ROBUST SEGMENTATION OF RELEVANT REGIONS IN LOW DEPTH OF FIELD IMAGES

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Original

This approach

[12]

[10]

[11]

Automatically segment the region of interest in Low Depth Of Field photos

Low depth of field (DOF) is an important technique for photographers to emphasize the object of interest within an image. When viewing a low depth of field image, the viewer implicitly segments the image into region of interest and non regions of interest which has major impact on the perception of the image.

AIM / REQUIREMENTS:

Given an image with Low DOF, create a segmentation for the sharply displayed region = the Object of Interest.

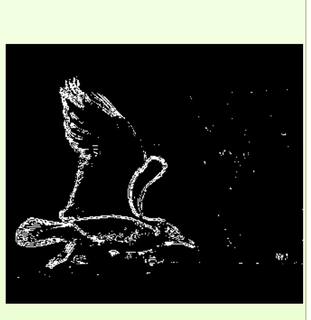
- Stability w.r.t. internal parameters
- Robustness w.r.t. different image domains
- Not required to set external parameters explicitly by the user
- Applicable on still images (not movies) without additional information like meta data, etc.

ALGORITHM:

1. Deviation Scoring / Edge Detection

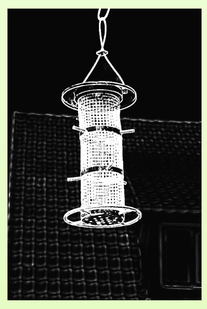
For each pixel p:
a) calculate mean color of neighborhood in L*a*b* space
b) calculate L2 distance to pixel p in L*a*b*
c) Edge pixel = pixel with distance(p, mean color) > Θ_1

→ **Robust edge detection**



Original

Canny



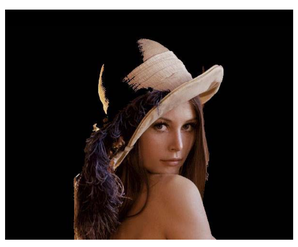
HOS

Dev.Scoring

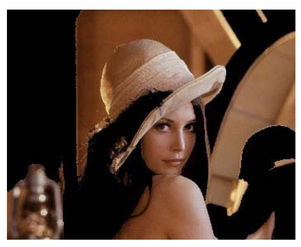
2. Score Clustering

a) DBSCAN clustering on edge image (Clustering parameters are computed w.r.t. image size and score clustering values automatically).
b) Select clusters with a cluster size of > 0.5x the size of the largest clusters for further processing.

→ **Identification of relevant clusters & removal of noise sets**



This approach



[12]

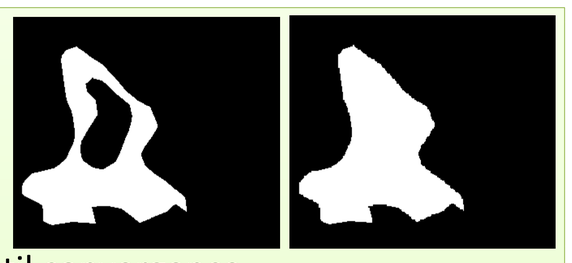
[10]

[11]

3. Mask Approximation

a) Compute convex hull for each cluster from step 2
b) Create binary approximation mask by filling all convex hulls
c) Apply geodesic erosion and dilation until convergence

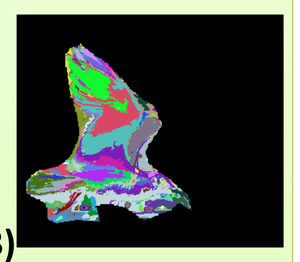
→ **Candidate mask for later segmentation**



4. Color Segmentation

For each pixel covered by the mask:
a) Compute similarity to neighboring pixel in color space
b) Expand region while similarity between region and neighboring pixel > Θ_2 , otherwise begin new region

→ **Set of color regions within the candidate mask (step 3)**



5. Region Scoring

For each color region from step 4:
a) Compute Mask Boundary Overlap (MBO) (w.r.t color regions from #4) and
b) Compute Score Boundary Overlap (SBO) (w.r.t #2)
c) Compute relevancy MR = MBO x SBO
d) Remove regions with low relevancy

→ **the Final Result**

EVALUATION:

65 flickr images with different DOF, manually annotated.
Compared to algorithms of [10], [11], [12] using spatial distortion

$$d(I, I_{mask}) = \frac{\sum I(x,y) \otimes I_{mask}(x,y)}{\sum I_{mask}(x,y)}$$

Result

- Speed
+ most robust method on a diverse image data set with varying DOF
+ no parameters needed to hand tune, parameters calculated dynamically
+ also works on images with textured background
+ best method according to spatial distortion!

Distortion	this	[10]	[12]	[11]
Minimum	**0.01**	0.03	0.02	0.07
Maximum	**1.58**	> 43 (2)	> 8 (2)	> 20 (2)
Mean	**0.22**	1.4 (0.5)	1.2 (1.0)	2.2 (1.3)
Std.dev	**0.26**	6 (0.4)	1.2 (0.5)	3.1 (0.7)
Time	35s	9s	54s	**2.7s**
Images (d<2)	**65**	65 (63)	65 (58)	65 (45)

[10] : C. Kim, “Segmenting a Low-Depth-of-Field Image Using Morphological Filters and Region Merging” IEEE Transactions on Image Processing , (2005)
[11]: H. Li and K.N. Ngan, “Unsupervized video segmentation with low depth of field,” IEEE Transactions on Circuits and Systems for Video Technology” (2007)
[12]: K.D. Zhang, H.Q. Lu, Z.Y. Wang, Q. Zhao and M.Y. Duan, “A Fuzzy Segmentation of Salient Region of Interest in Low Depth of Field Image,” (2006)

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Database Group

Online Demo, Source Code, Data Set & Annotations available at
http://www.dbs.ifi.LMU.de/research/ICIP-ImageSegmentation/