Depth Saliency Based On Anisotropic Center-Surround Difference

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Color image

Depth map

Saliency map

Abstract

We introduce a novel method to detect salient object using depth information. Different from previous works which use absolute depth, we measure the saliency of a point by how much it stands out from its surrounding, i.e. its relative depth to the background. Besides, two common priors based on depth and location are used for refinement. Our method is efficient and works within a complexity of $O(N)$. We test and compare our method with other state-of-the-art methods on a dataset including 1382 stereo images. The results show the effectiveness of our method.

Method

Feature. We introduce a new feature called Anisotropic Center-Surround Difference (ACSD) to measure the saliency:

$$D_{acsd}(p) = \sum_{i\in[1,S],k\in[1,L]} \max(d(p) - \min(d_k^i)\ ,0)$$

where $d(p)$ is the depth value of p and $\min(d_k^i)$ is the minimum depth in the segment of length L in the ith scanline, as shown in the right figure.

Saliency map. We first utilize SLIC to segment the color image into superpixels. Then we compute the ACSD for each superpixel at the centroid. Next, we employ two common priors for refinement. Firstly, we add a linear weighting to highlight closer regions. Secondly, we use a Gaussian to emphasize center area. The time complexity of the method is linear to the number of pixels.

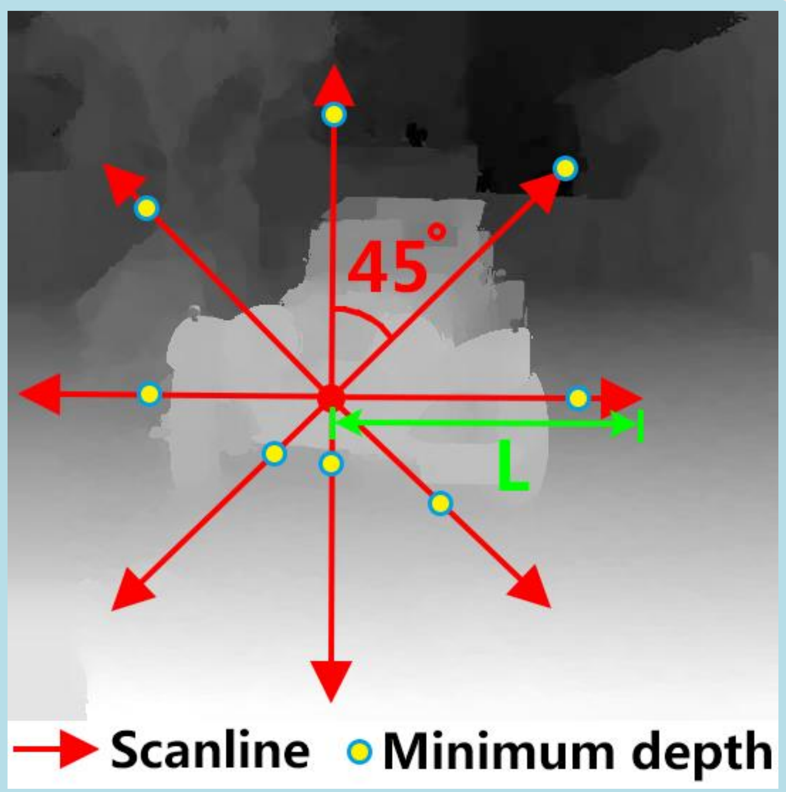

Figure 1. ACSD feature.

Experiments

We build a dataset including 1382 stereo images from Internet, 3D movies and photographs taken by a Fuji W3 stereo camera. The groundtruth are generated manually and the depth maps are recovered using [1]. We compare our method with three representative color based methods: CNTX[2], RC[3], PCA[4], and three depth based method: CURV[5], SS[6], DP[7]. A few examples are shown in Fig. 2. We can see that the color-based methods are easily to be puzzled in complex scenes, e.g. in the 6th row the fish is lost. In comparison, the depth-based methods are insensitive to high textures, except CURV, which tends to highlight depth edges. DP only considers absolute depth and thus erroneously highlight grounds and walls, as shown from 1st to 5th row. SS tends to miss flat regions of objects (see 2nd to 4th row) and does not inhibit vertical support planes (see 1st row). The precision-recall curves are given in Fig. 3. The average running time is give in Table 1, which shows the efficiency of the proposed method.

Color image | Depth image | Ground truth | CNTX | RC | PCA | CURV | SS | DP | Ours

Figure 2. Saliency maps comparison.

Method	CNTX	RC	PCA	CURV	SS	DP	Ours
Time(s)	40.726	0.269	10.874	0.063	1.232	0.143	0.344
Code	Matlab	C++	Matlab	Matlab	C++	Matlab	C++

Table 1. Average running time comparison.

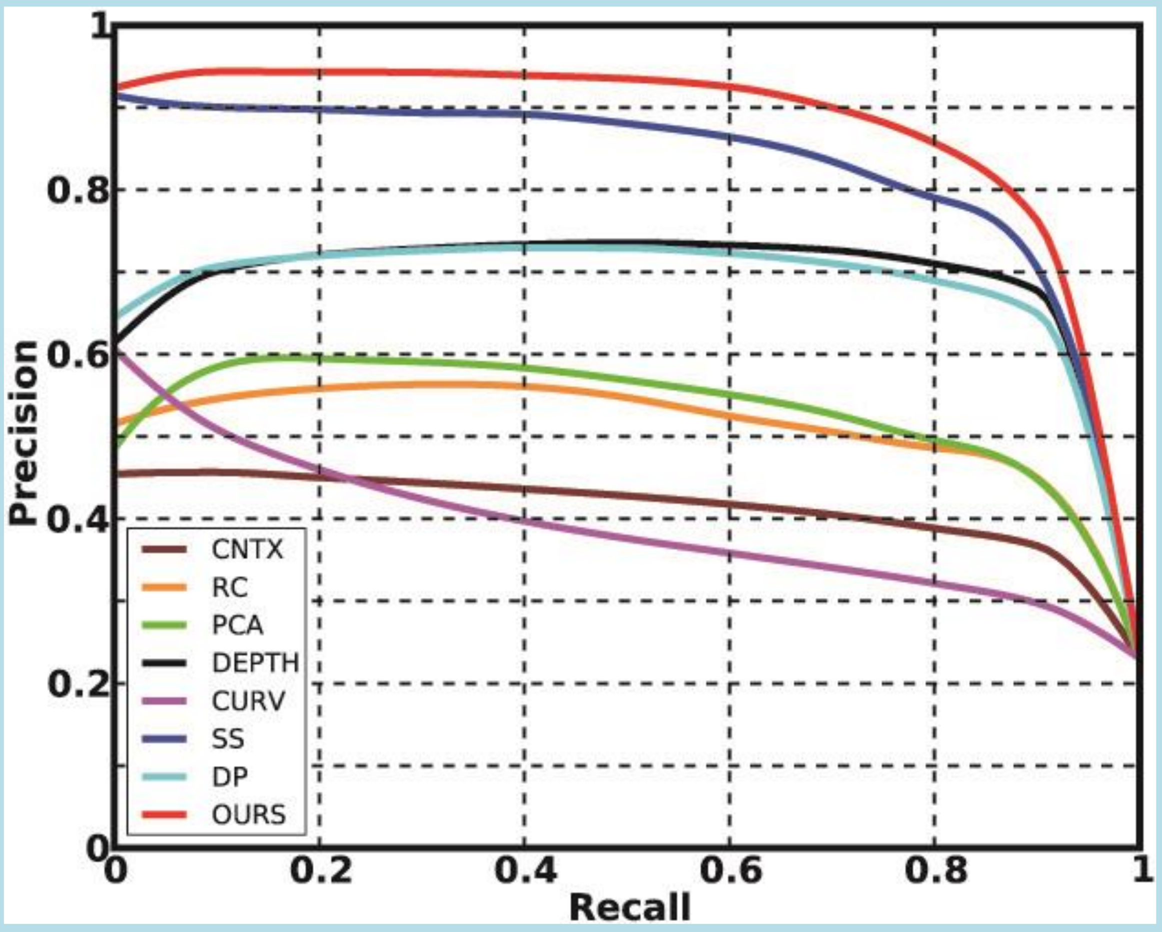

Figure 3. Precision-recall curves.

Our code and dataset are available at http://mcg.nju.edu.cn/publication/2014/ICIP14-JuR.html

References

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