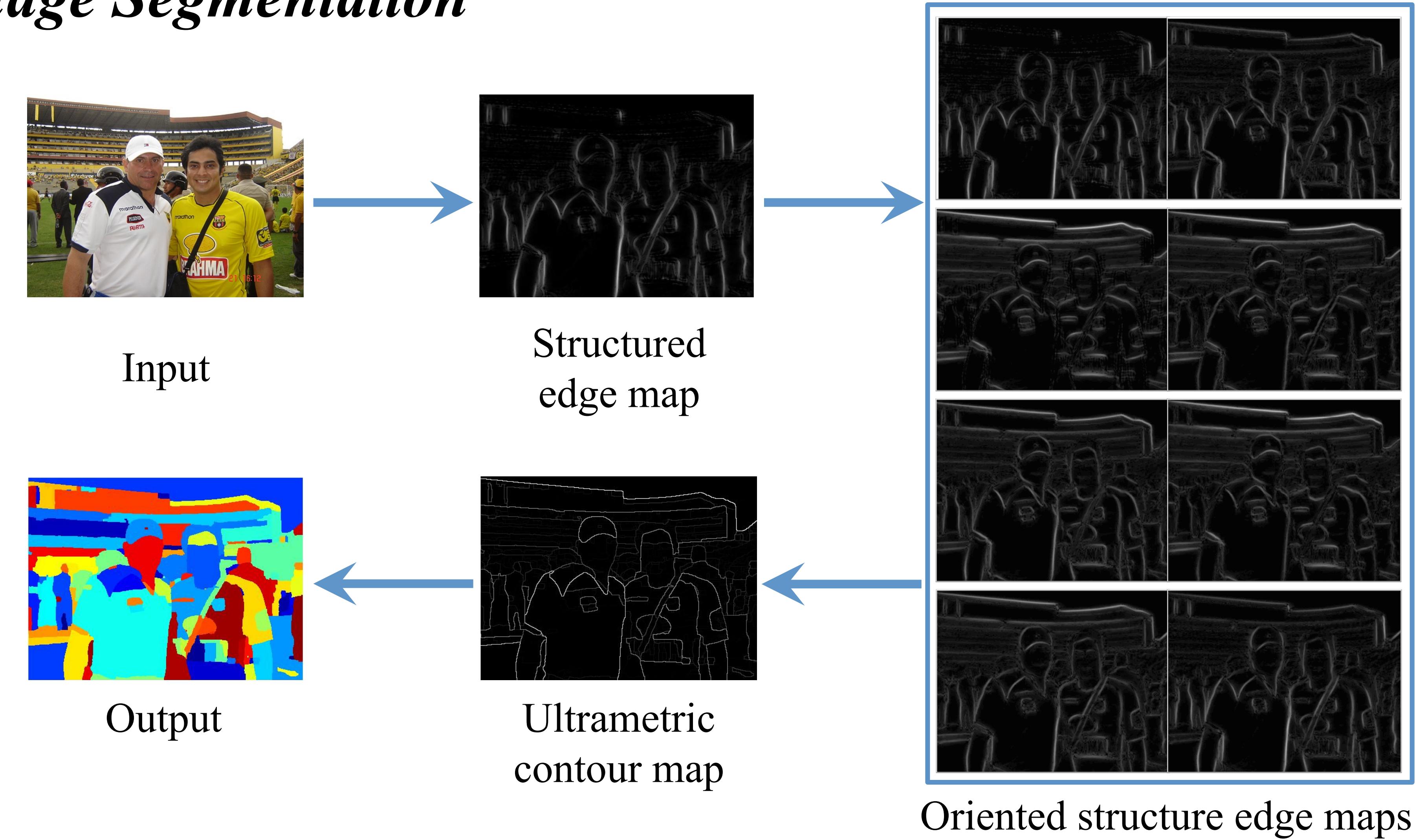


## Introduction

- Motivation**
  - Effective image regions can be used in different applications such as image segmentation and object detection
- Challenges**
  - High computational load of the gPb contour detector
  - Irregular size and shape of the regions generated by the graph-based segmentation algorithm
- Problems**
  - How to generate high quality image regions efficiently?
  - How to apply the image regions to obtain good object proposals?

## Our Approaches

### Image Segmentation



- gPb framework v.s. our framework
  - gPb framework: gPb contour detector + OWT (oriented watershed transform) + UCM
  - Our framework: structured edge + steerable filter + OWT + UCM
  - Steerable filter: link structured edge and OWT step
- Integrate structured edge with steerable filters
  - Gradient in x direction  $e_x(x, y) = e(x, y) \cos(\Theta(x, y))$
  - Gradient in y direction  $e_y(x, y) = e(x, y) \sin(\Theta(x, y))$
  - Oriented structured edge map  $e(x, y, \theta) = |e_x(x, y) \cos(\theta) + e_y(x, y) \sin(\theta)|$

### Object Detection

- Use the image segments generated by the proposed image segmentation algorithm in the graph-based segmentation algorithm
- Integrate the high quality regions with the hierarchical grouping, proposed by selective search

## Segmentation Results on BSDS500

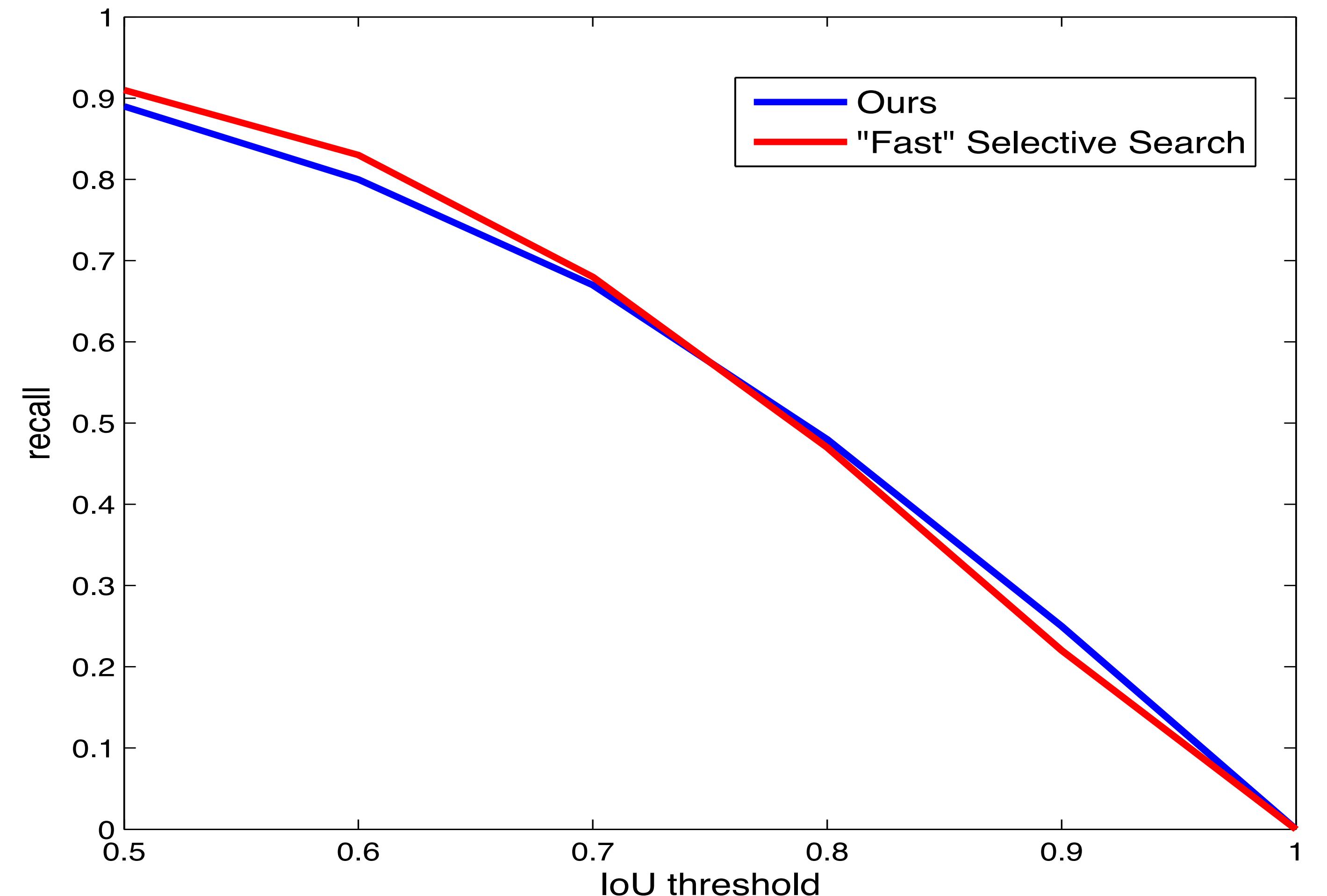
	Covering		PRI	VI			
	ODS	OIS	AP	ODS	OIS	ODS	OIS
gPb-OWT-UCM	<b>0.59</b>	<b>0.65</b>	<b>0.74</b>	<b>0.83</b>	<b>0.86</b>	<b>1.69</b>	<b>1.48</b>
Mean Shift	0.54	0.58	0.74	0.79	0.81	1.85	1.64
F&H	0.52	0.57	0.69	0.80	0.82	2.21	1.87
Normalized Cut	0.45	0.53	0.67	0.78	0.80	2.23	1.89
Ours	0.58	0.64	<b>0.74</b>	0.82	<b>0.86</b>	1.71	1.52

- PRI: probabilistic rand index
- VI: variation of information
- ODS: optimal dataset scale
- OIS: optimal image scale
- AP: average precision

Method	Computational time (s)
gPb-OWT-UCM	53.6
Ours	<b>4.6</b>



## Detection Results on PASCAL VOC 2007

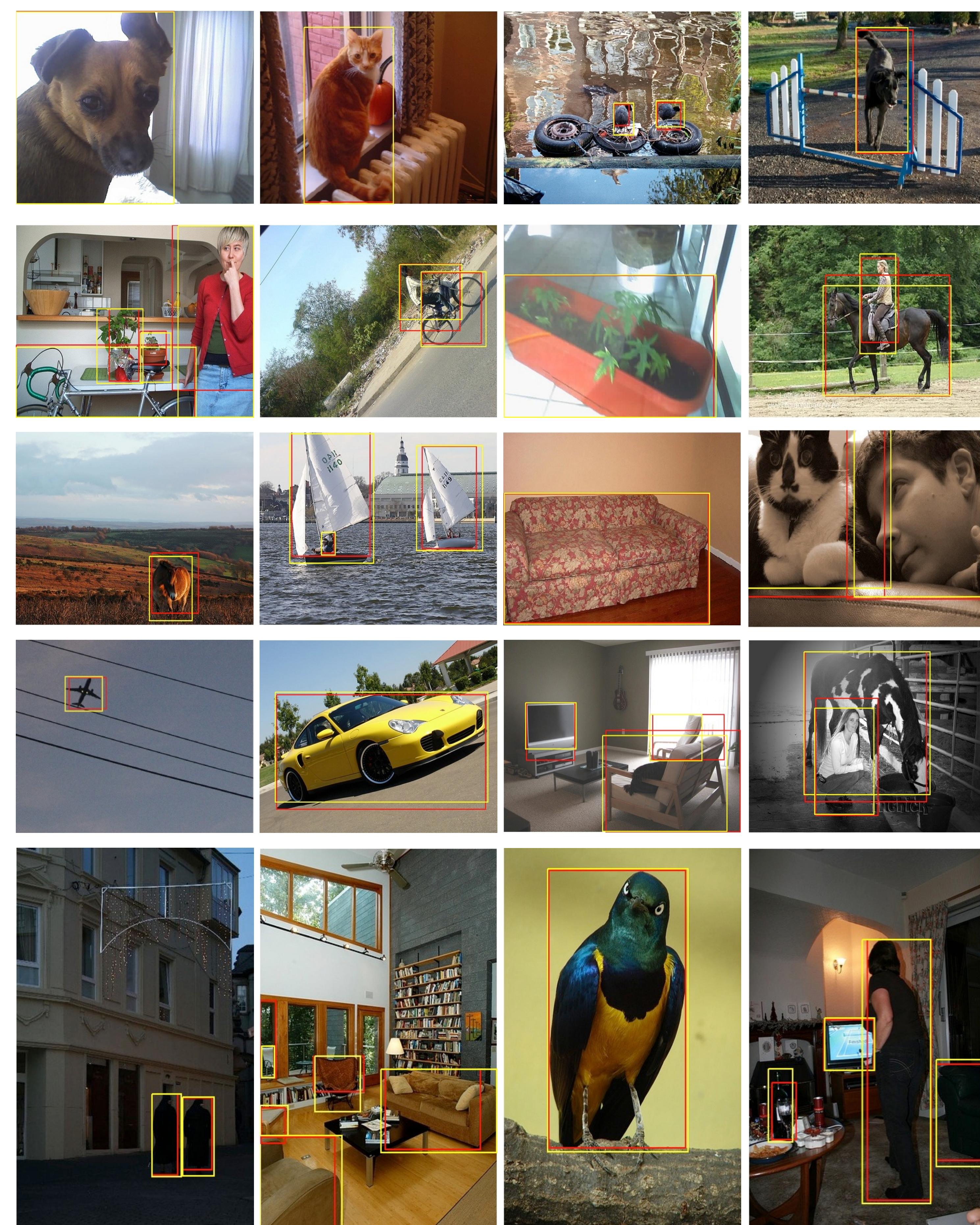


- MABO: mean average best overlap

$$ABO = \frac{1}{|G^c|} \sum_{g_i^c \in G^c} \max_{l_j \in L} IoU(g_i^c, l_j)$$

- $G^c$ : ground truth window sets for class  $c$
- $g_i^c$ : a ground truth window for class  $c$
- $L$ : object proposals
- $l_j$ : an object proposal

Method	MABO	# of windows
Selective Search	<b>0.81</b>	2007
Ours	<b>0.81</b>	<b>1191</b>



Example results: our method (yellow), ground truth (red)