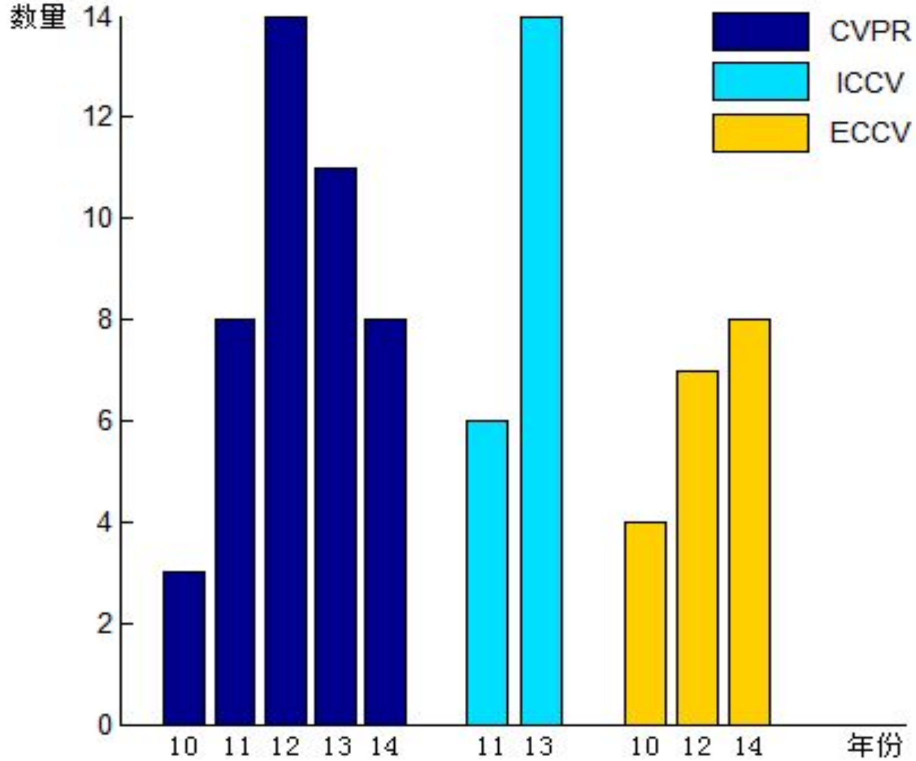
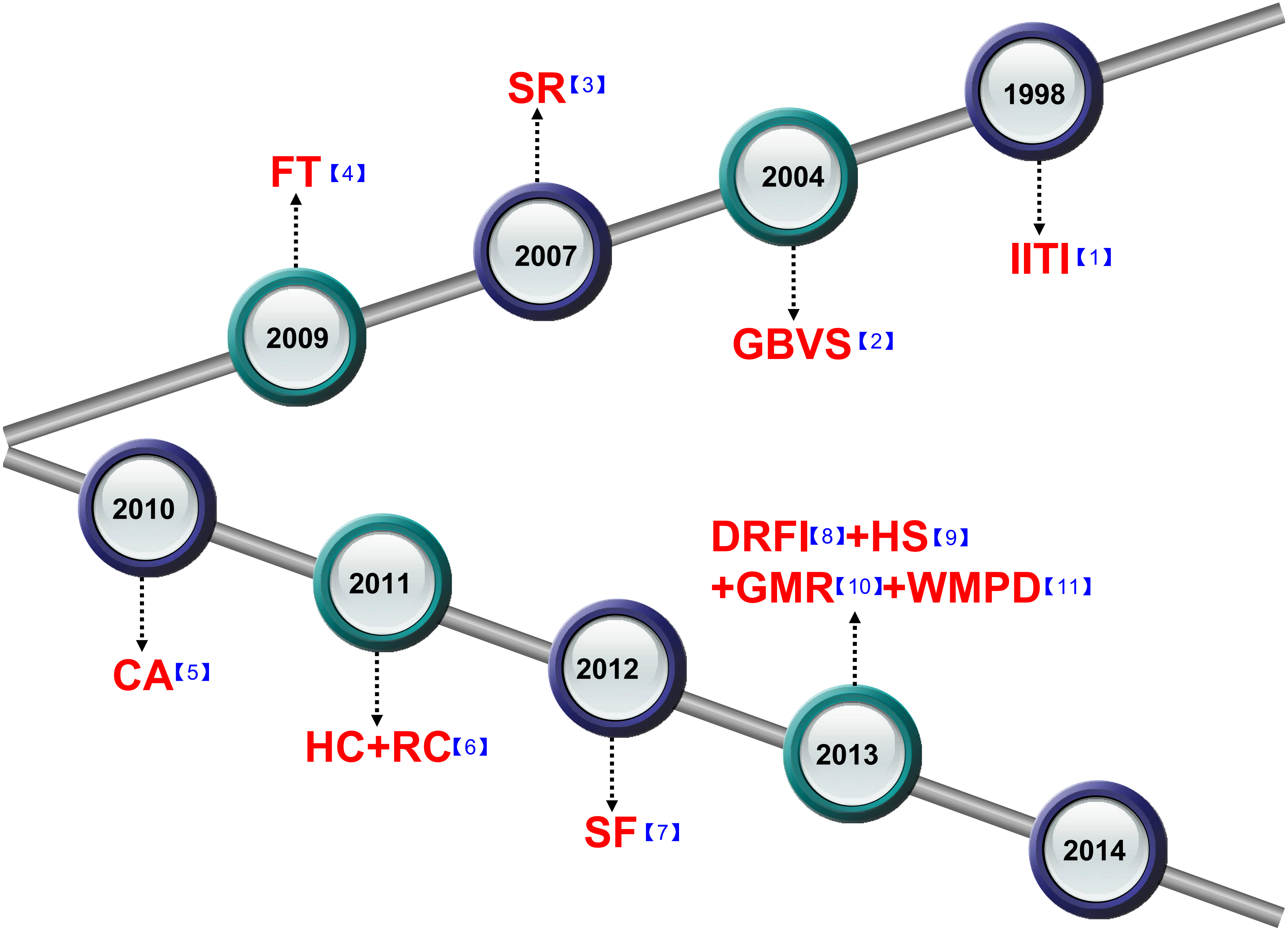
Saliency detection

Zhao tong



数量
14
12
10
8
6
4
2
0
CVPR
ICCV
ECCV
10 11 12 13 14
11 13
10 12 14
年份


1998
IITI【1】
2004
GBVS【2】
2007
SR【3】
2009
FT【4】
2010
CA【5】
2011
HC+RC【6】
2012
SF【7】
2013
DRFI【8】+HS【9】
+GMR【10】+WMPD【11】
2014

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[2] Harel J, Koch C, Perona P. Graph-based visual saliency[C]//Advances in neural information processing systems. 2006: 545-552. 被引用次数：989

[3] Hou X, Zhang L. Saliency detection: A spectral residual approach[C]//Computer Vision and Pattern Recognition, 2007. CVPR'07. IEEE Conference on. IEEE, 2007: 1-8. 被引用次数：1193

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[6] Cheng M M, Zhang G X, Mitra N J, et al. Global contrast based salient region detection[C]//Computer Vision and Pattern Recognition (CVPR), 2011 IEEE Conference on. IEEE, 2011: 409-416. 被引用次数：568

[7] Perazzi F, Krahenbuhl P, Pritch Y, et al. Saliency filters: Contrast based filtering for salient region detection[C] //Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on. IEEE, 2012: 733-740. 被引用次数：135

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[9] Yan Q, Xu L, Shi J, et al. Hierarchical saliency detection[C]//Computer Vision and Pattern Recognition (CVPR), 2013 IEEE Conference on. IEEE, 2013: 1155-1162. 被引用次数：44

[10] Yang C, Zhang L, Lu H, et al. Saliency detection via graph-based manifold ranking[C]//Computer Vision and Pattern Recognition (CVPR), 2013 IEEE Conference on. IEEE, 2013: 3166-3173. 被引用次数：52

[11] Margolin R, Tal A, Zelnik-Manor L. What Makes a Patch Distinct?[C]//Computer Vision and Pattern Recognition (CVPR), 2013 IEEE Conference on. IEEE, 2013: 1139-1146. 被引用次数：24

[12] Zhang L, Gu Z, Li H. SDSP: A novel saliency detection method by combining simple priors[C]//ICIP. 2013: 171-175.被引用次数：3

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[16] Yan Q, Xu L, Shi J, et al. Hierarchical saliency detection[C]//Computer Vision and Pattern Recognition (CVPR), 2013 IEEE Conference on. IEEE, 2013: 1155-1162. 被引用次数：44

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[21] Zhang J, Sclaroff S. Saliency detection: a boolean map approach[C]//Computer Vision (ICCV), 2013 IEEE International Conference on. IEEE, 2013: 153-160. 被引用次数：10

[22] Zhang L, Tong M H, Marks T K, et al. SUN: A Bayesian framework for saliency using natural statistics[J]. Journal of vision, 2008, 8(7): 32. 被引用次数：404

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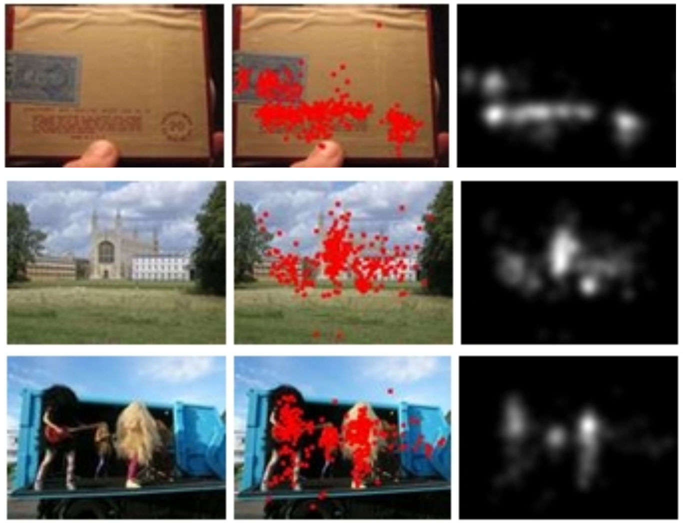
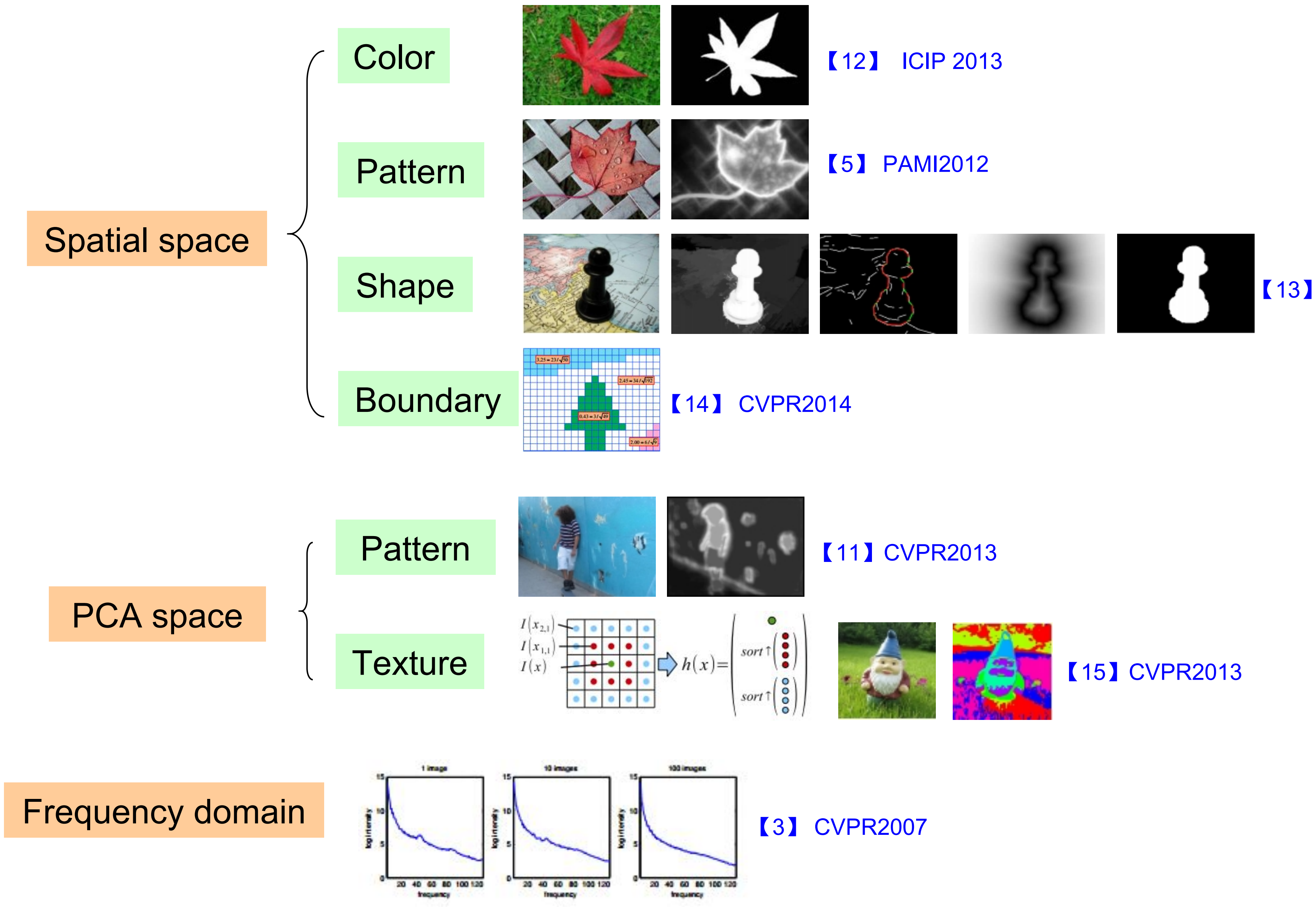
Saliency/
Salient

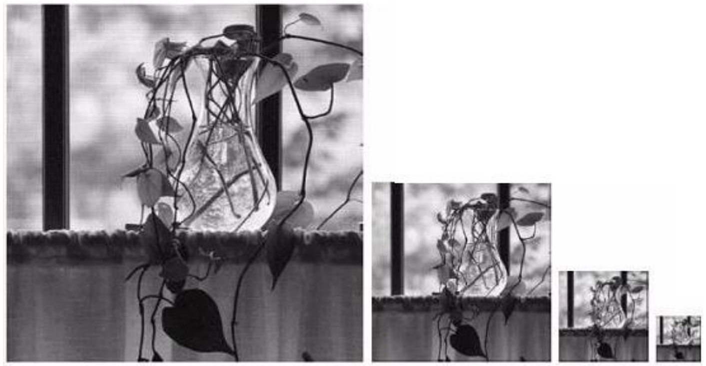
Fixation prediction → Computing a “saliency map” that simulates the eye movement behaviors of human



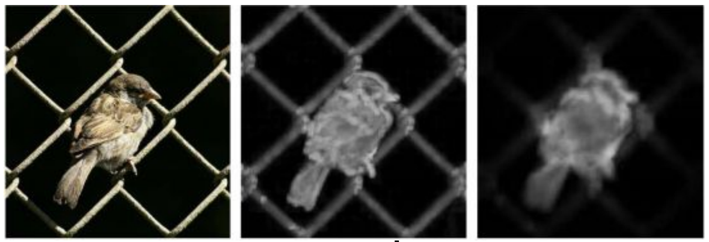
Salient objects detection


Spatial space
Color
【12】 ICIP 2013
Pattern
【5】 PAMI2012
Shape
【13】
Boundary
【14】 CVPR2014
PCA space
Pattern
【11】CVPR2013
Texture
$h(x)=$
sort
【15】CVPR2013
Frequency domain
【3】 CVPR2007

Multi-
scales

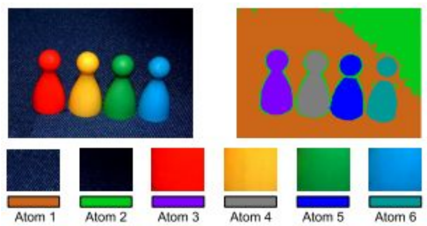


【1】PAMI 1998



【5】PAMI 2012

【16】CVPR 2013



【15】CVPR2013

Contrast-based models
【 5、7、15 】
CVPR10/CVPR12/CVPR13

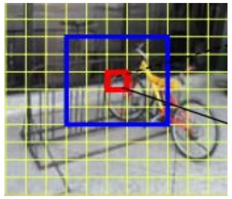
1. Areas that have distinctive colors or patterns should obtain high saliency.
2. Frequently occurring features should be suppressed.
3. The salient pixels should be grouped together and not spread all over the image.
4. Ideally colors belonging to the background will be distributed over the entire image exhibiting a high spatial variance.

Learning-based models

1. Regression problem. 【8,17,19】 CVPR13/CVPR14/CVPR12
2. Conditional Random Field 【20】 PAMI2011(CVPR2007)

Other models

1. Sparsity pursuit. 【18】 CVPR2012
2. Graph-based model 【2,9,10】CVPR2004/CVPR2013/CVPR2013
3. Boolean map 【21】 ICCV2013
4. Bayes 【22,23】 JV2008/TIP2013



Saliency Filters: Contrast Based Filtering for Salient Region Detection

In this paper we reconsider some of the design choices of previous methods and propose a conceptually clear and intuitive algorithm for contrast-based saliency estimation.

[7] Perazzi F, Krahenbuhl P, Pritch Y, et al. Saliency filters: Contrast based filtering for salient region detection[C] // Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on. IEEE, 2012: 733-740. 被引用次数：135

Preprocessing- SLIC super-pixels [24]

Gaussian filter [4] and Graph-based image segmentation [6][25] are also used in other models

[24] Achanta R, Shaji A, Smith K, et al. SLIC superpixels compared to state-of-the-art superpixel methods[J]. Pattern Analysis and Machine Intelligence, IEEE Transactions on, 2012, 34(11): 2274-2282. 被引用次数：445

[25] Felzenszwalb P F, Huttenlocher D P. Efficient graph-based image segmentation[J]. International Journal of Computer Vision, 2004, 59(2): 167-181. 被引用次数：2718

1. Image regions, which stand out from other regions in certain aspects, should be labeled more salient.

$$\begin{cases} U_i = \sum_{j=1}^{N} \left\| c_i - c_j \right\|^2 \cdot w_{ij}^{(p)} & (1) \\ w_{ij}^{(p)} = \frac{1}{Z_i} \exp\left(-\frac{1}{2\sigma_p^2} \left\| p_i - p_j \right\|^2\right) & (2) \end{cases}$$

2. Ideally colors belonging to the background will be distributed over the entire image exhibiting a high spatial variance.

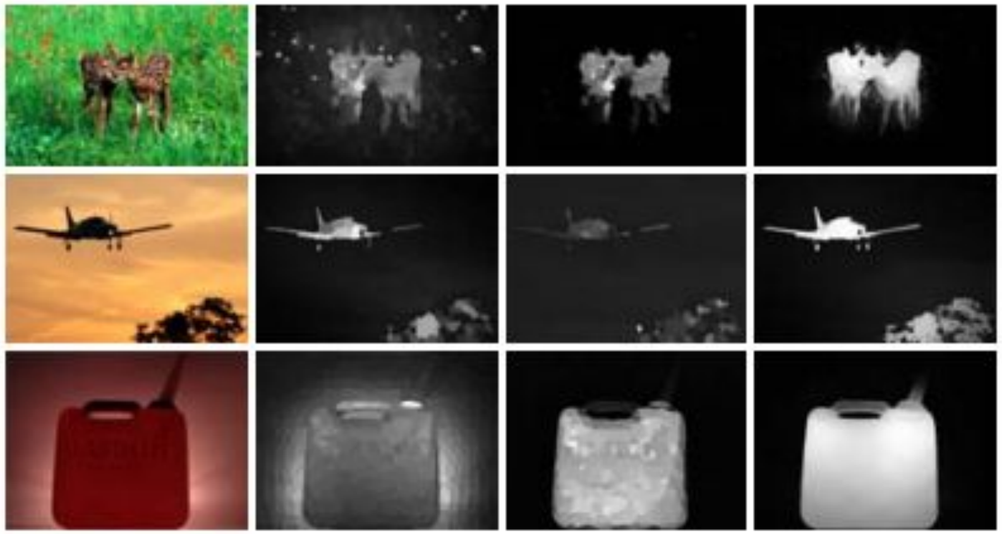
$$\begin{cases} D_i = \sum_{j=1}^{N} \left\| p_j - a_i \right\|^2 \cdot w_{ij}^{(c)} & (3) \\ w_{ij}^{(c)} = \frac{1}{Z_i} \exp\left(-\frac{1}{2\sigma_c^2} \left\| c_i - c_j \right\|^2\right) & (4) \\ a_i = \sum_{j=1}^{N} w_{ij}^{(c)} p_j & (5) \end{cases}$$

a_i defines the weighted mean position of color c_i

$$S_i = U_i \cdot \exp(-k \cdot D_i) \quad (6)$$

$$\tilde{S}_i = \sum_{j=1}^{N} w_{ij} \cdot S_j \quad (7)$$

$$w_{ij} = \frac{1}{Z_i} \exp(-\frac{1}{2}(\alpha\|c_i - c_j\|^2 + \beta\|p_i - p_j\|^2)) \quad (8)$$

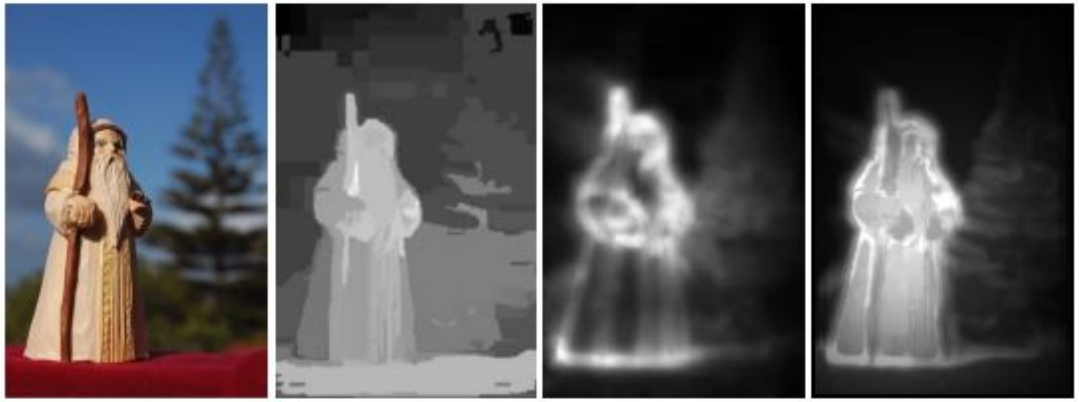


(a) Source image. (b) Uniqueness. (c) Distribution. (d) Saliency.

What Makes a Patch Distinct?

Our key contribution is a novel and fast approach to compute pattern distinctness. We rely on the inner statistics of the patches in the image for identifying unique patterns.

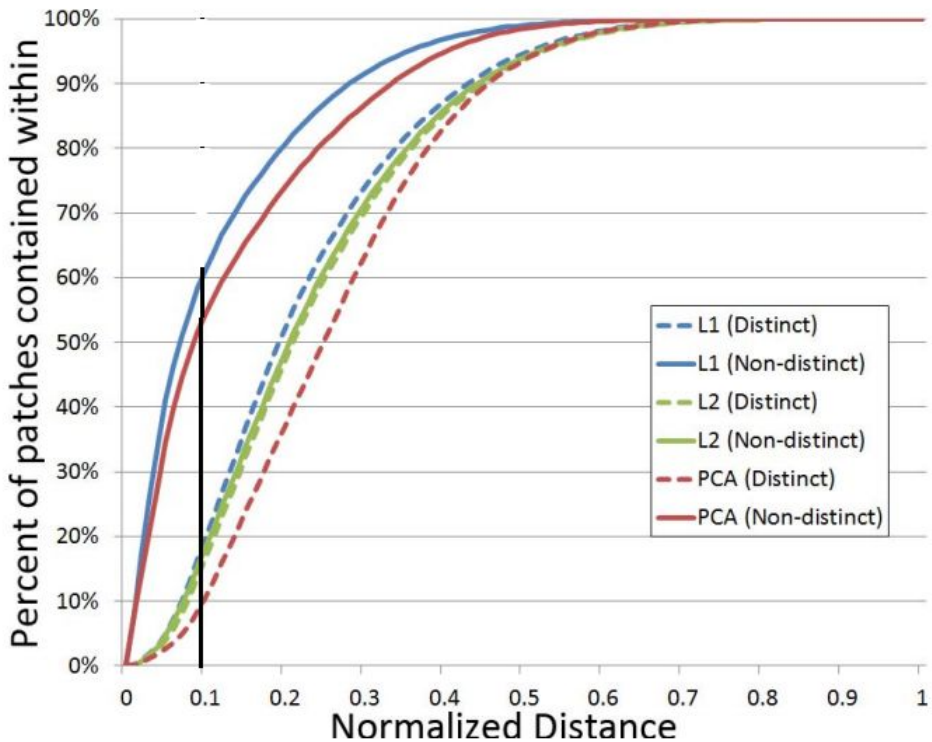
[11] Margolin R, Tal A, Zelnik-Manor L. What Makes a Patch Distinct?[C]//Computer Vision and Pattern Recognition (CVPR), 2013 IEEE Conference on. IEEE, 2013: 1139-1146. 被引用次数：24


(a) Input (b) RC [6] (c) CNTX [5] (d) Ours

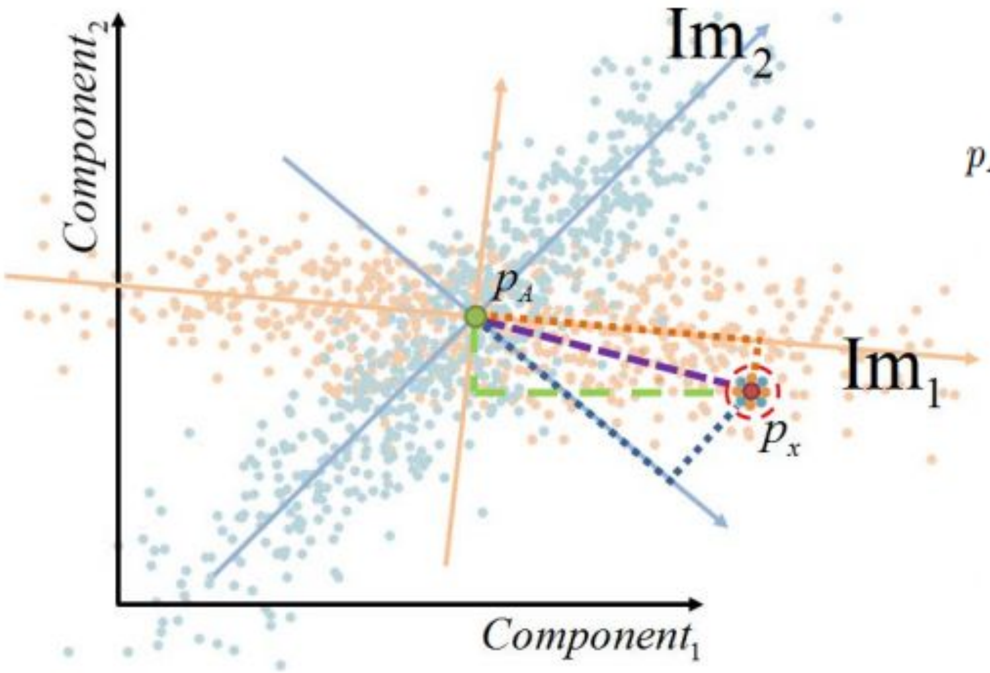
Some focus on the patterns, others on the colors, and several add high-level cues and priors. We propose a simple, yet powerful, algorithm that integrates these three factors.

[5] Goferman S, Zelnik-Manor L, Tal A. Context-aware saliency detection[J]. Pattern Analysis and Machine Intelligence, IEEE Transactions on, 2012, 34(10): 1915-1926. 被引用次数：545
[6] Cheng M M, Zhang G X, Mitra N J, et al. Global contrast based salient region detection[C]//Computer Vision and Pattern Recognition (CVPR), 2011 IEEE Conference on. IEEE, 2011: 409-416. 被引用次数：568

Our first observation is that the non-distinct patches of a natural image are mostly concentrated in the high-dimensional space, while distinct patches are more scattered



This figure presents the cumulative histograms of the distances between distinct (dashed lines) and non-distinct (solid lines) patches to the average patch.



$$p_A = \frac{1}{N}\sum_{x=1}^{N} p_x. \quad (1)$$

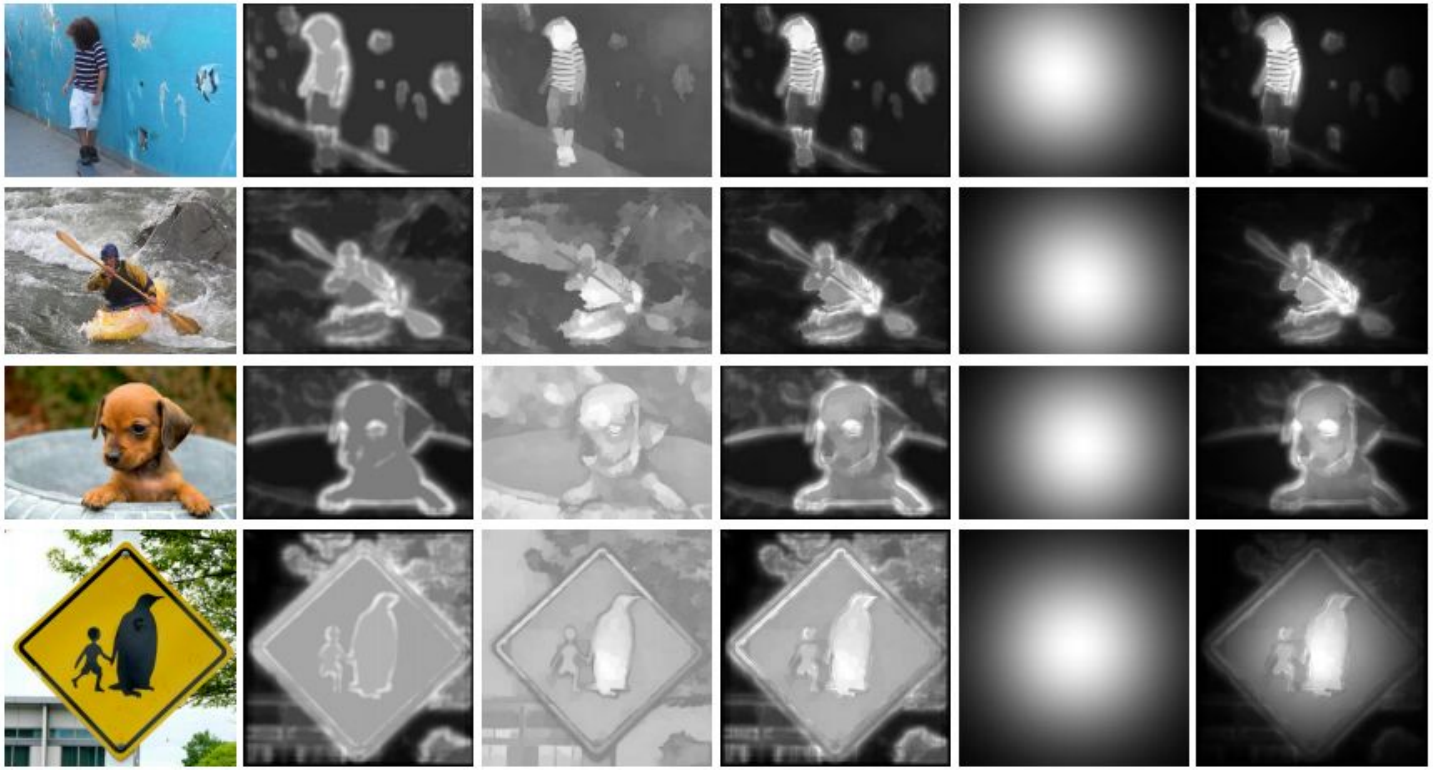
Im1 and Im2 represent two different images whose principal components are marked by the solid lines. The images share the average patch p_A. The patch p_x is highly probable in the distribution of Im1 and hence should not be considered distinct in Im1, while the same patch is less probable in image Im2 and hence should be considered distinct in Im2. The L2 distance (purple line) and L1 distance (green line) between p_x and p_A are oblivious to the image distributions and therefore will assign the same level of distinctness to p_x in both images. Instead, computing the length of the paths between p_x and p_A, along the principal components of each image, takes under consideration the distribution of patches in each image. The path for image Im2 (dashed blue line) is longer than the path for image Im1(dashed orange line), correctly corresponding to the distinctness level of p_x in each image.

$$P(p_x) = ||\tilde{p_x}||_1, \tag{2}$$

$$C(r_x) = \sum_{i=1}^{M} ||r_x - r_i||_2. \tag{3}$$

$$D(p_x) = P(p_x) \cdot C(p_x). \tag{4}$$

$$S(p_x) = G(p_x) \cdot D(p_x). \tag{5}$$



(a) Input (b) Pattern distinctness (c) Color distinctness (d) Pattern & Color (e) Organization priors (f) Final saliency