Weakly Supervised Object Boundaries

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Is it possible to get object boundaries with bounding box supervision?

Full supervision
Time-consuming.

Weak supervision
Only 2 clicks per object.
**Task:** detection of object boundaries

**Image**

**Ground truth**
Image

Generic boundary detector output
Image

Generic boundary detector output

- True positive boundaries
- False positive boundaries
- False negative boundaries
Full supervision

Object boundary detector output

- **True positive boundaries**
- **False positive boundaries**
- **False negative boundaries**
Weak supervision

Object boundary detector output

- True positive boundaries
- False positive boundaries
- False negative boundaries
It is possible to get object boundaries with bounding box supervision.
Pipeline:

Input: Image and bounding boxes

Generation of annotations

Regular boundary detector training

Output: Object boundary detections
**Task:** detection of generic boundaries

**Dataset:** BSDS [Martin et al., ICCV’01; Arbeláez et al., PAMI’11]
Task: generic boundaries, BSDS dataset.
Task: generic boundaries, BSDS dataset.
Task: generic boundaries, BSDS dataset.
Full supervision

Unsupervised

[Felzenszwalb et al., IJCV’04]
Task: generic boundaries, BSDS dataset.
Task: generic boundaries, BSDS dataset.
Boundary detectors are robust to annotation noise.
Pipeline:

Input:
- Image and bounding boxes

Generation of annotations:
- Object boundary detections

Output:
- Regular boundary detector training
- Object boundary detections
**Task:** detection of object boundaries

**Dataset:** VOC [Everingham et al., IJCV’15]
Generation of annotations:

Detection bounding boxes

Object proposals

[Fast-RCNN, Girshick, ICCV’15]

[SeSe, Uijlings et al., IJCV’13]
Combining weak annotations from:

Object proposals

GrabCut

Graph-based segmentation

Consensus between different methods
Ground truth

Generated annotations

Positive boundaries
Ignore boundaries
Negative boundaries
Ground truth

Generated annotations

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Positive boundaries  Ignore boundaries  Negative boundaries
Pipeline:

Input

- Image and bounding boxes

Generation of annotations

Regular boundary detector training

Output

- Object boundary detections
Boundary detectors:

- Structured Edge Forests [SE, Dollar et al., PAMI’15]

- Holistically-nested Edge Detection [HED, Xie & Tu, ICCV’15]
**Task:** detection of object boundaries

**Datasets:**
- **VOC** [Everingham et al., IJCV’15]
- **SBD** [Hariharan et al., ICCV’11]
VOC [Everingham et al., IJCV’15]
Task: object boundaries, VOC dataset.
Task: object boundaries, VOC dataset.
Task: object boundaries, VOC dataset.
HED results

Task: object boundaries, VOC dataset.
HED results

Task: object boundaries, VOC dataset.
HED results

Task: object boundaries, VOC dataset.

Better

ODS

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<th>HED</th>
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<tbody>
<tr>
<td>Fully supervised</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Weakly supervised</td>
<td>45</td>
<td>55</td>
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<tr>
<td>Generic boundaries</td>
<td>40</td>
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Image | Generic boundaries | Fully supervised | Weakly supervised

- True positives
- False positives
- False negatives
While training an object detector one can also get a high quality object boundary detector for free.
SBD [Hariharan et al., ICCV’11]
Task: semantic object boundaries, SBD dataset.
Weakly supervised object boundaries can reach the full supervision quality.
Contributions:

• Introduce the problem of weakly supervised object boundaries.

• Boundary detectors are robust to annotation noise.

• High quality object boundaries can be obtained using box annotations alone.
Even more results in the paper!

<table>
<thead>
<tr>
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<th>Method</th>
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<th>OIS</th>
<th>AP</th>
</tr>
</thead>
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<td>F&amp;H</td>
<td>64</td>
<td>67</td>
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<td>gPb-owt-ucm</td>
<td>73</td>
<td>76</td>
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<tr>
<td></td>
<td>Det. + SE(BSDS)</td>
<td>74</td>
<td>76</td>
<td>79</td>
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<tr>
<td></td>
<td>HED(BSDS)</td>
<td>79</td>
<td>81</td>
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<th>AP</th>
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<td>Other</td>
<td>Hariharan et al.</td>
<td>28</td>
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<td></td>
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<th>AP</th>
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<td>44</td>
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Details and more results at poster 20 tomorrow

Project page at https://www.mpi-inf.mpg.de/wsob

Trained models, generated annotations, and results are available online.

Thank you for your attention!