Abstract
Superpixel segmentation methods aim to partition the image into homogeneous connected regions of pixels (i.e., superpixels) such that the union of its comprising superpixels precisely defines the objects of interest. However, the homogeneity criterion is often based solely on color, which, in certain conditions, might be insufficient for inferring the extension of the objects (e.g., low gradient regions). In this dissertation, we address such issue by incorporating prior object information – represented as monochromatic object saliency maps – into a state-of-the-art method, the Iterative Spanning Forest (ISF) framework, [...]

Introduction
Superpixel segmentation methods often rely on color variations to generate homogeneous groups of connected pixels (i.e., superpixels); however, in regions with low color gradient, such heuristic might not be sufficient for effective delineation.

 [...] resulting in a novel framework named Object-based ISF (OISF). For a given saliency map, OISF-based methods are capable of increasing the superpixel resolution within the objects of interest, whilst permitting a higher adherence to the map’s borders, when color is insufficient for delineation. We compared our work with state-of-the-art methods, considering two classic superpixel segmentation metrics, in three datasets. Experimental results show that our approach presents effective object delineation with a significantly lower number of superpixels than the baselines, especially in terms of preventing superpixel leaking.

Given an object saliency map, one could control all of the segmentation steps for generating effective results that benefit subsequent tasks in an application. In this dissertation, we propose the Object-based Iterative Spanning Forest (OISF), a superpixel segmentation framework which grants the user such control and requires a minimal quantity of superpixels.
Given an image and its object saliency map, the Object-based Iterative Spanning Forest (OISF) framework is capable of generating distinct and effective segmentation by altering the percentage of seeds within the objects (of interest) and by controlling the superpixel adherence to the maps’ borders in the Image Foresting Transform.
Superpixel Generation by the Iterative Spanning Forest using Object Information

SIBGRAPI 2020 - 33rd Conference on Graphics, Patterns and Images

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Experimental Setup

Datasets:
- DUT-OMRON: 5168 natural images;
- ECSSD: 1000 natural images;
- Parasitos: 72 images of helminth eggs;

Metrics:
- Boundary Recall: Adherence to object’s borders;
- Under-Segmentation Error: Occurrence of superpixel leaking;

Saliency estimators:
- Pyramid Feature Attention: ECSSD and DUT-OMRON
- OPF-based: Parasitos

Number of Superpixels: [20,1000]

Methods:
- LSC;
- SLIC;
- SNIC;
- OISF-OGRID;
- OISF-OSMOX;

Results

DUT-OMRON & ECSSD:
OISF surpasses ISF with a significant margin and is competitive with the top methods for 200 superpixels or less.

Parasitos: OISF manages to effectively delineate the parasite egg with minimal superpixel quantity, whereas the remaining methods cannot.

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We propose the Object-based Iterative Spanning Forest (OISF) superpixel segmentation framework, which incorporates prior object information from object saliency maps. Results show that our approach obtains effective delineation performance while requiring fewer superpixels than the baselines. For future work, we intend to evaluate OISF in medical applications, extend other superpixel methods, and overcome the limitations imposed by unchangeable maps.

Acknowledgements

Publications


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