Hierarchical Scene Annotation

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What to Annotate?
Objects/Parts

glasses
hat
apple
face
torso
Subparts

eyes
beard
finger
tie
shirt
jacket
Figure/Ground
Rich Annotation

Multiple modalities:

- Web-based annotation tool
- Computer-assisted segmentation
- Model invariant enforcement
- Visual feedback

"LabelMe on steroids"

Object segmentation dataset + benchmark

BMVC 2013 extension
Rich Annotation

- Multiple modalities:
  - Objects, parts, subparts
  - Object-part containment
  - Segmentation
  - Occlusion (figure/ground)
  - Attributes
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- Unifying abstraction: region trees

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- Object segmentation dataset + benchmark
Object Model: Region Tree
Object Model: Region Tree

- man
- head
- shirt
- arm
- watch
- hand
- arm

Object-Part ⇒
Object Model: Region Tree

Object-Part ⇒ Occlusion Ordering

man

head

shirt

arm

watch

hand

arm
Object Model: Self Occlusion

- man
- head
- shirt
- arm
- watch
- hand
- arm

Occlusion Ordering

Object-Part ⇒

⇒ Occlusion Ordering

Object-Part ⇒
Object Model: Virtual Link

- man
- head
- shirt
- arm
- V
- V
- V
- watch
- hand
- arm

Occlusion Ordering
Additional Object Models

- envelope
- stamp
- label
- glove
Scene Model: Region Tree

Objects/Parts

- glove
- envelope
- stamp
- label
- man
- head
- shirt
- arm
- watch
- hand

glove → envelope → stamp → label → man → head → shirt → arm → watch → hand → arm → glove
Tree Traversal Recovers Figure/Ground
Annotation Software
Region Tree Navigation

[Diagram of a region tree with nodes for man, car, person, people, canopy, street, traffic light, umbrella, and canopy. The diagram includes panes for 'Near' and 'Far' with options for 'Expand Subregions', 'New Region', and 'Merge'.]
Region Tree Navigation
Containment Constraints
Containment Constraints
Interactive Segmentation

Image

Oversegmentation

Click
Interactive Segmentation

Image  
Oversegmentation  
Release
Interactive Segmentation

Image

Oversegmentation

Touch-up
Annotated Scene Dataset
Annotated Scene Dataset
Example Object-Part Hierarchies
Groundtruth UCM vs gPb-UCM
Groundtruth UCM vs gPb-UCM
Groundtruth UCM vs gPb-UCM
Groundtruth UCM vs gPb-UCM
Boundary Benchmark

Boundary Detection [F=0.66 (R=0.76, P=0.59)]
Hierarchical Boundary Benchmark

Boundary Recovery Order by Hierarchy Level

Overall Boundary Recall
Level Recovery Fraction
Boundary Recovery Order by Hierarchy Level

Level 1
Level 2
Level 3

Overall Boundary Recall

Level Recovery Fraction

1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Level 1
Level 2
Level 3
Thank You