The Secrets of Salient Object Segmentation

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Outline

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   A. Fixation Prediction and Salient Object Segmentation
   B. Dataset Design Bias and A Novel Dataset: Pascal-S
   C. A Novel Model: CPMC + fixationSolver
   D. Paper Experiments
2. Supplementary Experiments
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Paper Recap

Fixation Prediction

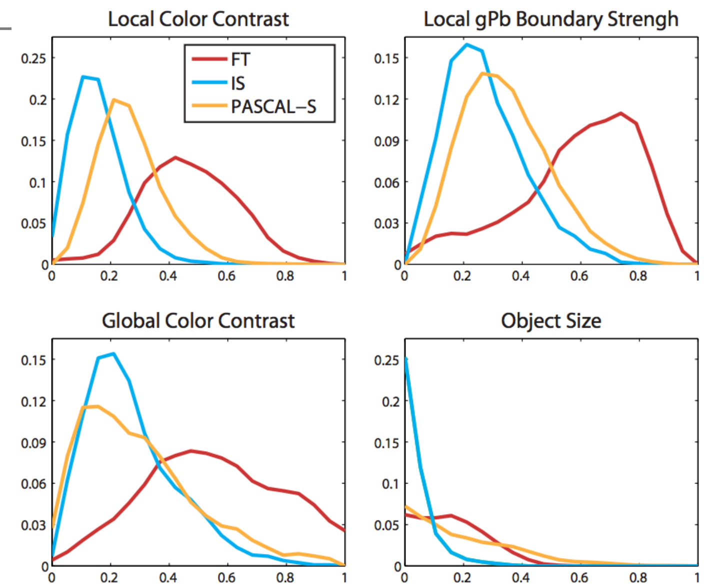
1. In fixation experiments, saliency is expressed as **eye gaze points**.
2. The goal of algorithms is to compute a “saliency map” that simulates the eye movement behaviors of human while looking at the image. (to capture eye gaze pattern)
3. Not pixel-accurate: Eye tracking devices are normally imprecise. Recorded fixation locations can go up to 1 , or over 30 pixels.
4. ROC Area Under the Curve (AUC) is used to evaluate the quality of prediction against the human ground-truth.

Salient Object Segmentation

1. In Salient Object Segmentation experiments, saliency is what **image annotators believe** as **visually significant areas** in images.
2. The goal of algorithm is to generate a map that matches the annotated salient object mask. (annotators' perception)
3. Ground truth is pixel-accurate and region-based.
4. Distinct set of algorithms are developed.
5. Benchmark dataset: FT, IS.

A Novel Dataset: Pascal-S

1. Existing datasets are weak: Dataset design bias.
   A. The FT dataset has unnaturally strong color contrast.
   B. Intentionally filter images with blur object boundaries.
   C. Image Annotation and Image Selection are not independent.
   D. Unfortunately, most salient object segmentation algorithms report their result on the FT dataset with a large margin over fixation algorithms.
   E. Most importantly, after removal of center bias and the dataset design bias, the performance gap between salient object segmentation algorithms and fixation algorithms is mostly reduced.



2. Propose a novel dataset: Pascal-S
   A. Augmented 850 existing images from PASCAL 2010 dataset
   B. Ground truth labeling of Eye fixations and salient object segmentation
   C. Free of *dataset design bias*: the image selection and image annotation are kept *independent*

A Novel Model: CPMC + Fixation

1. Phrase One: object candidate proposal
   A. Achieved by the **unsupervised framework** called CPMC (segmentation algorithm).
   B. No need of category specific knowledge.
   C. Output a pool of object candidates with their "objectness" score disregarded.
2. Phrase Two: segments selection process based on estimated saliency map
   A. Achieved by learning a scoring function for each object candidate (fixation algorithm).
   B. Input **shape feature of object candidates** and **spatial distribution of fixations within** (fixation map).
   C. Output the **overlapping score** of the proposed region with respect to the ground-truth.
3. This simple combination results in a novel salient object segmentation method that outperforms *all* previous methods by a large margin.

Experiments

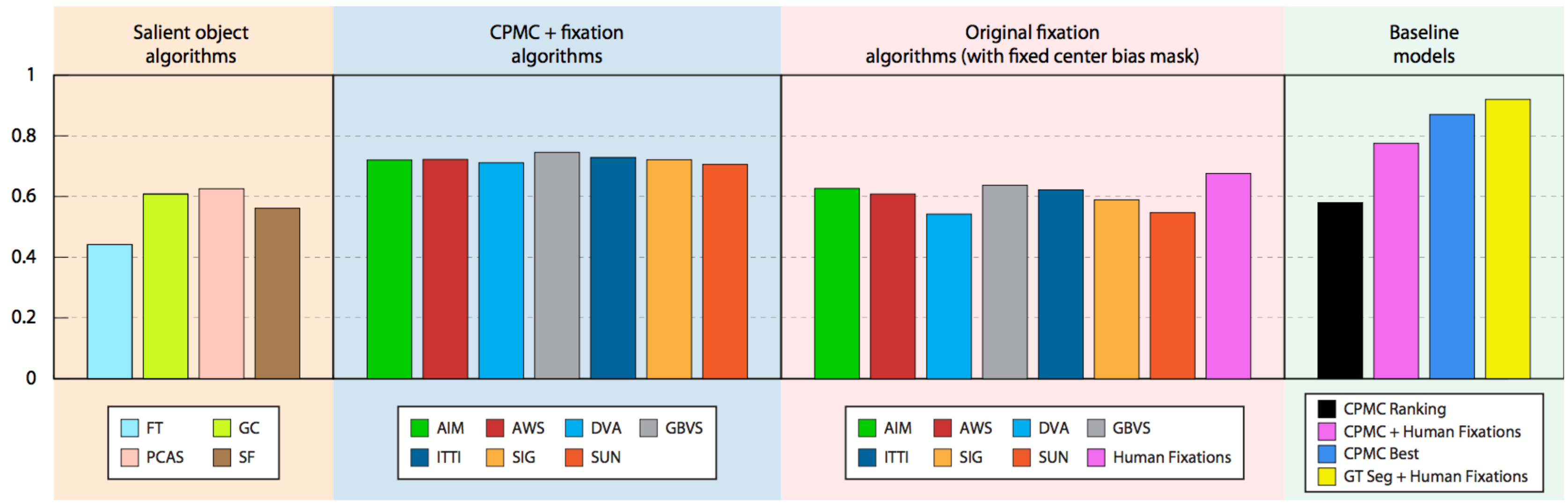


Fig. F-measure of all algorithms on Pascal-S dataset. K = 20.

Experiments (cont.)

K=20	PASCAL-S	IS	FT
Fixation Model Used	GBVS	GBVS	GBVS
F-Measure	0.7457	0.7264	0.9097
Improvements	**+11.82**	**+7.06**	**+2.47**
Best SalObj Model	PCAS	PCAS	SF
F-Measure	0.6275	0.6558	0.8850

Fig. Comparison of Best Performing Results on Other Segmentation Datasets

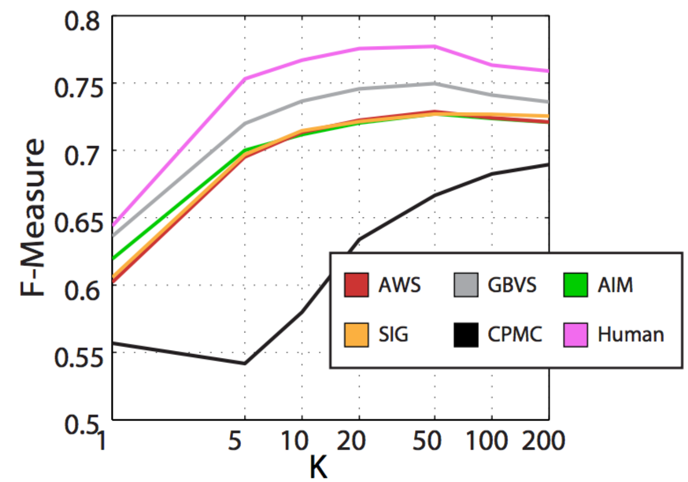


Fig. Performance of CPMC+Fixation Model under Various Quantities of Object Candidates K

Supplementary Experiments

Experiment #1

1. Idea: measure overall performance of the method in IS dataset (250 images)
2. The only third-party dataset where both fixation map and salient object segmentation labeling are available
3. Directly trained on IS and test on IS. Outcome is unexpected

Algorithm	sf	gc	pcas	ft	HumanFix
Performance	0.5022	0.5749	**0.6050**	0.4296	0.5837
Algorithm	**CPMC+aws**	**CPMC+aim**	**CPMC+sig**	**CPMC+dva**	**CPMC+gbvs**
Performance	0.5054	0.5053	0.5183	0.4753	**0.5461**

4. CPMC+gbvs is worse than pcas, the straight forward salient object segmentation algorithm.

Experiment #2

1. Idea: measure the cross-dataset performance of the method
2. Trained on PASCAL-S dataset and then test it on IS dataset

Algorithm	sf	gc	pcas	ft	CPMC+gbvs
Performance	0.4938	0.5698	**0.6116**	0.4183	0.4831

3. Trained on IS dataset and then test it on PASCAL-S dataset

Conclusion & Discussion

Conclusion

1. Discovers a new type of dataset bias: dataset design bias.
2. Augments a new dataset with both fixation prediction and salient object segmentation labelling.
3. Proposes a new state-of-the-art method that
   A. Simply combines the existing segmentation algorithm (CPMC) and fixation algorithms
   B. Outperforms all other models on all segmentation datasets.
4. Supplementary experiments show that this method is not robust when its parameters are not well-tuned.

Discussion

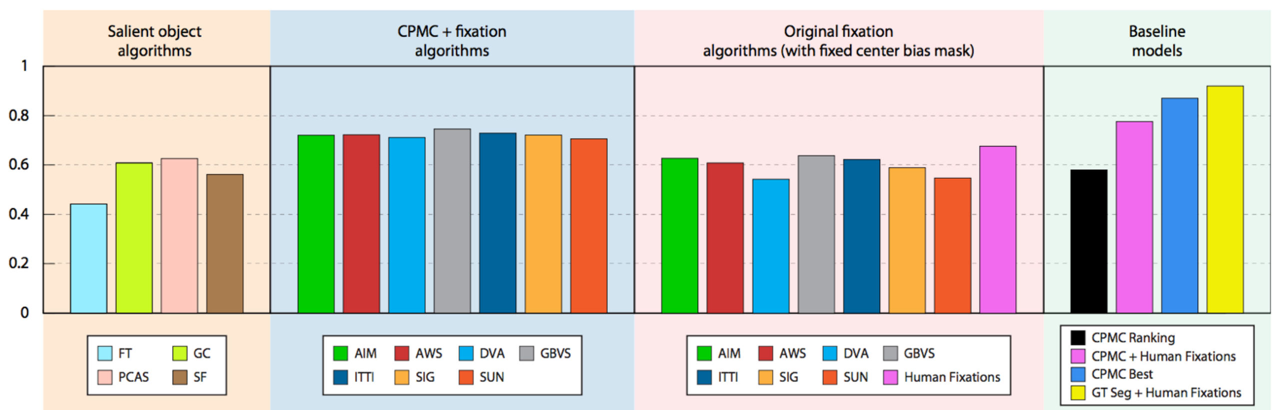
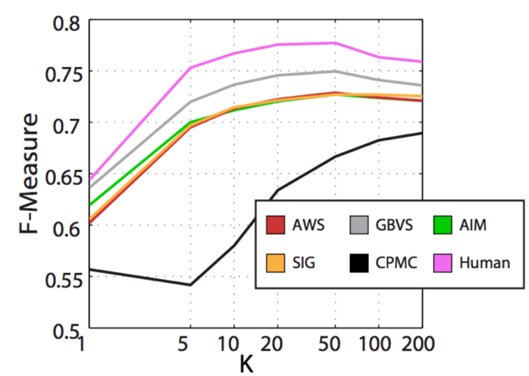


Fig. F-measure of all algorithms on Pascal-S dataset. K = 20.



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