Elastic Edge Boxes for Object Proposal on RGB-D Images

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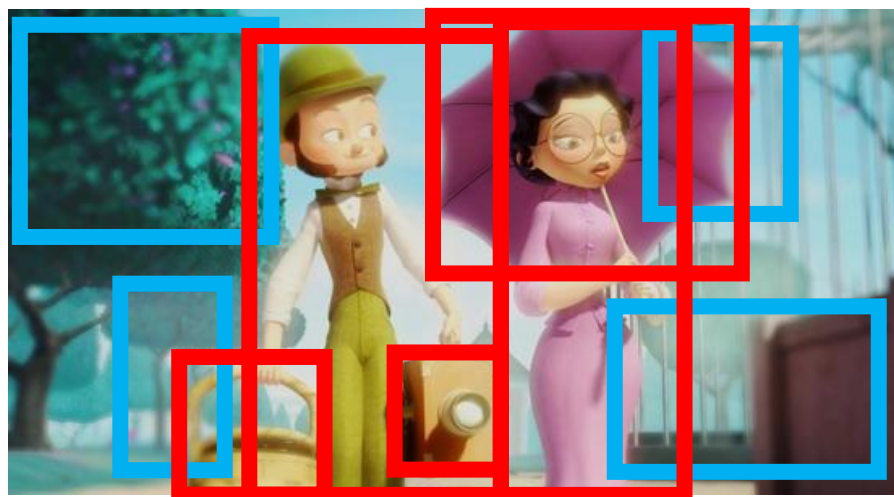
Nanjing University

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Outline

- **Motivation**
- **Elastic Edge Boxes Method**
- **Experiments**
- **Conclusion**

Object Proposal

- **Aims to detect bounding box which possibly contains class-independent objects in an image**

hit
miss

- **Applications**
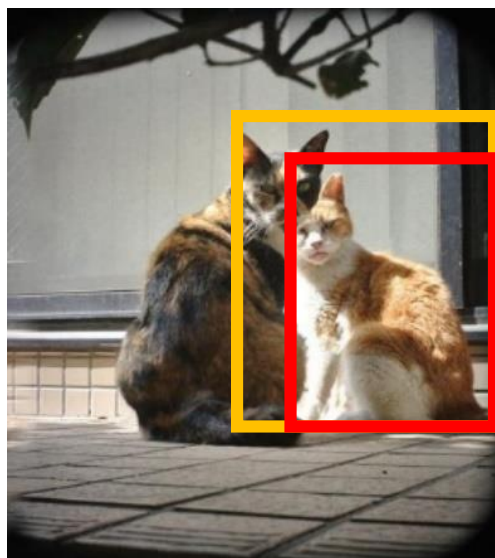

Object detection   **Image segmentation**   **Image retrieval**

Object Proposal is Challenging

- **High recall**

- **High efficiency**

- **High accuracy**
  - **Low intersection over union (IoU) is not enough**
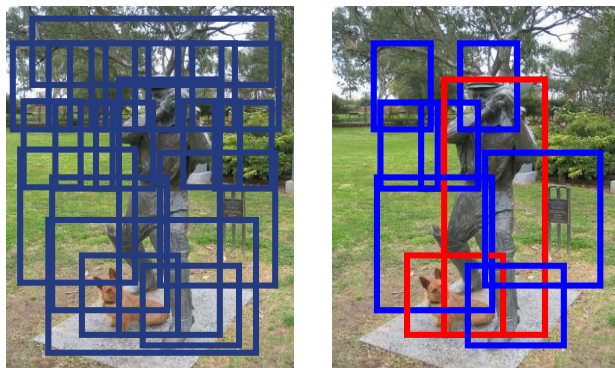

☐ **IoU = 0.5**
☐ **IoU = 0.8**

Current Methods

Window scoring

- **Generate a pool of boxes and score the boxes**
- **Efficient but not accurate enough**

[Cheng et. al, CVPR14]

Grouping

- **Over-segment images and merge the segments**
- **Accurate but not efficient enough**

[Uijlings et. al, IJCV13]

How to combine these two strategies to obtain good performance in both efficiency and accuracy?

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Overview

RGB channels and depth channel

Elastic edge box for RGB-D object proposal

result

Step 1

Initial boxes generation

Step 2

Elastic range search

Step 3

Bounding box adjustment
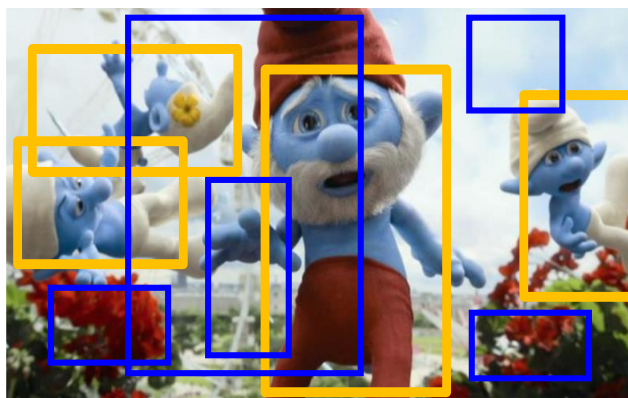
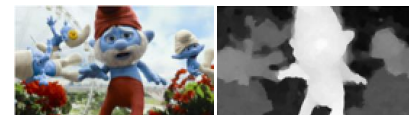# Initial Boxes Generation

- **Perform sliding window to sample boxes**
- **Calculate score by contours wholly enclosed in a box**
  - **Utilize edge boxes method** [Dollár et. al, ECCV 14]

Initial boxes generation
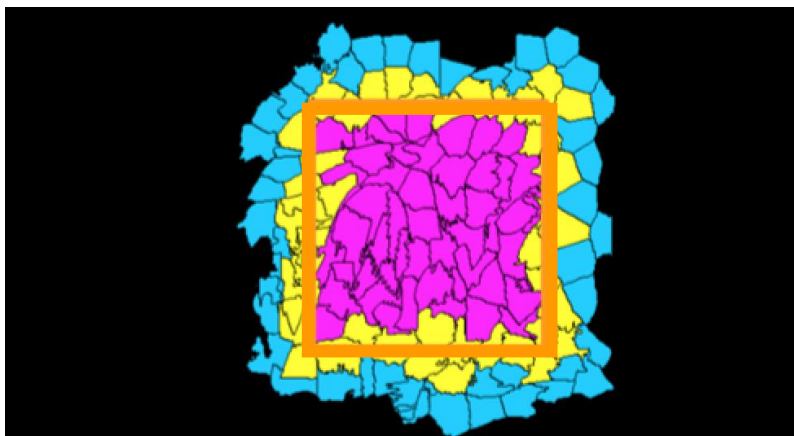

Edge detection result

**Initial boxes**

Elastic Range Search

- **Super-pixels straddling the box are elastic range**

- **Use Super-pixels wholly included in the box to represent object (cyan)**

- **Use super-pixels adjacent to elastic range of similar sum as object part to represent background (blue)**


**Elastic range (yellow super-pixels)**

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Initial boxes generation

Elastic range search
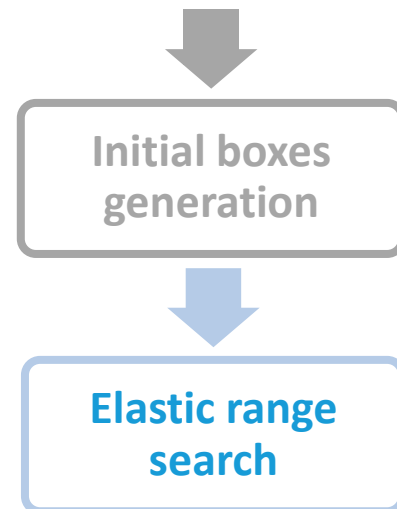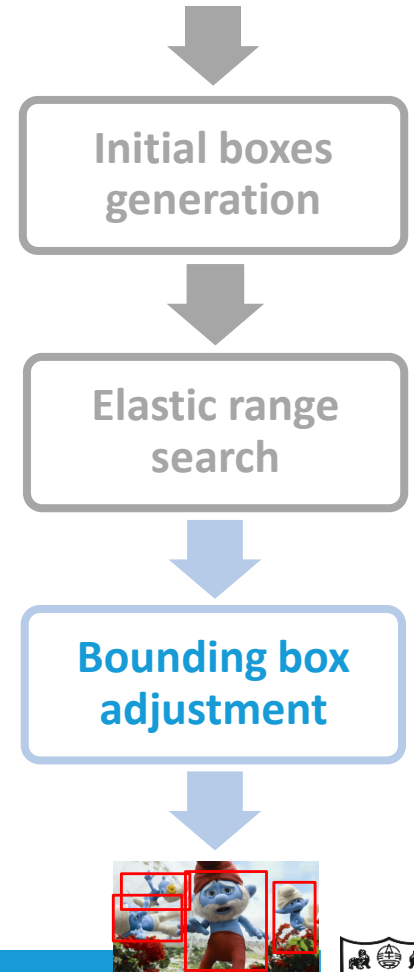
Bounding Box Adjustment

- **Compute color distance, spatial distance and depth distance as similar measurement**

- **Only super-pixels more similar to object than background in both RGB and depth channels will be assigned to object**

Initial boxes generation

Elastic range search

Bounding box adjustment
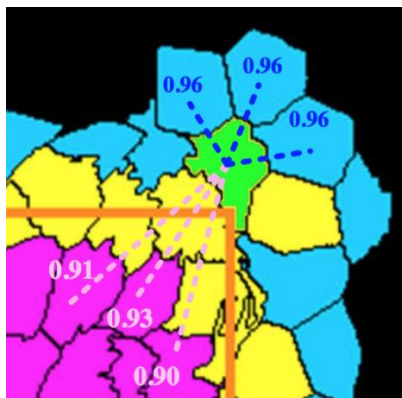
Decision
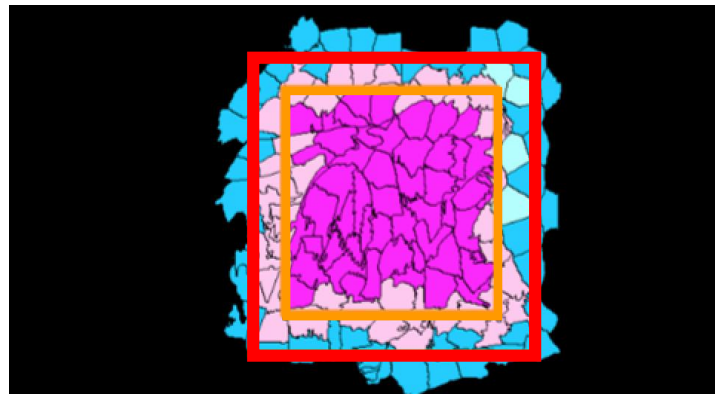
**Adjusted bounding box (red box)**

Outline

- **Motivation**
- **Elastic Edge Boxes Method**
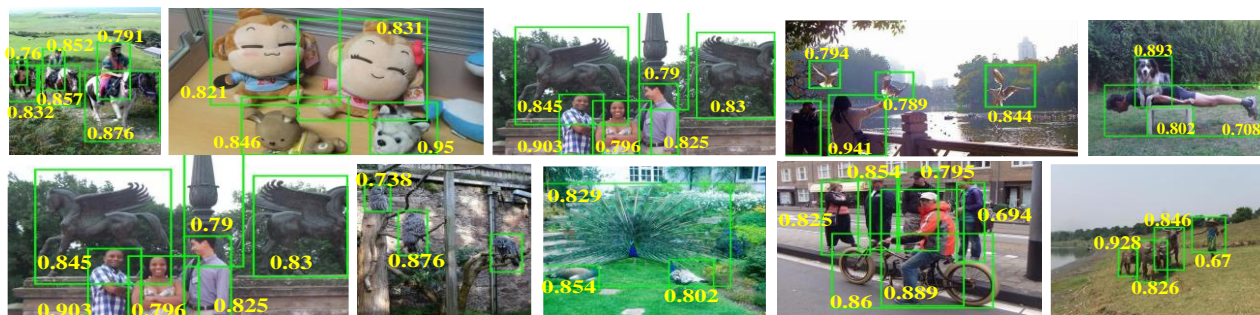- **Experiments**
- **Conclusion**

Dataset

- **NJU1500: 1,500 stereo images for object proposal**
  - **Extend from stereo objectness dataset [Xu et. al, ICME15]**

- **Improvement**
  - **More balanced**
    - **300 images in each group (2, 3, 4, 5, 5+ objects, respectively)**
  - **Higher average object number**
    - **PASCAL VOC 2012: 2.38**
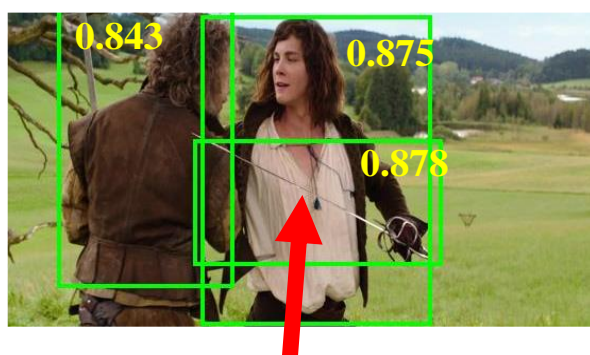   - **Stereo objectness: 2.98**
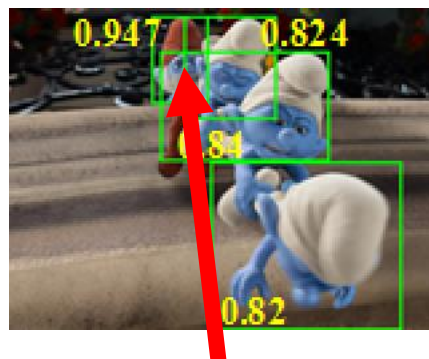   - **NJU1500: 4.22**
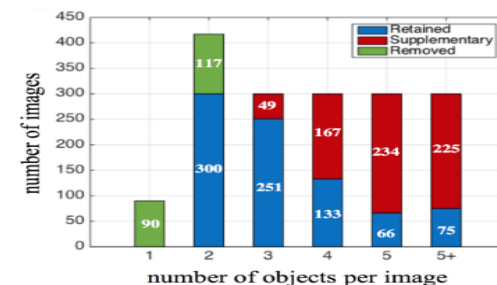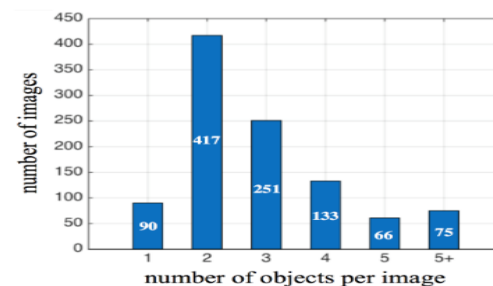
Result

- ## Suitable for various images under high IoU

- ## Challenging situations

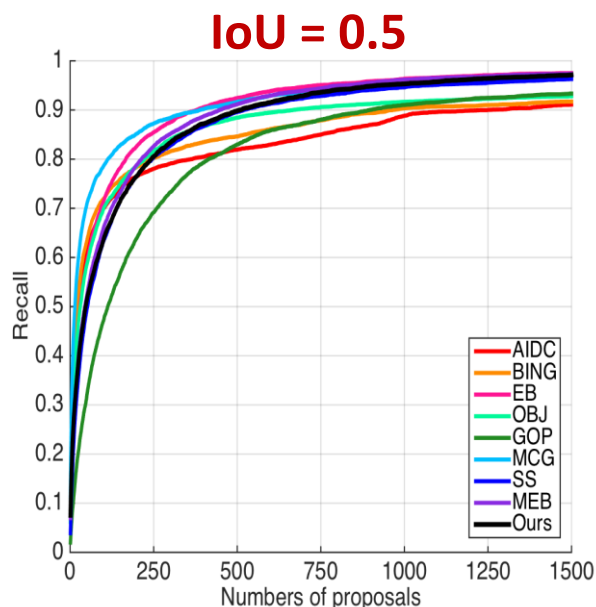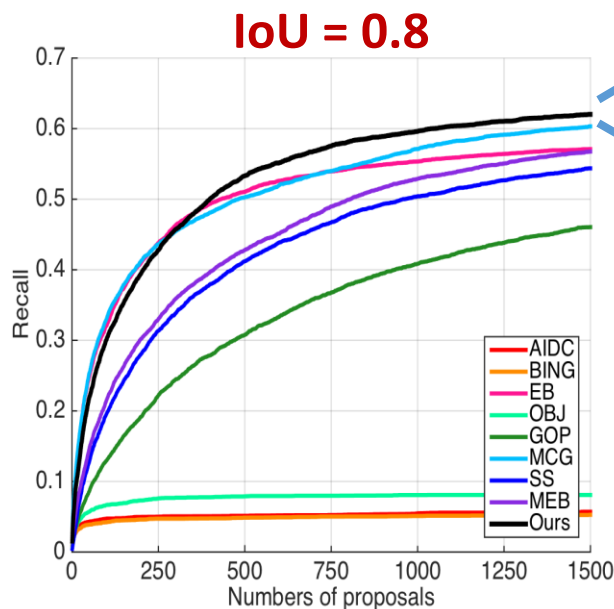| Obscure	Occluded	Small
(sword)	**(Papa Smurf)**	**(dustbin)**

Comparison

- **Compare with eight state-of-the-art methods**
  - **Including AIDC, BING, EB, OBJ, GOP, MCG, SS and MEB**
  - **Under IoU = 0.5 and IoU = 0.8, respectively**

IoU = 0.5

IoU = 0.8

Ours
5.78s per image

MCG
60.12s per image

Comparable to other methods when IoU = 0.5

Better than other methods when IoU = 0.8

Outline

Conclusion

- **Contribution**
  - **First attempt to integrate window scoring and grouping strategies for RGB-D object proposal**
  - **Provide an RGB-D image dataset *NJU1500* for object proposal**

- **Future work**
  - **Object proposal for video analysis**
  - **Usage of object proposal in multimedia applications**

Thank You

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