

Superpixel-Based Saliency Detection

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Saliency models and applications

● What is saliency?

- Generally defined as what captures human attention
- Perceptual quality that makes some objects in the scene stand out from their surrounding regions

● Saliency models

- Center-surround scheme
- Information theory
- Supervised learning
- Segmentation/clustering
- Frequency domain analysis
- Graph theory
- Statistical models
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Saliency models and applications

● Saliency-based applications

- Salient object detection/segmentation
- Content-aware image/video retargeting
- Content-based image/video coding
- Object-based image/video retrieval
- Objective image/video quality assessment
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Superpixel-based saliency model

● Overview

● Image simplification

- Superpixel segmentation
- Adaptive color quantization

● Inter-superpixel similarity

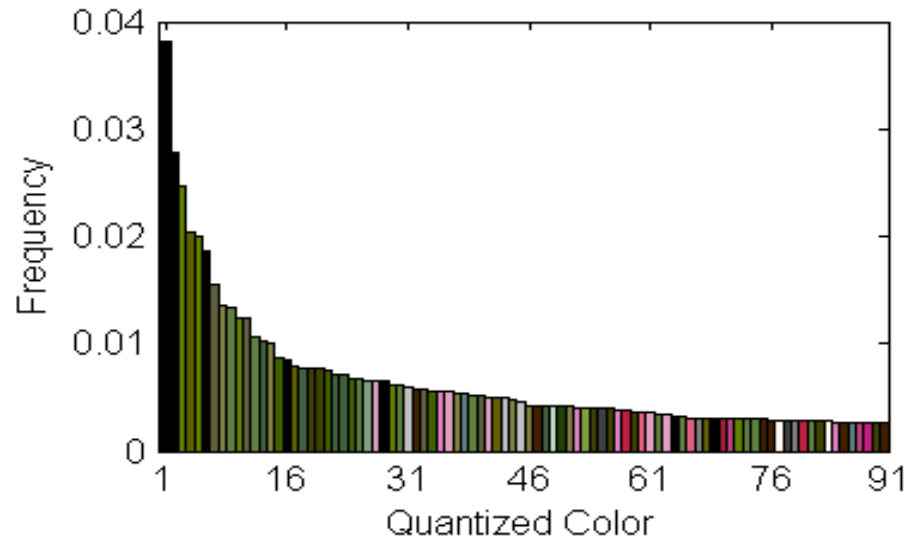
● Superpixel saliency

- Global contrast measure
- Spatial sparsity measure
- Saliency refinement and fusion

Image simplification

● Why superpixels?

- Regular and compact shape with **better boundary adherence**
- Facilitate to preserve well-defined boundaries in the generated saliency maps
- Superpixel-level features are more meaningful than pixel/block level features



- Color-spatial similarity between superpixels

$$Sim(i, j) = \underbrace{\sum_{k=1}^m \min\{H_i(k), H_j(k)\}}_{\text{Color similarity}} \cdot \underbrace{\left[1 - \frac{\|\mu_i - \mu_j\|}{d} \right]}_{\text{Spatial similarity}}$$

Superpixel pairs with similar color distribution and shorter spatial distance are assigned with higher similarity

● Global contrast measure

$$NGC(i) = \sum_{j=1}^n \left[|SP_j| \cdot \left(1 - \frac{\|\mu_i - \mu_j\|}{d} \right) \right] \cdot \underbrace{\|\mathbf{mc}_i - \mathbf{mc}_j\|}_{\text{Color difference}} \quad \text{+} \quad \text{Normalization}$$

Weight based on area and distance

● Spatial sparsity measure

$$NSS(i) = \frac{\sum_{j=1}^n Sim(i, j) \cdot D(j)}{\sum_{j=1}^n Sim(i, j)} \quad \text{+} \quad \text{Inverse normalization}$$

Spatial spread

- Refinement using inter-superpixel similarity

$$RGC(i) = \frac{\sum_{j=1}^n Sim(i, j) \cdot NGC(j)}{\sum_{j=1}^n Sim(i, j)}$$

Refined global contrast measure

$$RSS(i) = \frac{\sum_{j=1}^n Sim(i, j) \cdot NSS(j)}{\sum_{j=1}^n Sim(i, j)}$$

Refined spatial sparsity measure

- Superpixel-wise fusion

$$Sal(i) = RGC(i) \cdot RSS(i)$$

Superpixel saliency measure

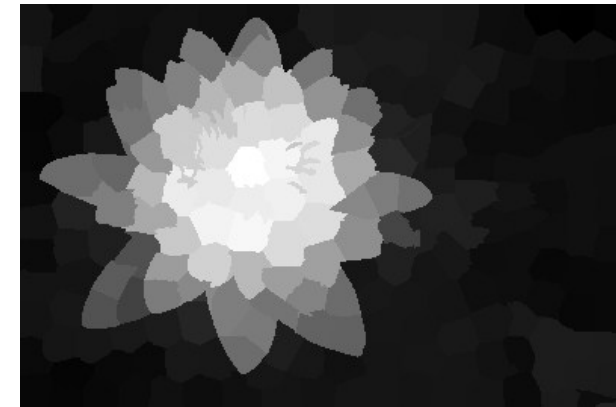
Superpixel saliency (example)



Refined global contrast map

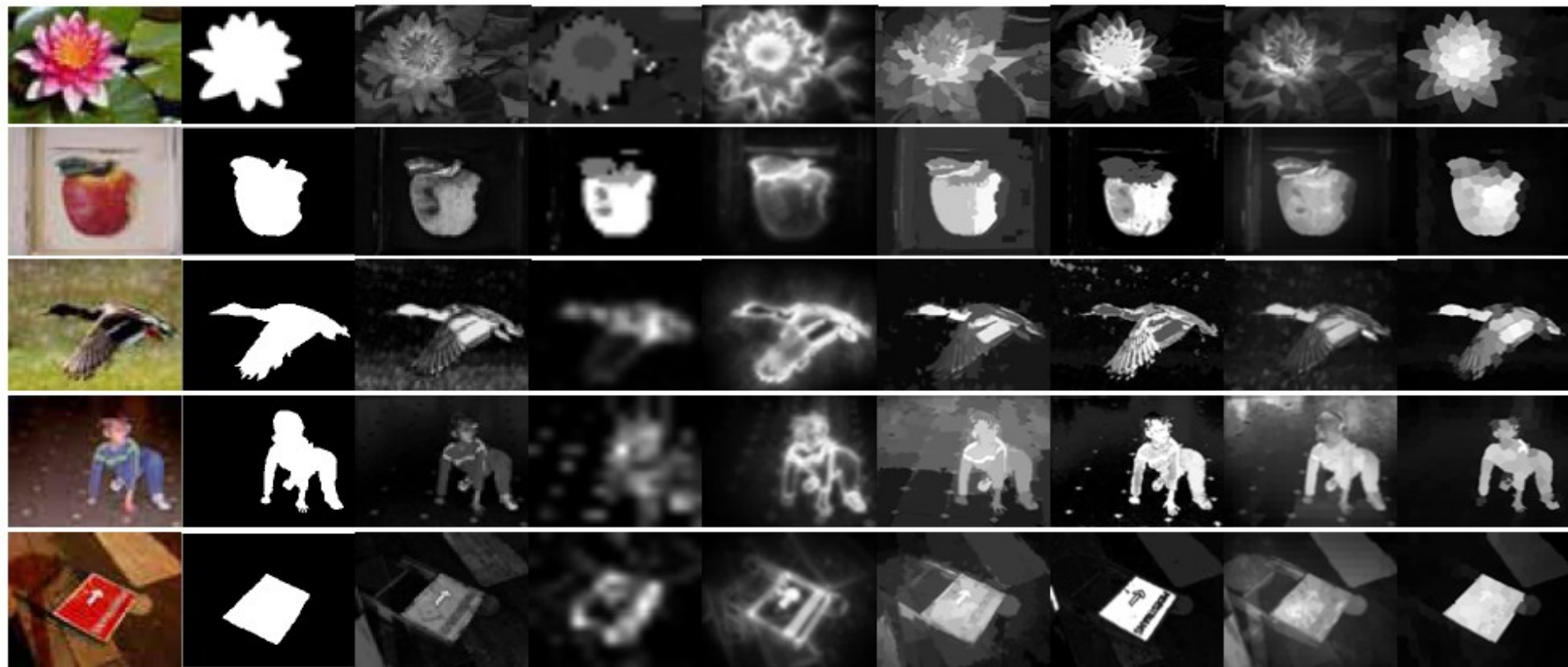


Refined spatial sparsity map



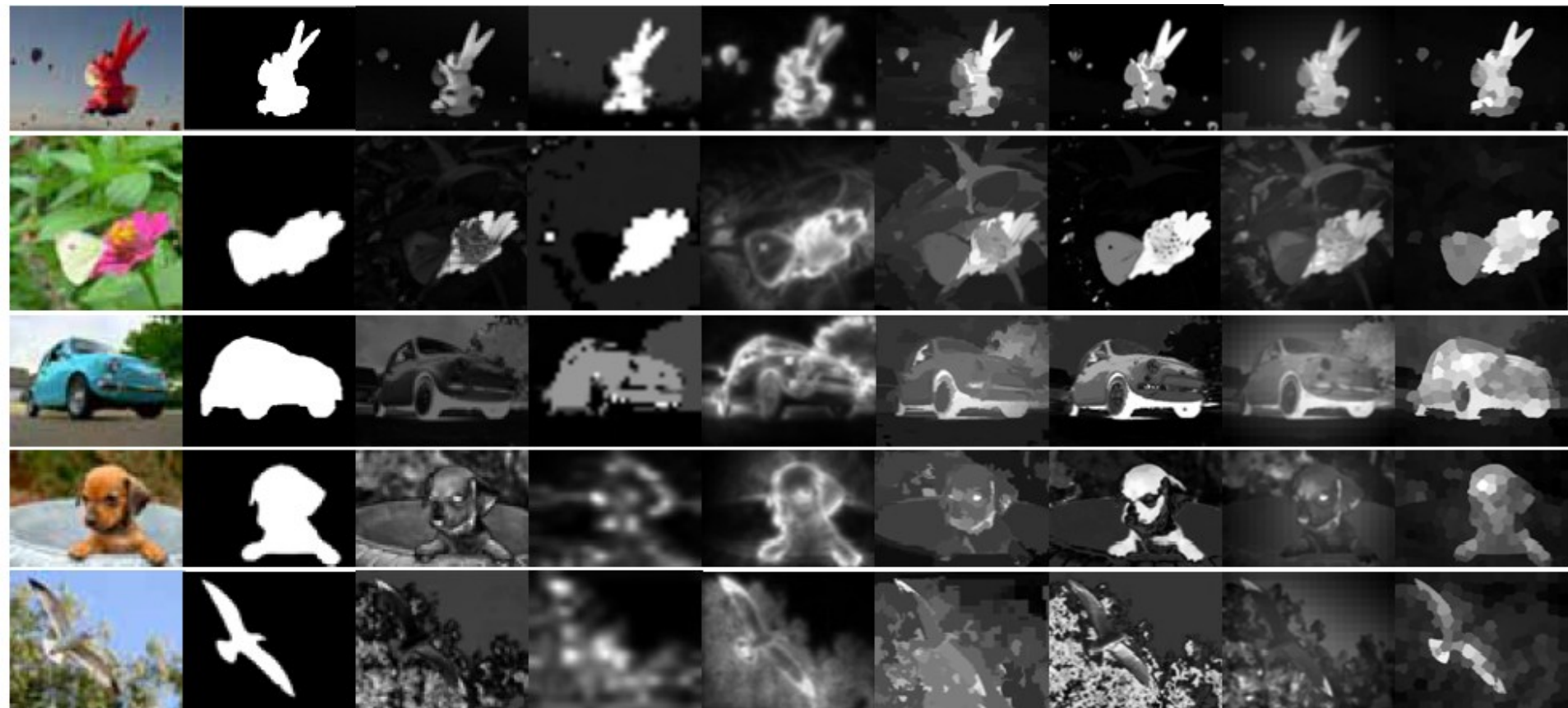
Superpixel-level saliency map

Experimental results



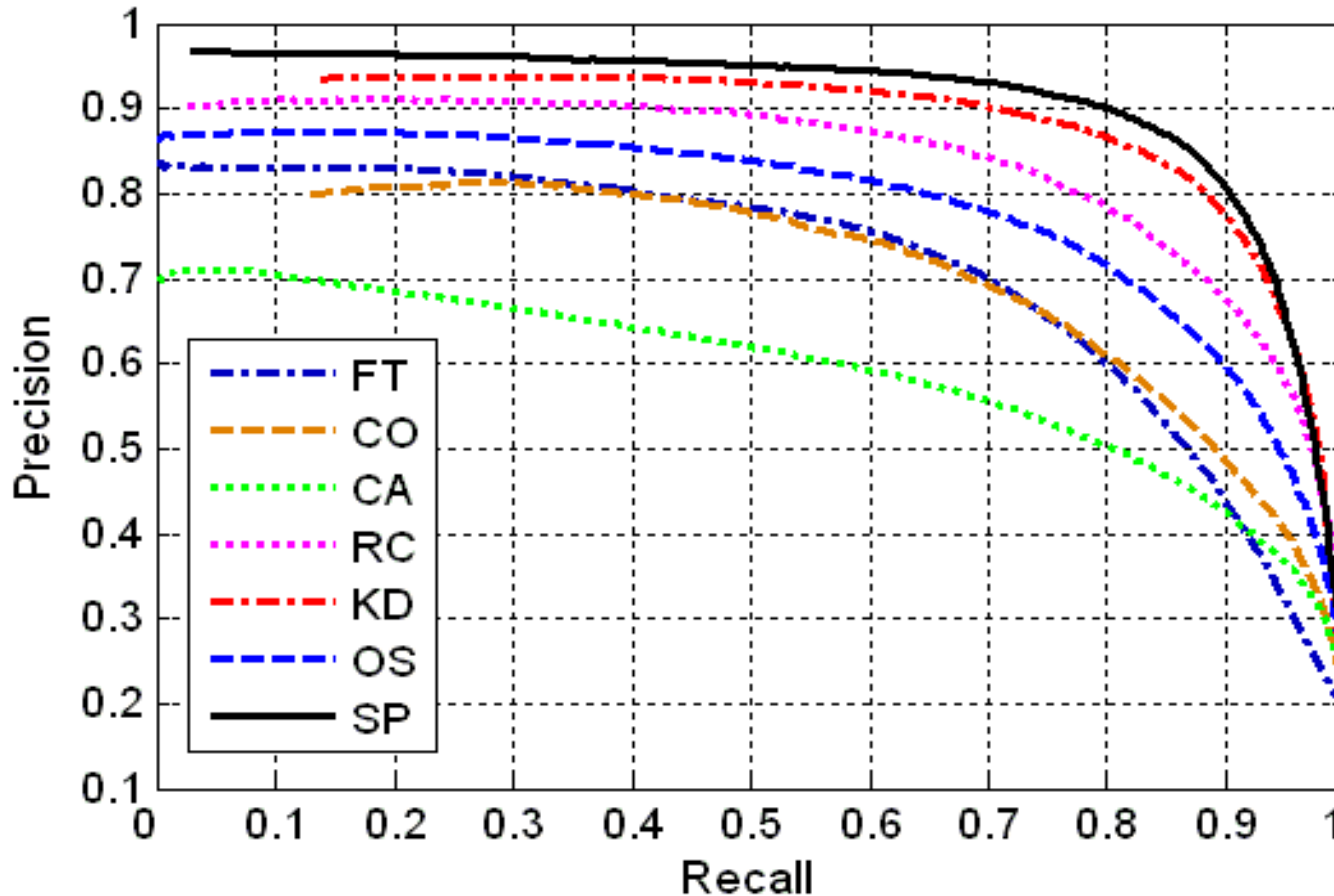
IM	GT	FT	CO	CA	RC	KD	OS	SP
		CVPR'09	TMM'09	CVPR'10	CVPR'11	TMM'12	ICME'12	Our

Experimental results



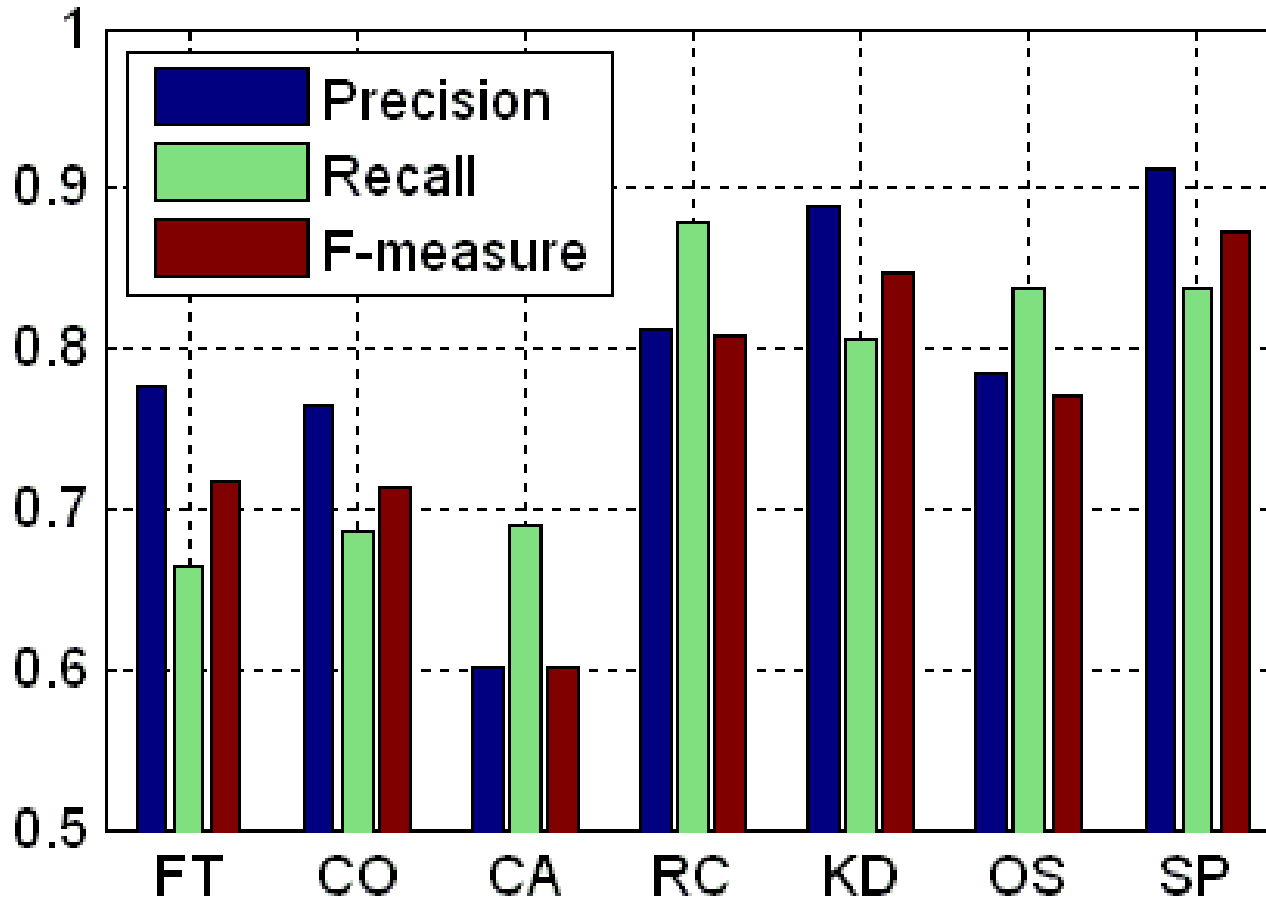
IM GT FT CO CA RC KD OS SP
 CVPR'09 TMM'09 CVPR'10 CVPR'11 TMM'12 ICME'12 **Our**

Experimental results



Precision-recall curves of different saliency models

Experimental results



Average precision, recall, F-measure achieved using different saliency models

Thank you for your attention!