Unconstrained motion of single *uncalibrated* camera
- *Feature tracking* across motion sequence.
- Good recent results, but solutions are somewhat brittle.

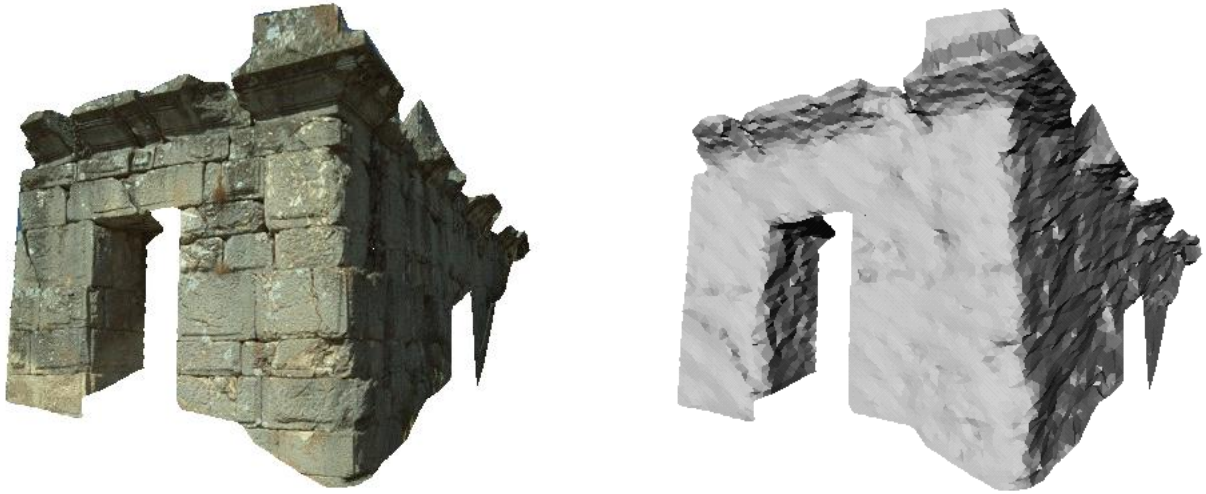
Structure from motion results

Input frames (3 of 5)

Texture-mapped model

Shaded model

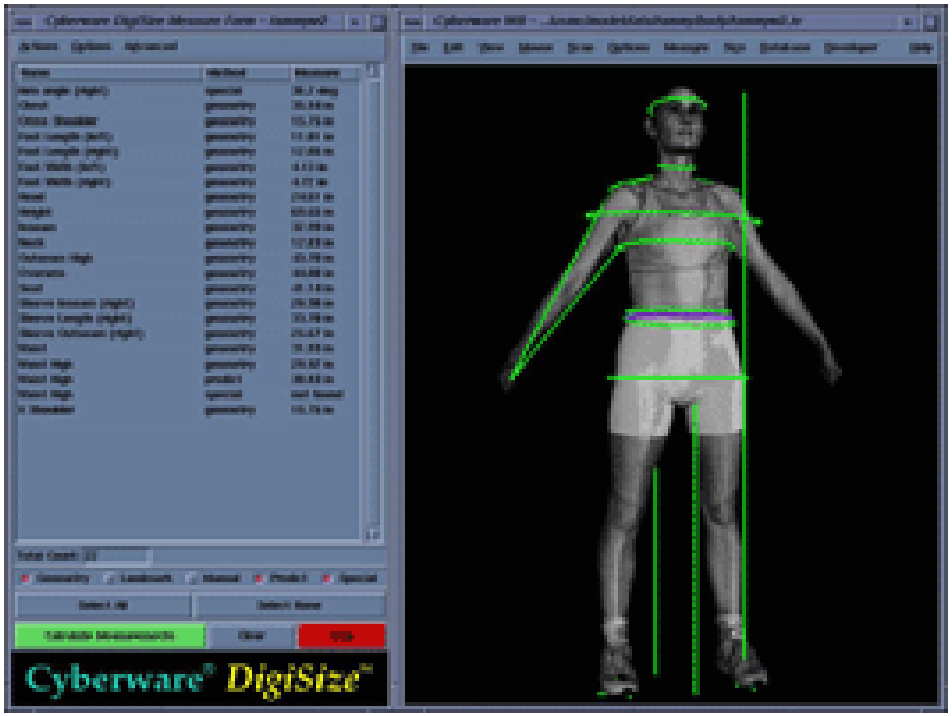
Output 3-D model



(Images courtesy of Luc Van Gool)

Clothing

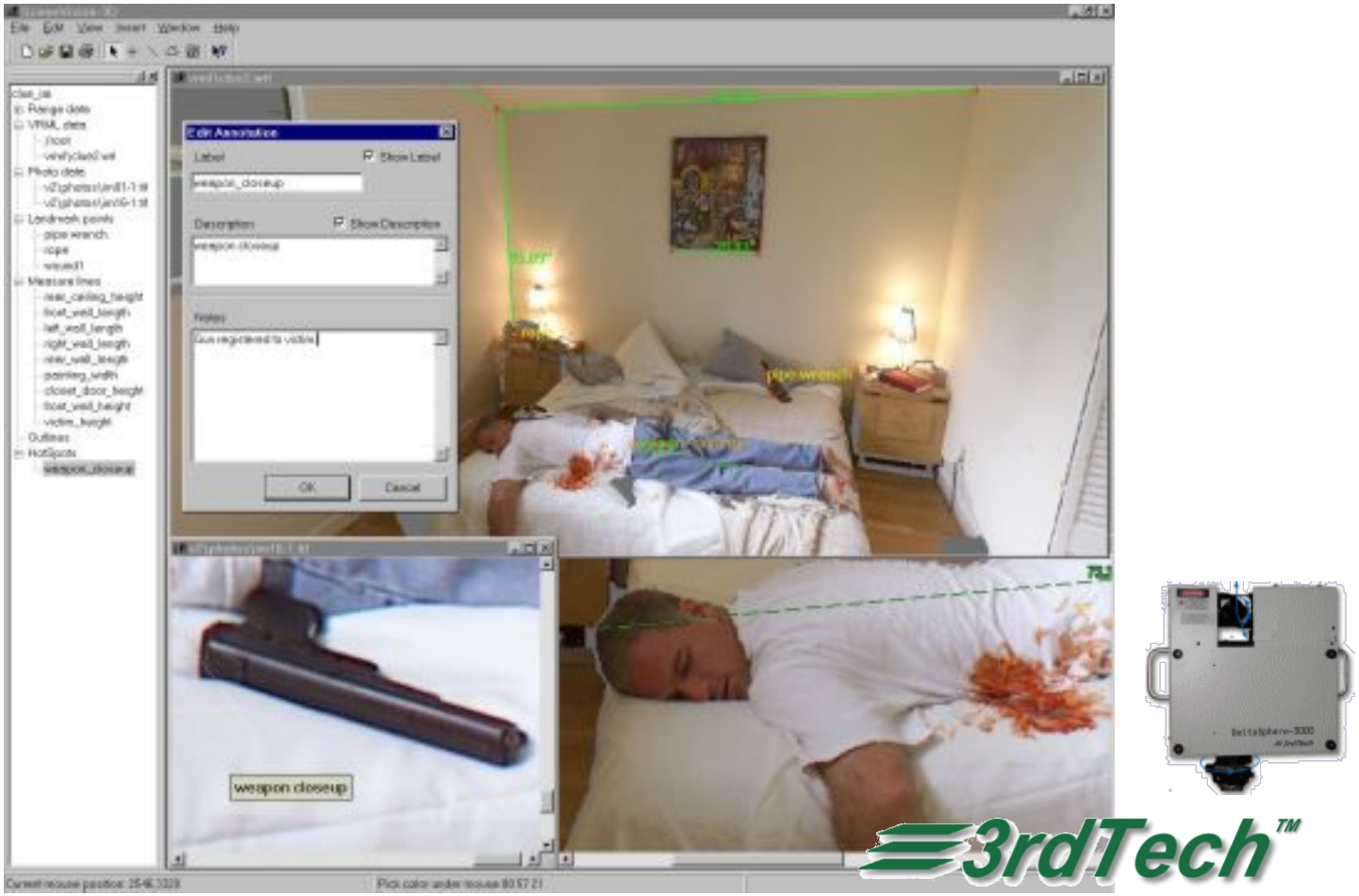
- Scan a person, custom-fit clothing



http://www.cs.unc.edu/Research/vision/comp256/

Forensics

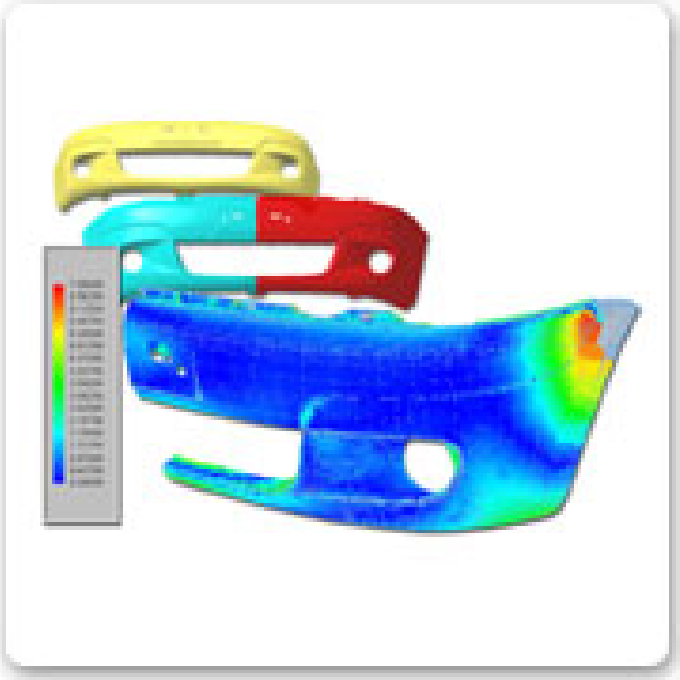
- Crime scene recording and analysis



http://www.cs.unc.edu/Research/vision/comp256/

Industrial inspection

- Verify specifications
- Compare measured model with CAD



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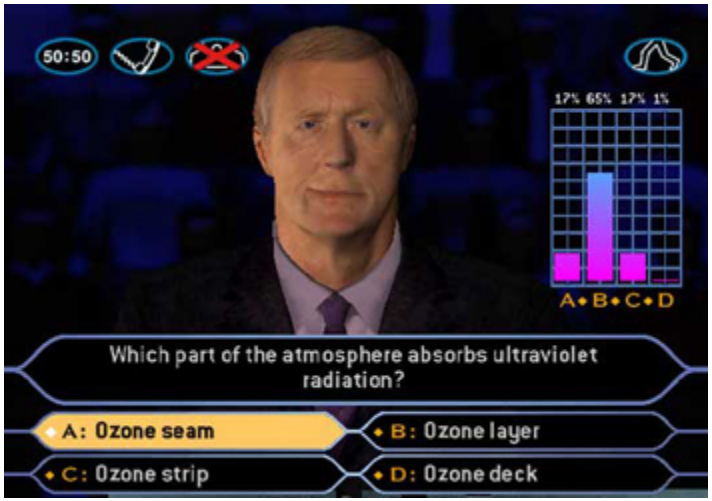
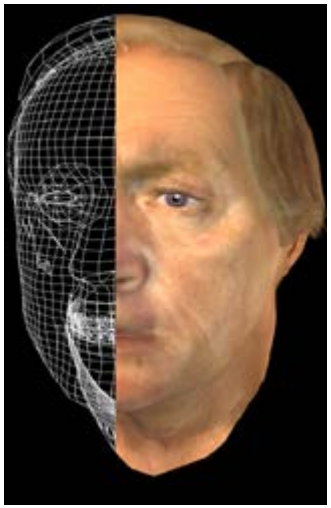
Computer games





http://www.cs.unc.edu/Research/vision/comp256/

Up Next: Chapter #1 Introduction

Questions?