



图像分割的评价 Evaluation of Image Segmentation

Ning Tang

Evaluation of Image Segmentation

Compare **segmentation result** with **ground-truth**

segmentation
result



ground-truth



Evaluation of Image Segmentation

Compare **segmentation result** with **ground-truth**

How ?

Evaluation of Image Segmentation

Compare **segmentation result** with **ground-truth**

How ?

Evaluation Measure

Evaluation Measures

- **F-measure**
- **Segmentation Covering**
- **Probabilistic Rand Index (PRI)**
- **Normalized Probabilistic Rand Index (NPRI)**
- **Variation of Information (Vol)**
- **Global Consistency Error (GCE)**
- **Boundary Displacement Error (BDE)**
-

F-measure

A combination of precision and recall leads to the F-measure.

		Predicted class	
		Yes	No
Actual class	Yes	True positive	False negative
	No	False positive	True negative

$$P = \frac{TP}{TP + FP}$$

$$R = \frac{TP}{TP + FN}$$

F-measure

A combination of precision and recall leads to the F-measure.

$$F = \frac{PR}{\tau R + (1 - \tau)P}$$

Segmentation Covering

It measures the similarity between segmentations by weight averaging the overlaps of regions in two segmentations.

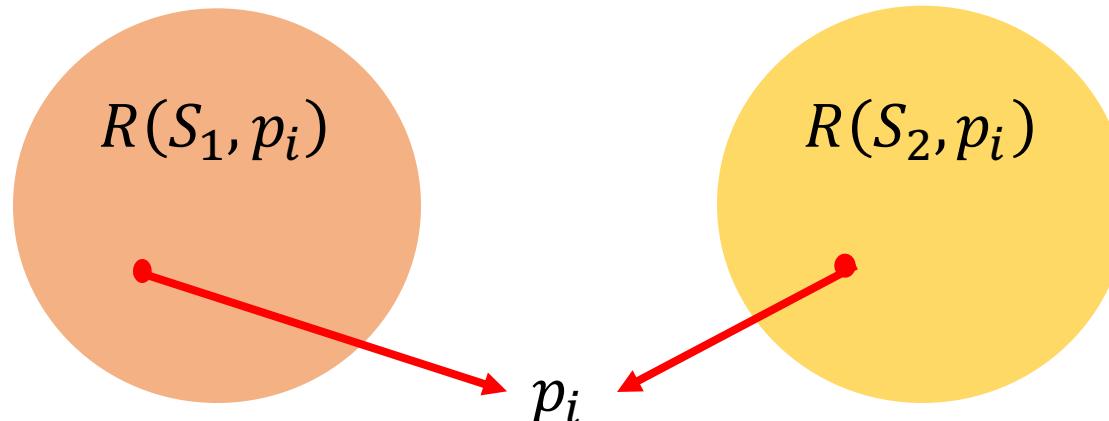
$$C(S_1 \rightarrow S_2) = \frac{1}{N} \sum_{R \in S_1} |R| \cdot \max_{R' \in S_2} \frac{|R \cap R'|}{|R \cup R'|}$$

Global Consistency Error (GCE)

It measures to which degree the segmentations S_1 and S_2 agree with each other.

$$E(S_1, S_2, p_i) = \frac{|R(S_1, p_i) \setminus R(S_2, p_i)|}{|R(S_1, p_i)|}$$

$$GCE(S_1, S_2) = \frac{1}{N} \min \left\{ \sum_i E(S_1, S_2, p_i), \sum_i E(S_2, S_1, p_i) \right\}$$



Probabilistic Rand (PR) index

It measures to which degree the segmentations S_1 and S_2 agree with each other.

$$PR(S_1, \{S_2\}) = \frac{1}{\binom{N}{2}} \sum_{i,j} [c_{ij}p_{ij} + (1 - c_{ij})(1 - p_{ij})]$$

S_1 : segmentation result

S_2 : ground-truth

p_{ij} : the ground-truth probability that the labels of (x_i, x_j) are the same

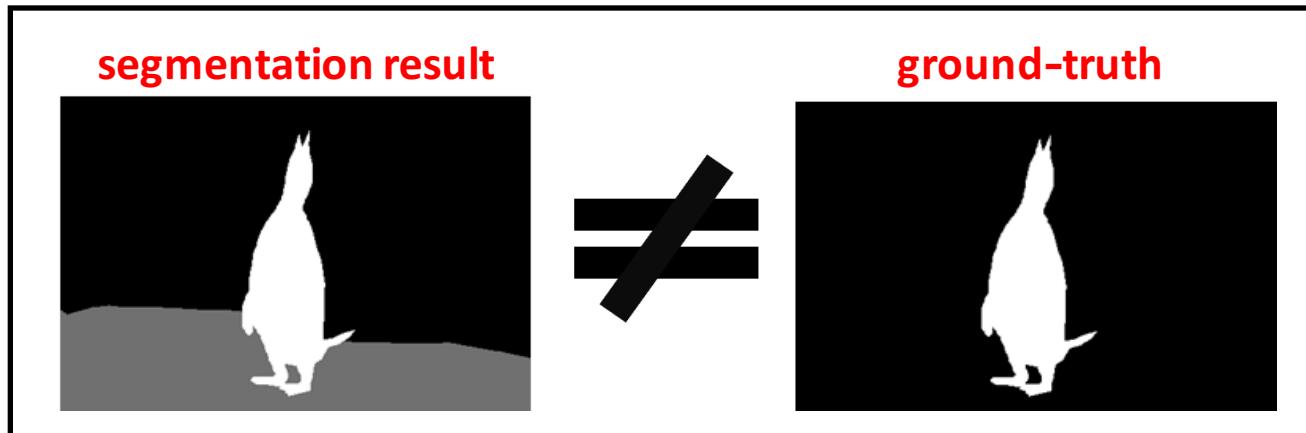
Variation of Information (VoI)

It measures the distance between two segmentations in terms of their average conditional entropy.

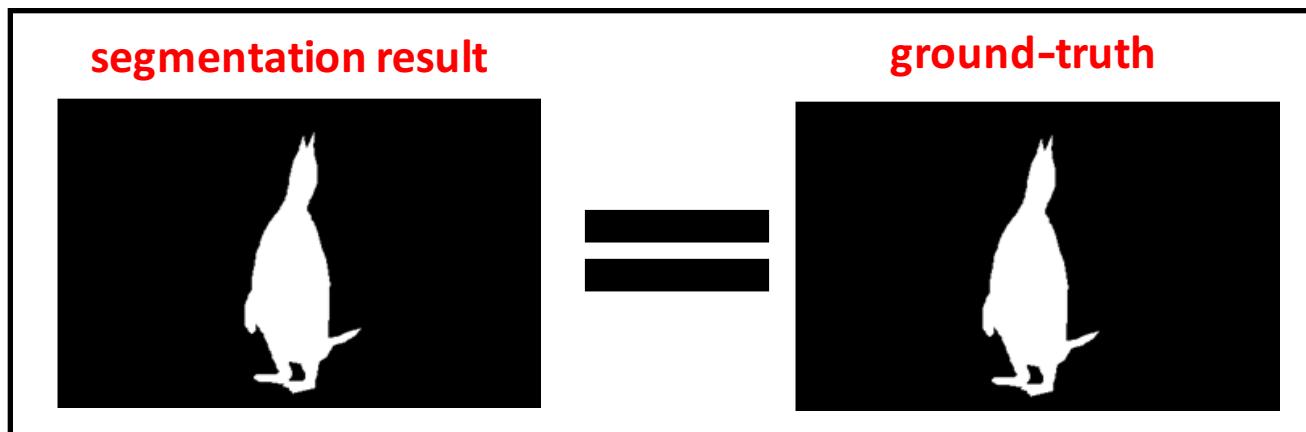
$$\begin{aligned} VoI(S_1, S_2) &= H(S_1|S_2) + H(S_2|S_1) \\ &= H(S_1) + H(S_2) - 2I(S_1, S_2) \end{aligned}$$

Variation of Information (Vol)

It measures the distance between two segmentations in terms of their average conditional entropy.



 **Abundance Information**



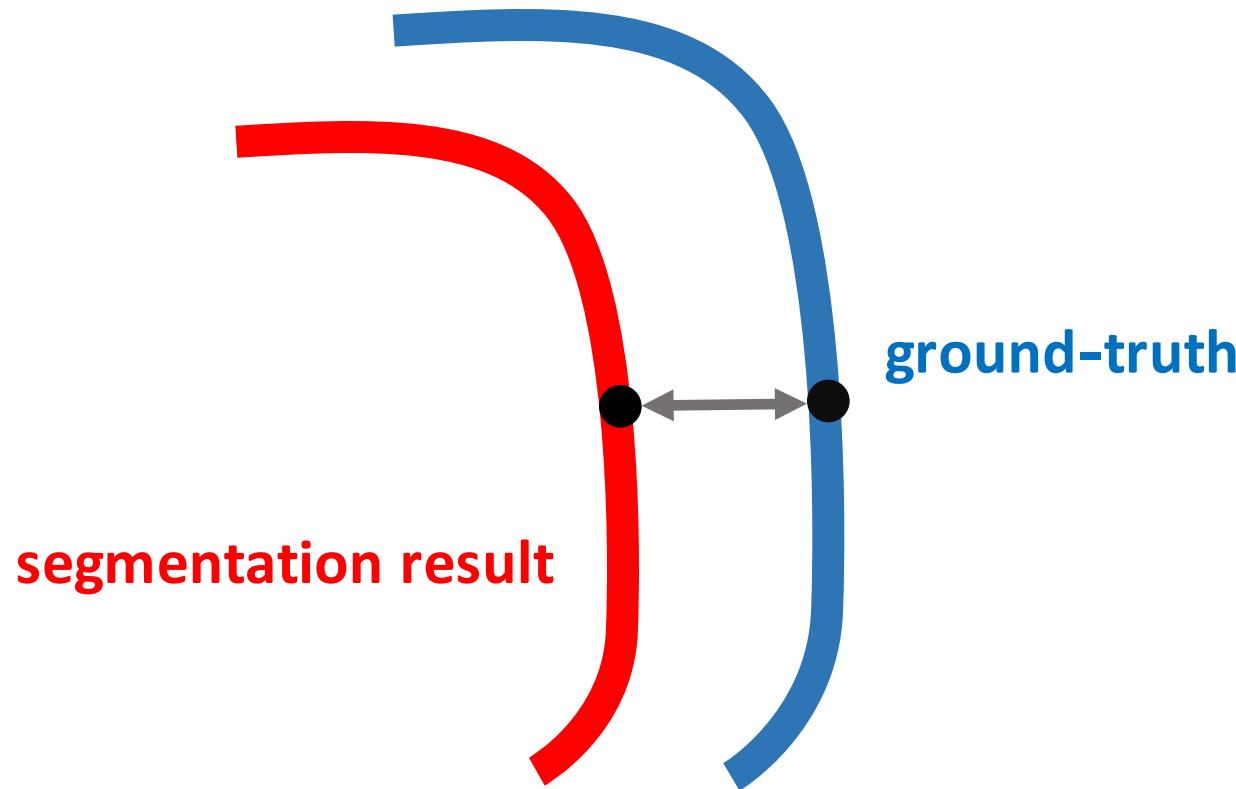
 **limited information**

Boundary Displacement Error (BDE)

It defines the error of one **boundary** pixel as the **distance** between the pixel and its closest pixel in the other boundary image.

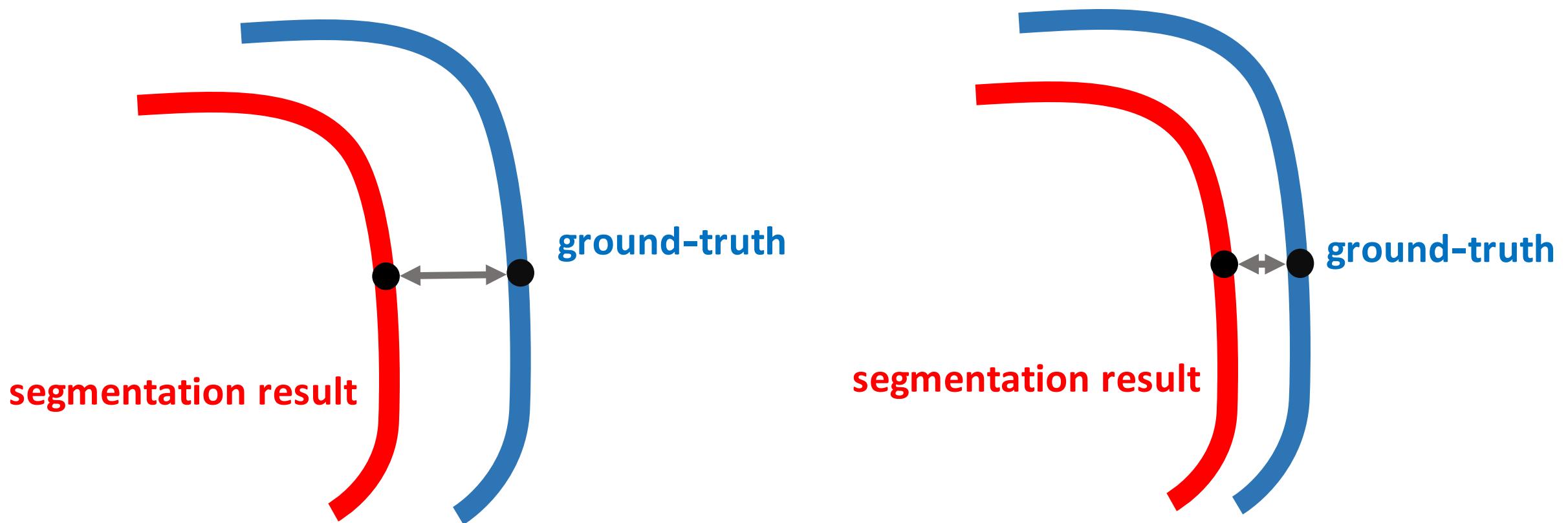
Boundary Displacement Error (BDE)

It defines the error of one boundary pixel as the distance between the pixel and its closest pixel in the other boundary image.



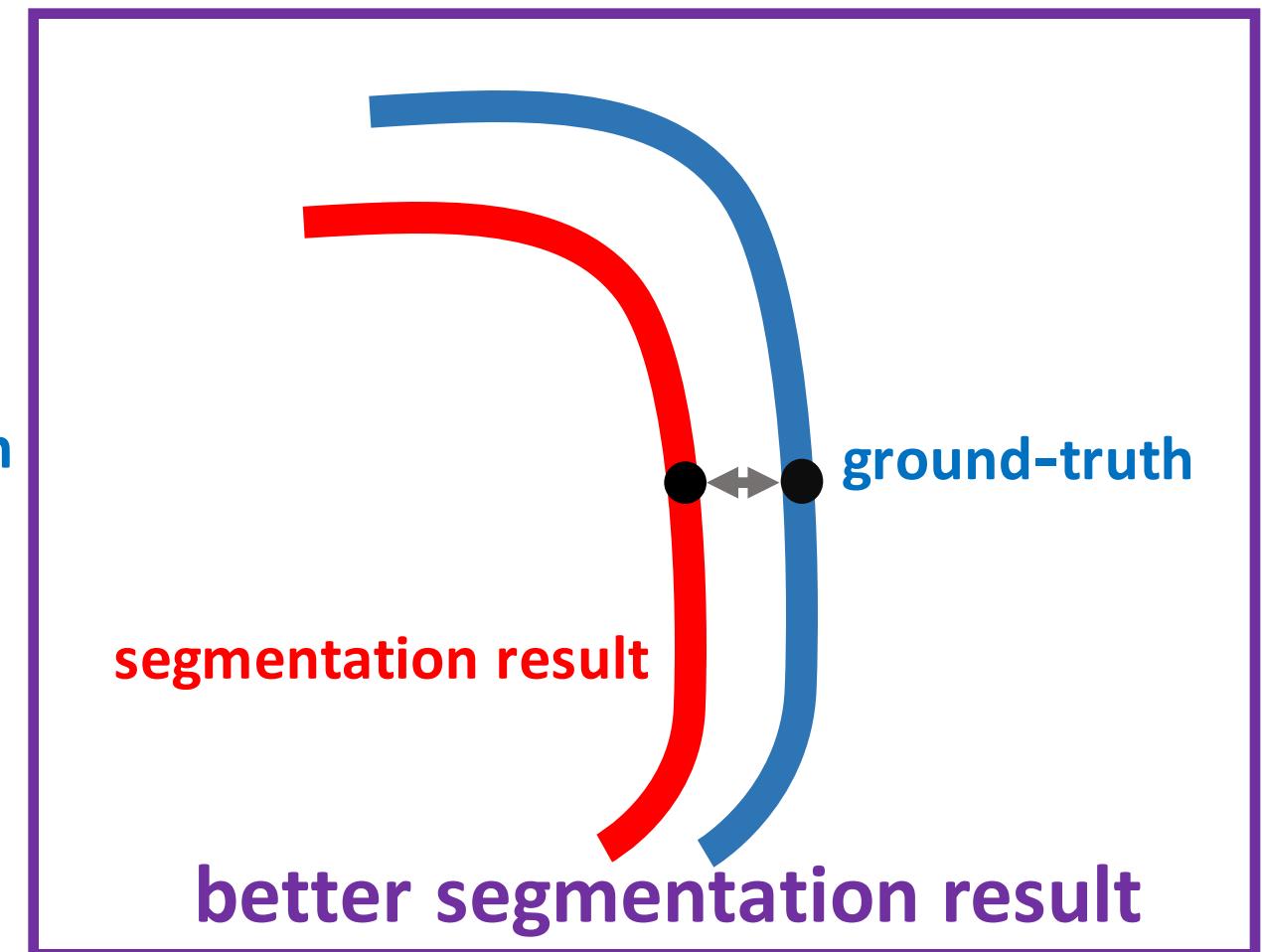
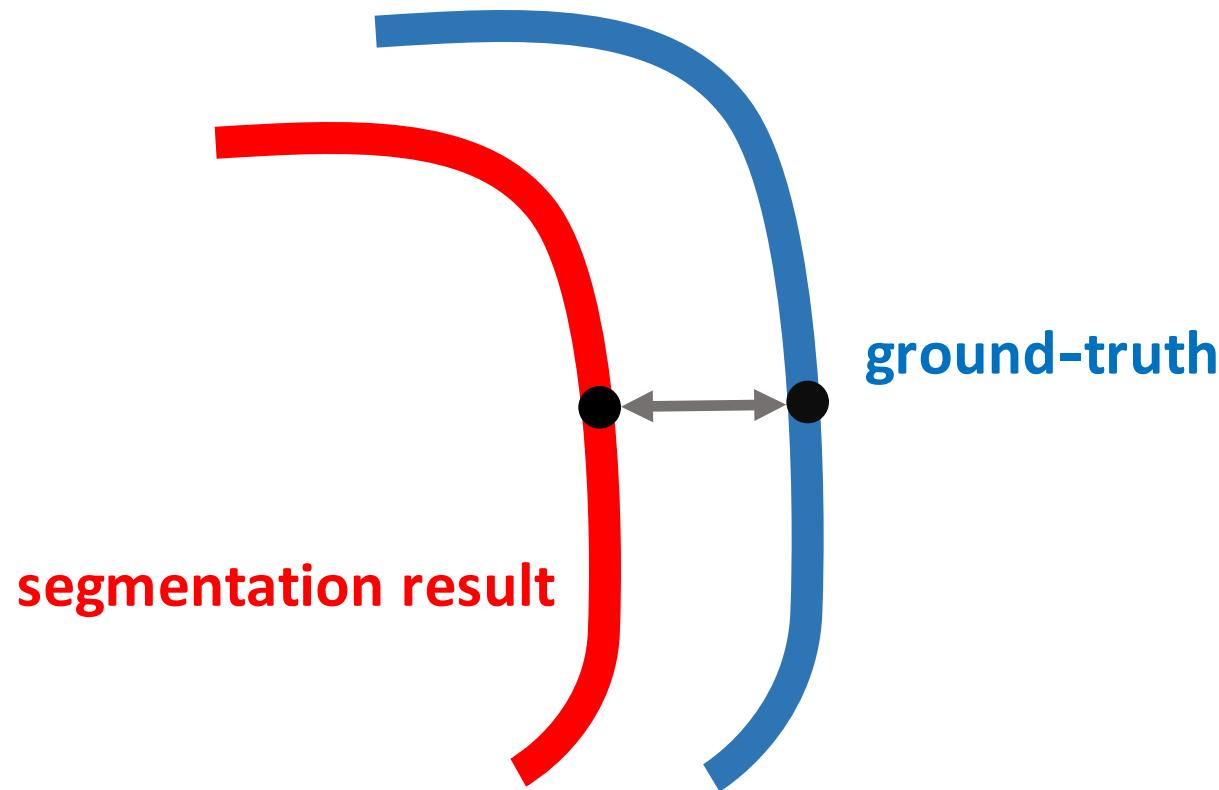
Boundary Displacement Error (BDE)

It defines the error of one boundary pixel as the distance between the pixel and its closest pixel in the other boundary image.

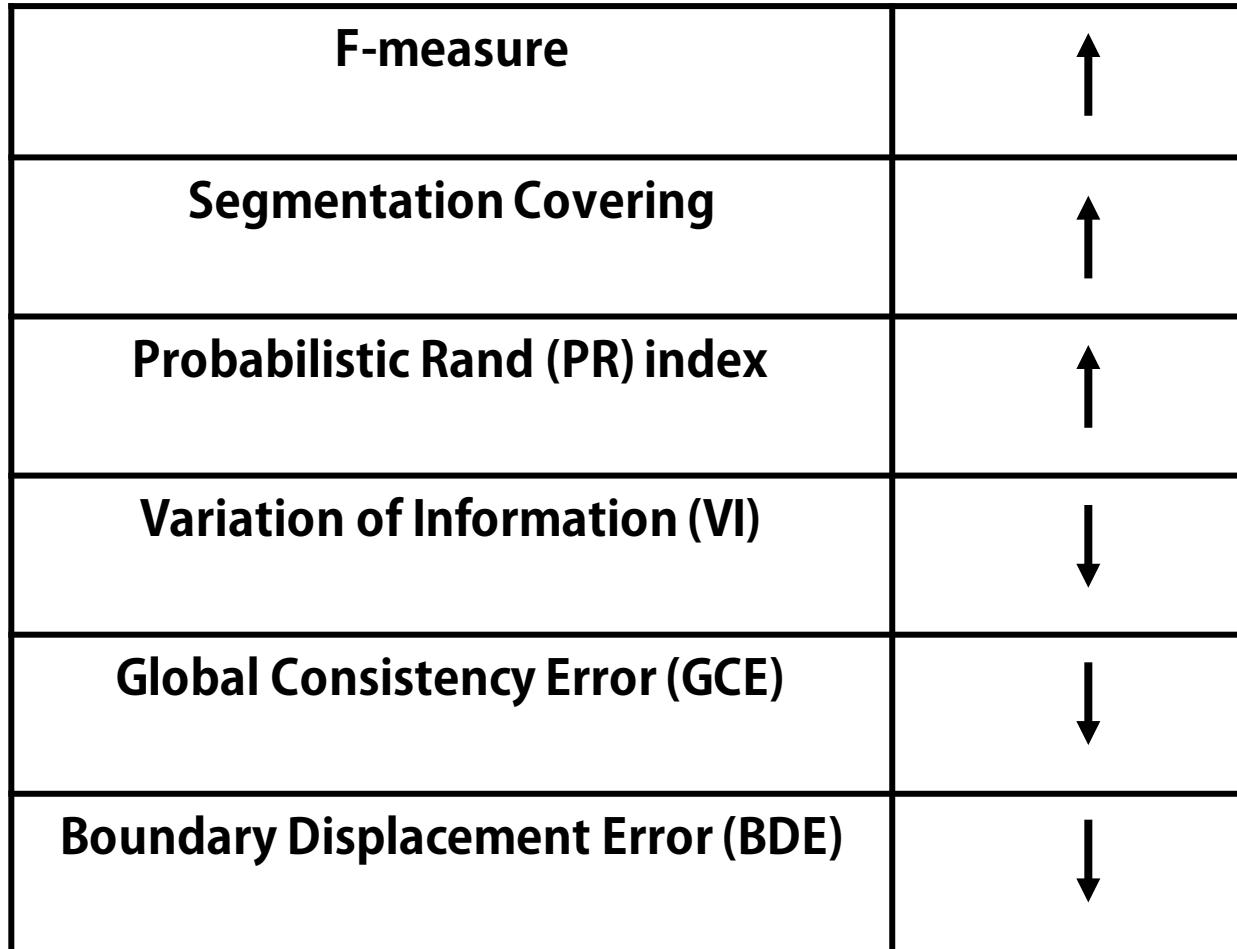


Boundary Displacement Error (BDE)

It defines the error of one boundary pixel as the distance between the pixel and its closest pixel in the other boundary image.



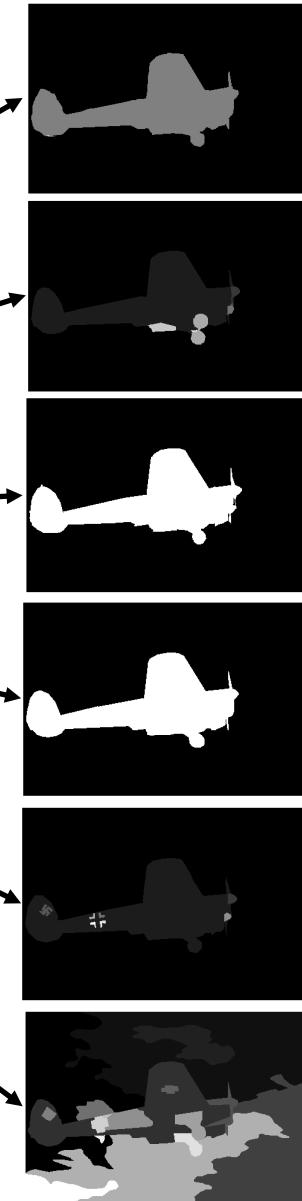
To Get High Quality of Segmentation



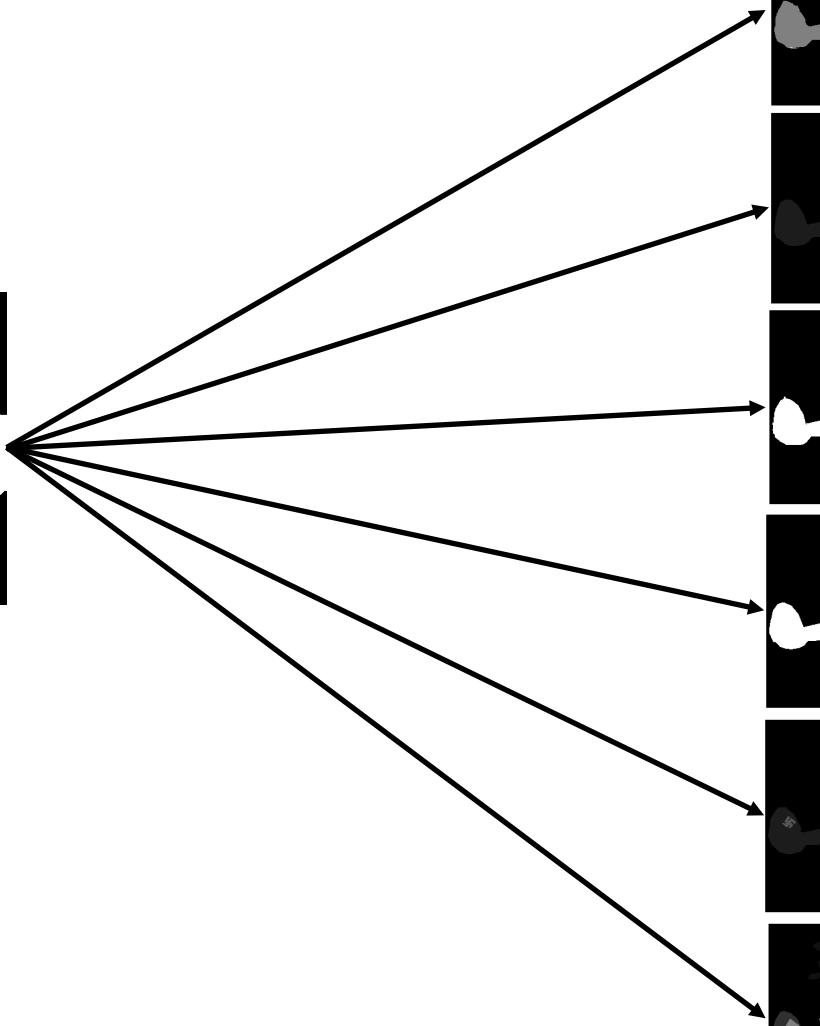
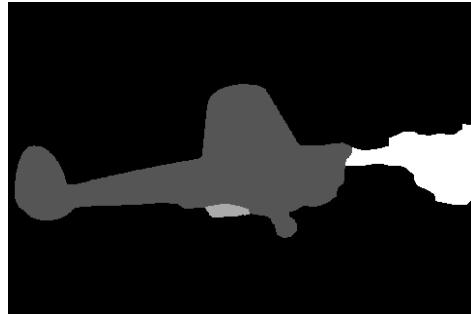
Original

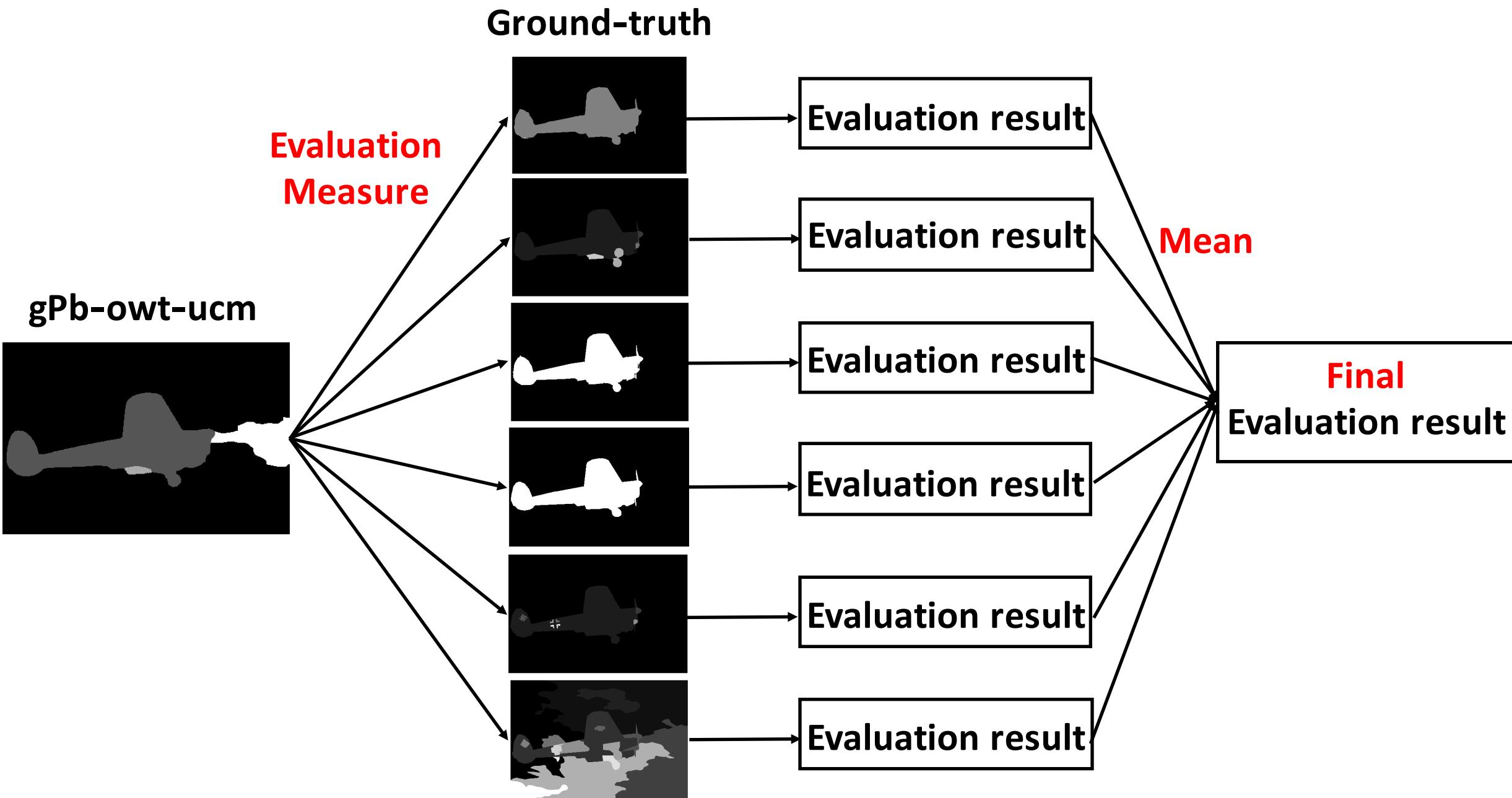


Ground-truth



gPb-owt-ucm





Examples

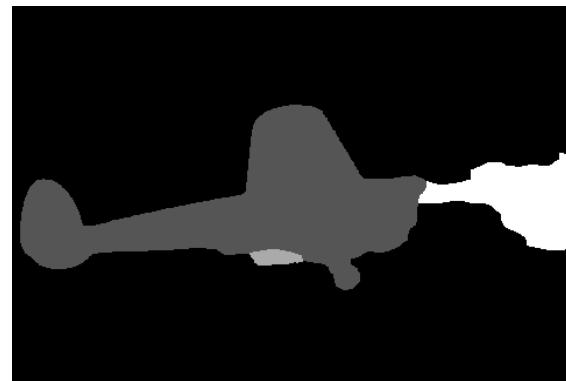


Original



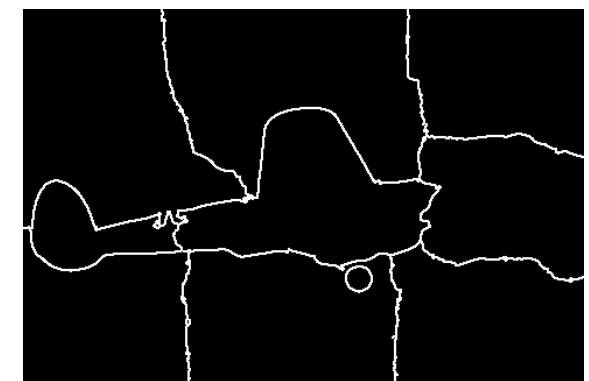
Mean shift

BDE: 19.1901
PR: 0.60805
Vol: 10.492
GCE: 0.052159



gPb-owt-ucm

BDE: 11.8276
PR: 0.86803
Vol: 1.0278
GCE: 0.10222



Normalized cut

BDE: 13.5303
PR: 0.41775
Vol: 2.0725
GCE: 0.066417

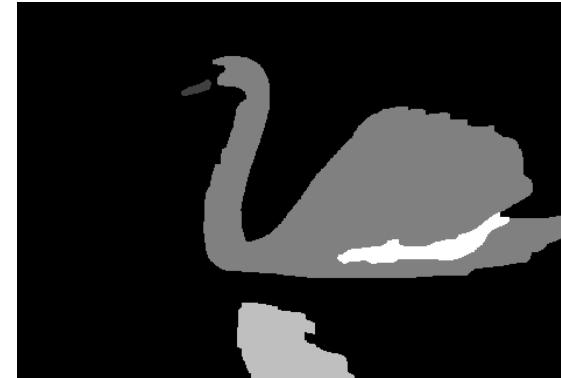
Examples



Original



Mean shift



gPb-owt-ucm

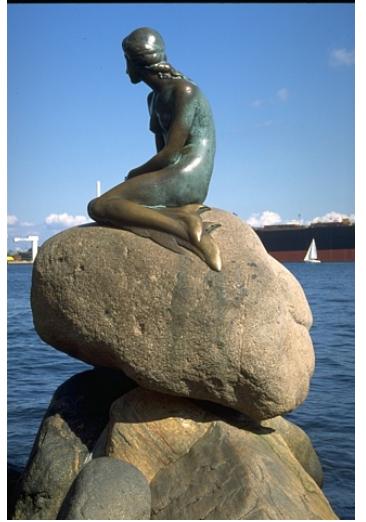


Normalized cut

BDE: 17.2482
PR: 0.66111
Vol: 10.2354
GCE: 0.050135

BDE: 12.7437
PR: 0.84461
Vol: 1.1124
GCE: 0.10237

BDE: 12.8711
PR: 0.3711
Vol: 2.3995
GCE: 0.067568



Original

Examples



Mean shift



gPb-owt-ucm



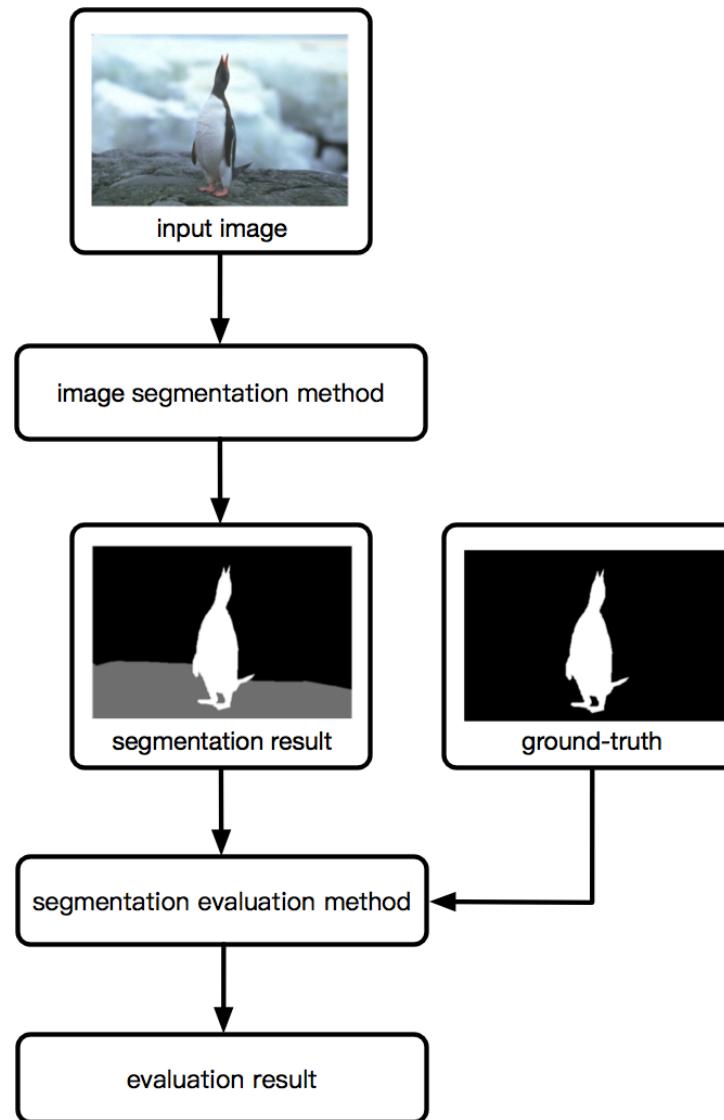
Normalized cut

BDE: 18.9191
PR: 0.62417
VOL: 10.5723
GCE: 0.051471

BDE: 11.9012
PR: 0.87111
Vol: 1.0349
GCE: 0.10537

BDE: 13.7155
PR: 0.40355
Vol: 2.1265
GCE: 0.067358

CV Assignment 1



Input images

Use test set of BSDS500 (includes 200 images)

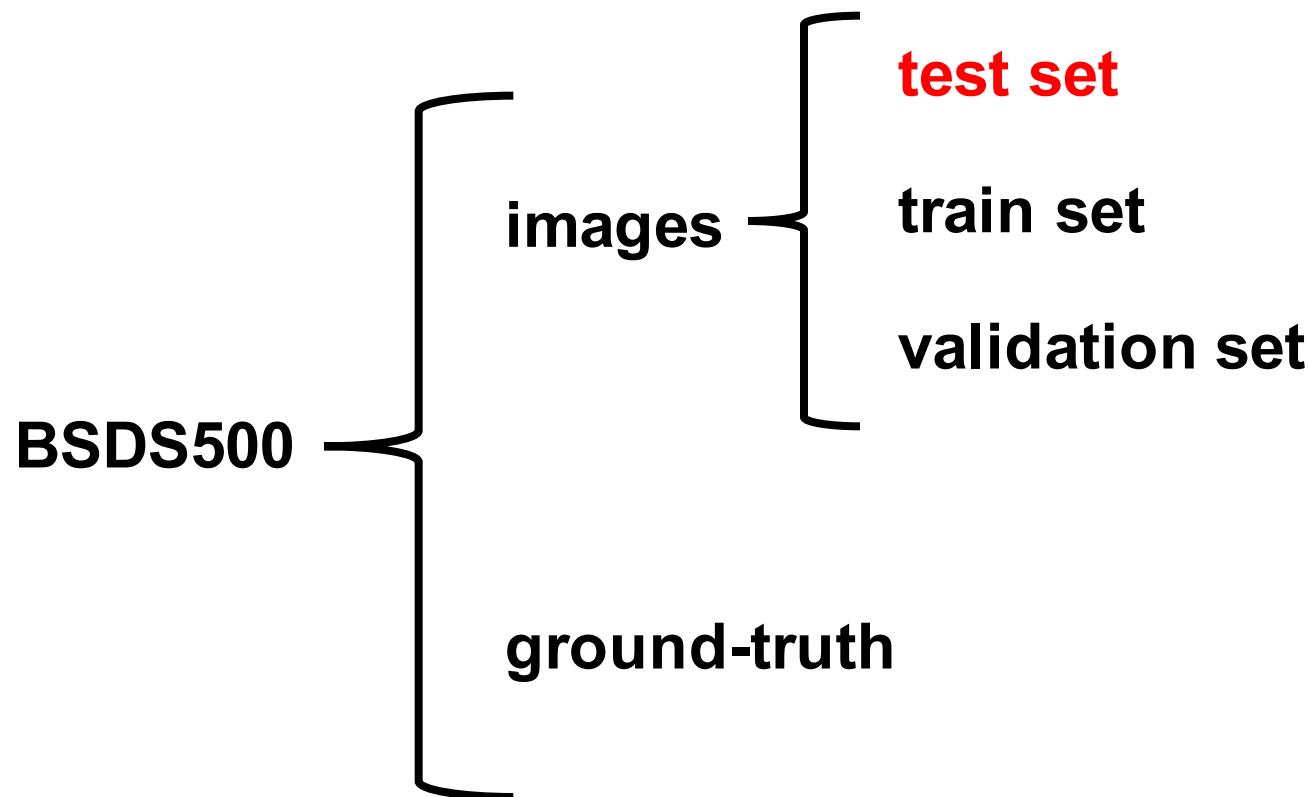


Image segmentation methods

Implement at least five image segmentation methods

Image segmentation methods

Choose one segmentation method **respectively** from:

- Threshold based image segmentation
- Edge based image segmentation
- Region based image segmentation

Select at least two approaches from:

- Mean Shift
- Normalized Cut
- Efficient Graph-Based Image Segmentation
- gPb-owt-ucm

Segmentation evaluation methods

Use at least three image segmentation measures from:

- F-measure
- Segmentation Covering
- Probabilistic Rand (PR) index
- Normalized Probabilistic Rand (NPR) index
- Variation of Information (Vol)
- Global Consistency Error (GCE)
- Boundary Displacement Error (BDE)

The final evaluation result of the dataset is the mean of all evaluation results.

CV Assignment 1

Due Date: April 24, 2017

Submission: 1. code
2. a report with your results and simple explanation

Zip all your files and submit your assignment to ouceecv@163.com

Thanks