Fast Forward, Part II

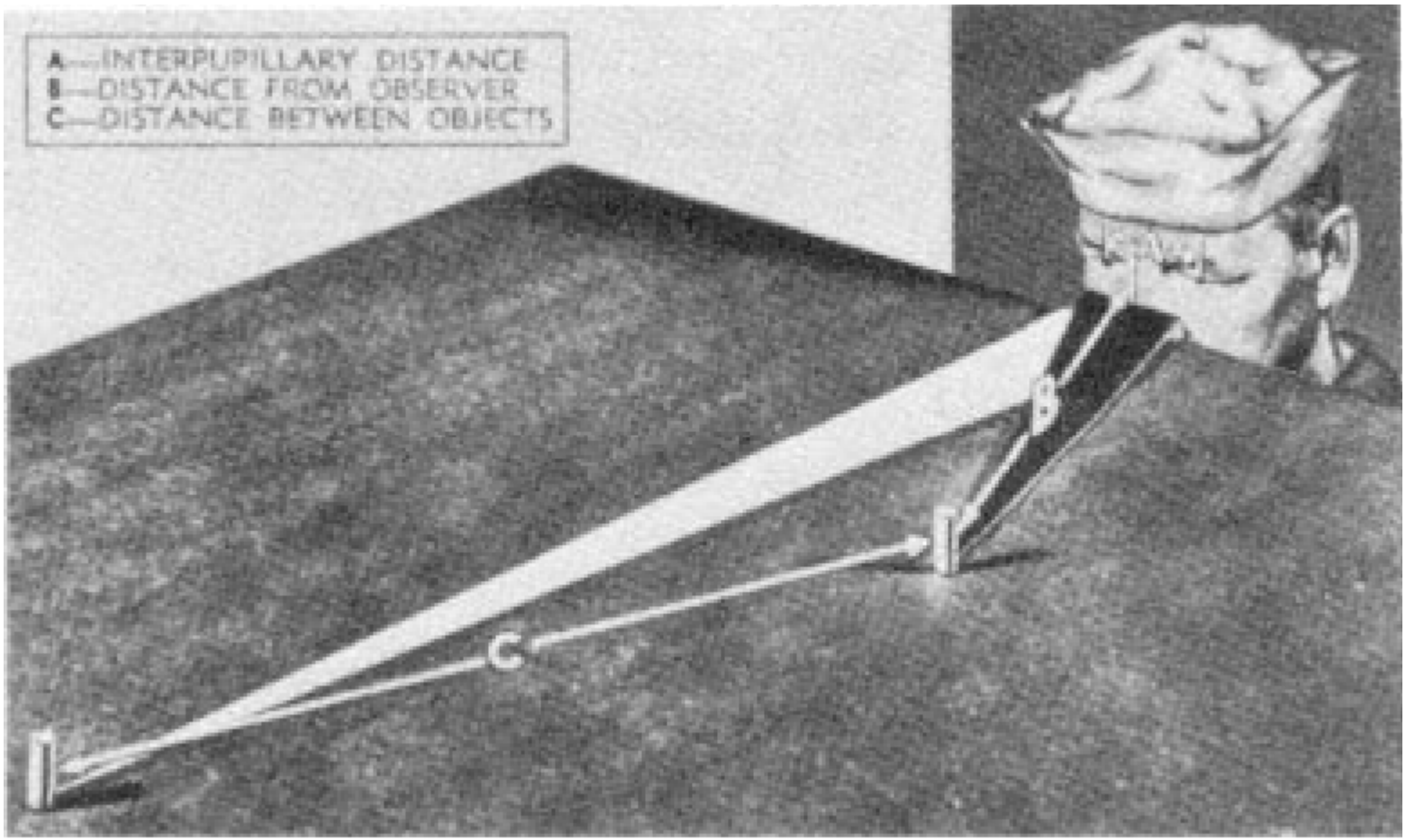
- Multi-view Geometry
- Stereo
- Ego-Motion
- Structure from Motion
- Segmentation
- Tracking

Multi-view Geometry

What are the relationships between images of point features in more than one view?

Given a point feature in one camera view, predict it's location in a second (or third) camera?

Stereo

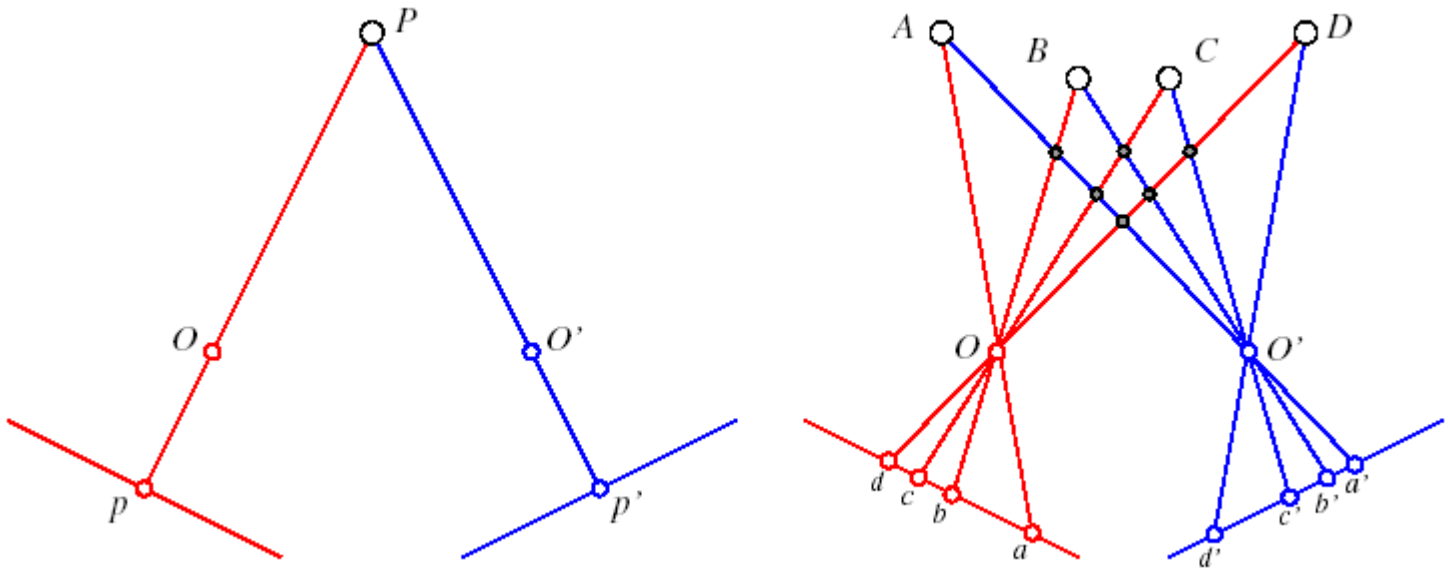

A—INTERPUPILLARY DISTANCE
B—DISTANCE FROM OBSERVER
C—DISTANCE BETWEEN OBJECTS
B
C

Stereo

Stereo

How far away are points in the scene?

Must solve the *correspondence* problem.



Stereo

Demo

Ego-Motion / “Match-move”

Where are the cameras?

Track points, estimate consistent poses…

Render synthetic objects in real world!

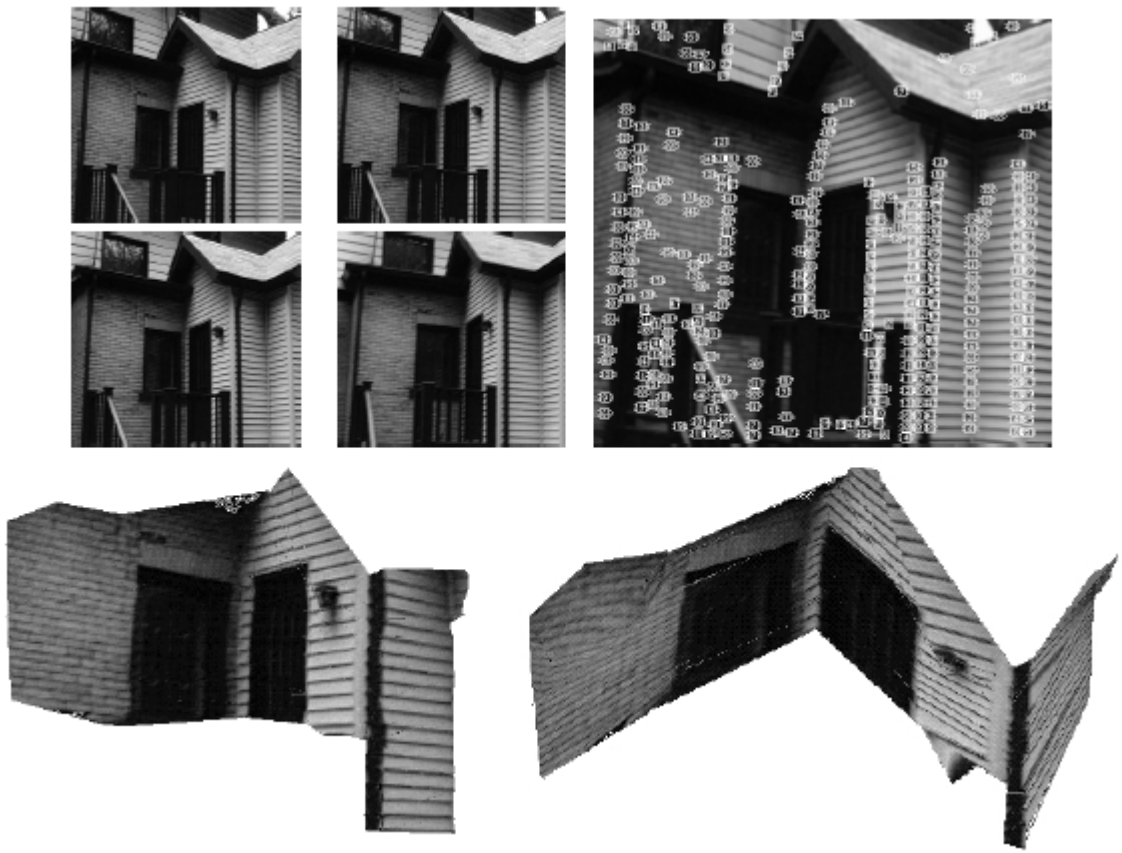
Ego-Motion / “Match-move”

Video

See “Harts War” and other examples in Gallery of examples for Matchmove program at www.realviz.com

Structure from Motion

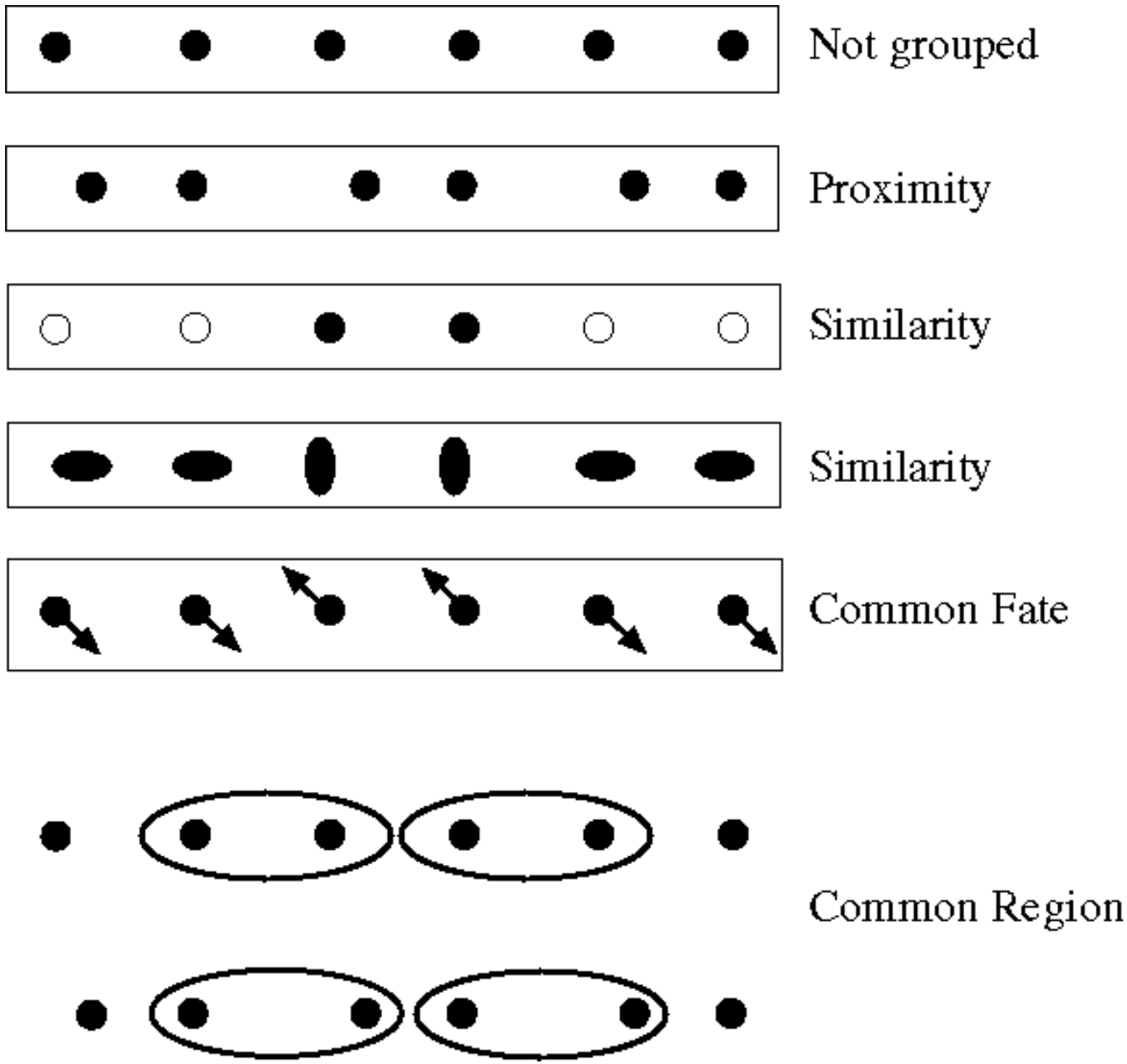
What is the shape of the scene?

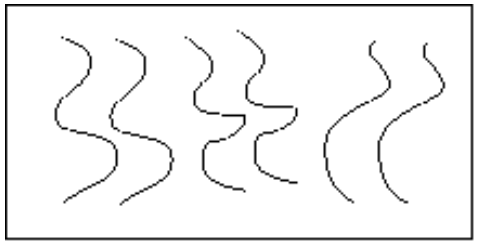


Segmentation

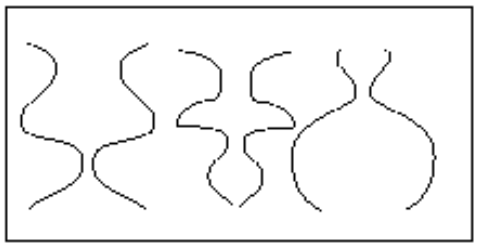
How many ways can you segment six points?

(or curves)

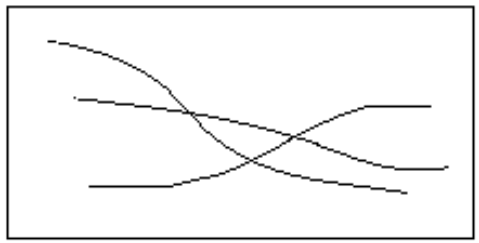

Not grouped
Proximity
Similarity
Similarity
Common Fate
Common Region



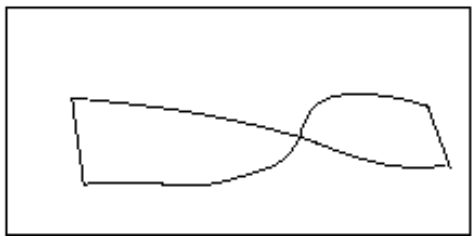
Parallelism



Symmetry



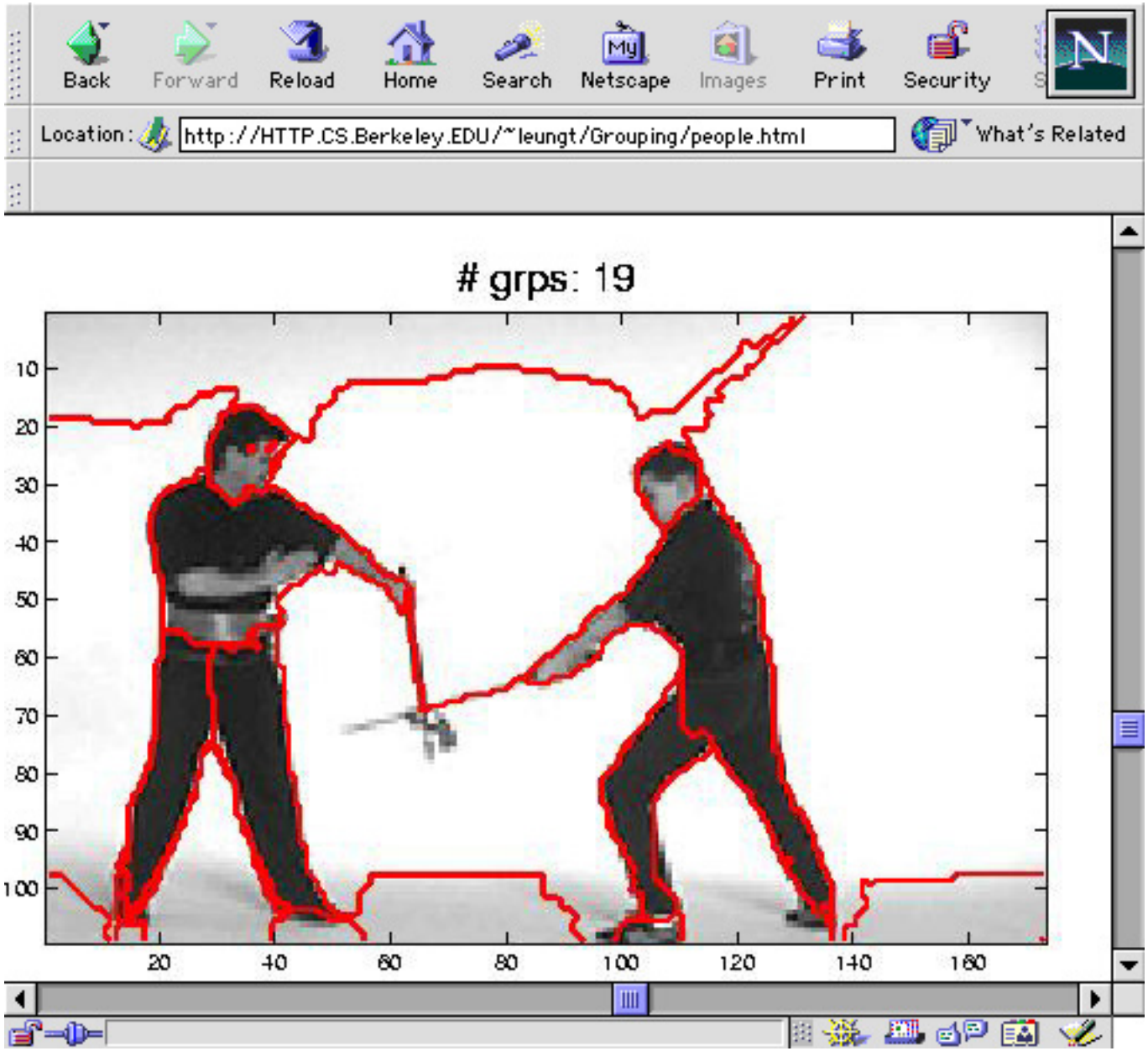
Continuity



Closure

Segmentation

- Which image components “belong together”?
- Belong together=lie on the same object
- Cues
  - similar colour
  - similar texture
  - not separated by contour
  - form a suggestive shape when assembled


Back
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Netscape
Images
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Security
Location :
http://HTTP.CS.Berkeley.EDU/~leungt/Grouping/people.html
What's Related
grps: 19
10
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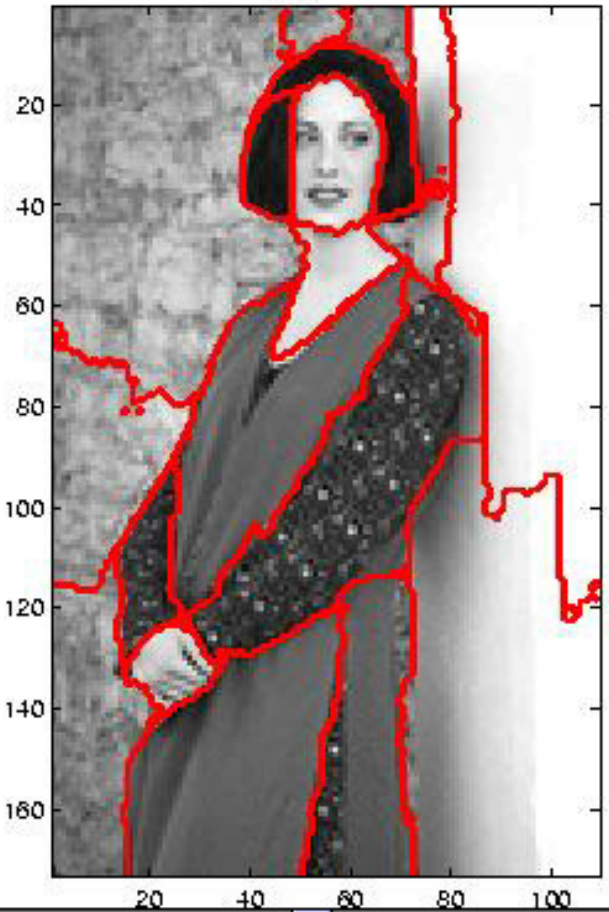
160

Back Forward Reload Home Search Netscape Images

Location : http://HTTP.CS.Berkeley.EDU/~leungt/Gro What's Related

corel img # 181087

grps: 19



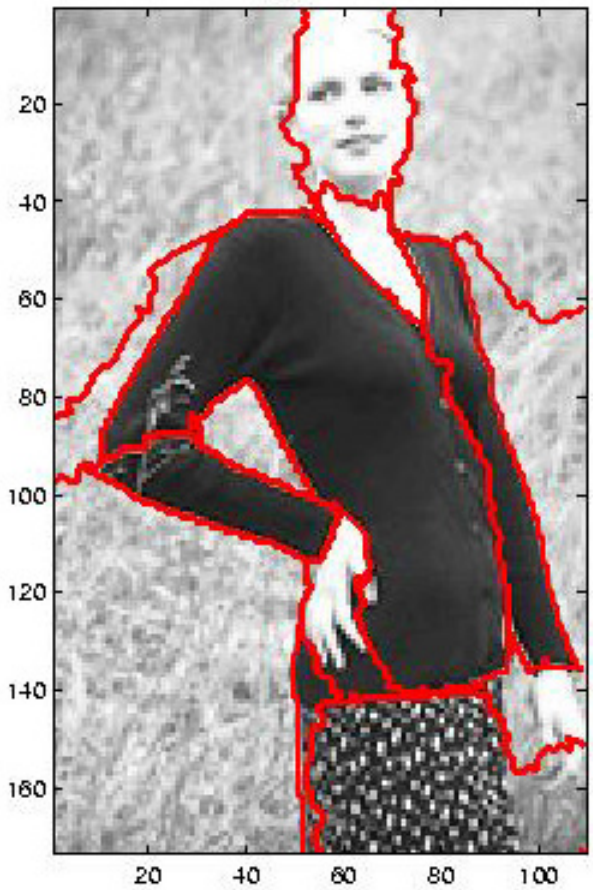
Netscape: Image Segmentation

Back Forward Reload Home Search Netscape Images

Location : http://HTTP.CS.Berkeley.EDU/~leungt/Gro What's Related

corel img # 181000

grps: 15



23% of 51K (at 273 bytes/sec)

Netscape: Blobworld Query Results: Image #108019 (Prefiltered)

File Edit View Go Communicator Help

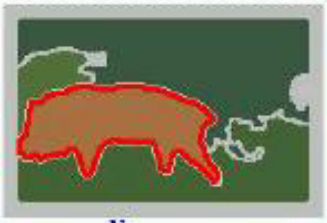
Query image: 108019

Query blobs

	feature importance:				
	overall	**color**	**texture**	**location**	**shape**
blob	very	very	somewhat	not	not
background	somewhat	very	not	not	not

Querying from 35000 images (2000 returned by the filter).

1: 108044 (score = 0.99)



New query

2: 108023 (score = 0.98)

New query

3: 108006 (score = 0.98)

New query

4: 108029 (score = 0.98)

New query

5: 108051 (score = 0.98)

New query

6: 108084 (score = 0.97)

New query

7: 108037 (score = 0.97)

New query

8: 108004 (score = 0.97)

New query

Tracking

Follow objects and estimate location..

- radar / planes
- pedestrians
- cars
- face features / expressions

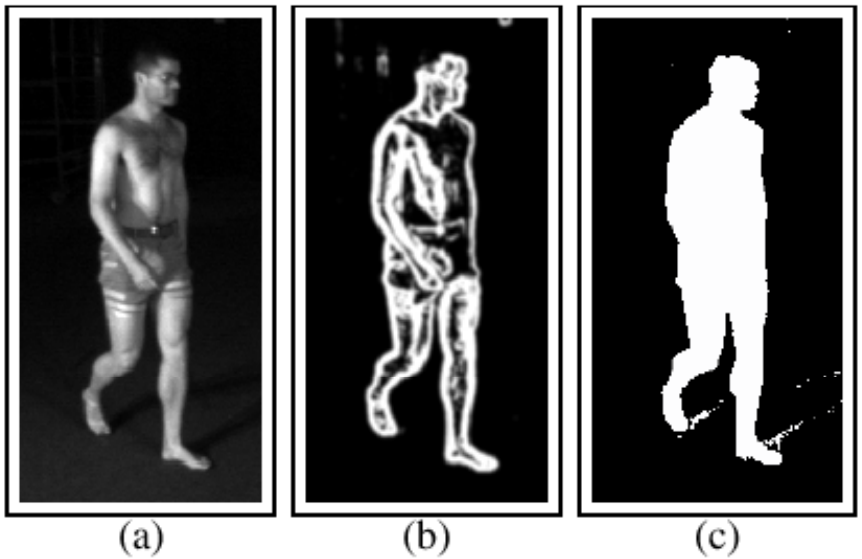
Many ad-hoc approaches..

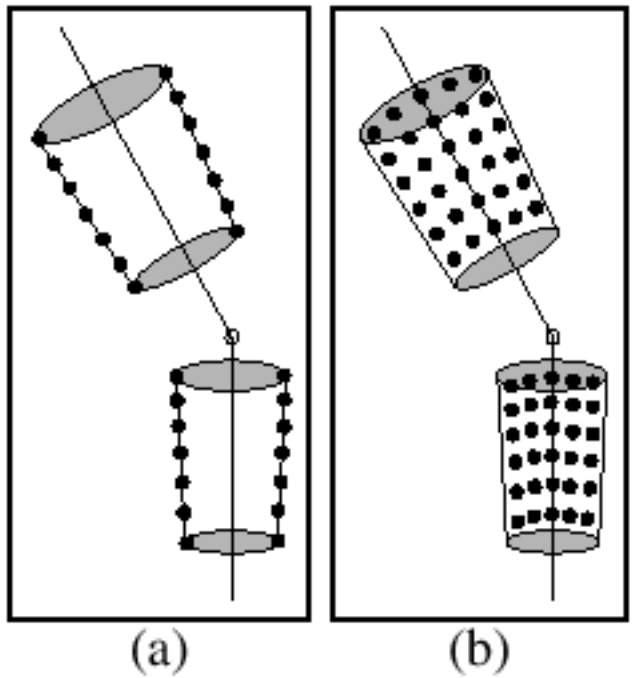
General probabilistic formulation: model density over time

Tracking

- Use a model to predict next position and refine using next image
- Model:
  - simple dynamic models (second order dynamics)
  - kinematic models
  - etc.
- Face tracking and eye tracking now work rather well

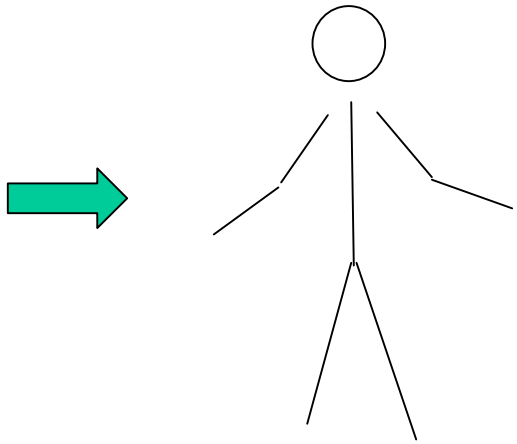
Articulated Models

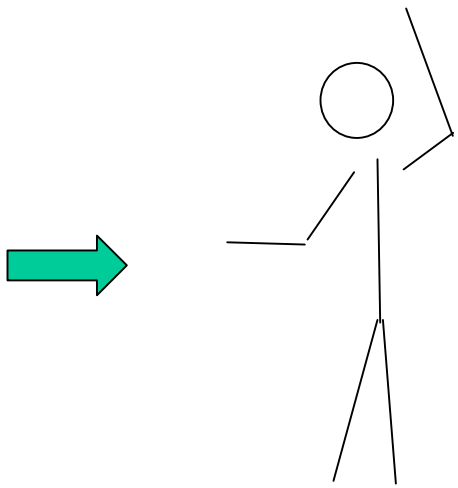




Find most likely model consistent with observations….(and previous configuration)

Articulated tracking





- Constrained optimization
- Coarse-to-fine part iteration
- Propagate joint constraints through each limb
- Real-time on Ghz pentium…

Video

Applications

- VSAM
- Image Databases
- Image-based Rendering

Why study Computer Vision?

- Images and movies are everywhere
- Fast-growing collection of useful applications
  - building representations of the 3D world from pictures
  - automated surveillance (who's doing what)
  - movie post-processing
  - face finding
- Various deep and attractive scientific mysteries
  - how does object recognition work?
- Greater understanding of human vision

Why study Computer Vision?

- One can "see the future" (and avoid bad things…)
  - Crickets avoid being hit in the head
    - There's a reflex --- when the right eye sees something going left, and the left eye sees something going right, move your head fast.
  - Gannets pull their wings back at the last moment
    - Gannets are diving birds; they must steer with their wings, but wings break unless pulled back at the moment of contact.
    - Area of target over rate of change of area gives time to contact.

Why study Computer Vision?

- 3D representations are easily constructed
  - There are many different cues.
  - Useful
    - to humans (avoid bumping into things; planning a grasp; etc.)
    - in computer vision (build models for movies).
  - Cues include
    - multiple views (motion, stereopsis)
    - texture
    - shading

Why study Computer Vision?

- People draw distinctions between what is seen
  - "Object recognition"
  - This could mean "is this a fish or a bicycle?"
  - It could mean "is this George Washington?"
  - It could mean "is this poisonous or not?"
  - It could mean "is this slippery or not?"
  - It could mean "will this support my weight?"
  - Great mystery
    - How to build programs that can draw useful distinctions based on image properties.