Contrast Based Filtering for Salient Region Detection

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1 Introduction

The computational identification that are likely to catch the attention of a human observer is a typical perceptual research problem. The research indicate that the most influential factor in low level visual saliency is contrast. This project is based on the observation that an image can be decomposed into basic, structurally representative elements that abstract away unnecessary detail and at the same time allow for very clear and intuitive definition of contrast based saliency. The definition of contrast in previous works is based on various different types of image features, including color variation of individual pixels, edges and gradients, spatial frequencies, structure and distribution of image patches, histograms, multi-scale descriptors, or combinations thereof.

This method is based on the observation that an image can be decomposed into basic, structurally representative elements that abstract away unnecessary detail, and at the same time allow for a very clear and intuitive definition of contrast-based saliency.

2 Approach

Figure 1: Execution Pipeline

The process goes through 4 modules.

2.1 Abstraction

For the image abstraction we use an adaptation of SLIC superpixels to abstract the image into perceptually uniform regions. SLIC superpixels segment an image using K-means clustering in RGBXY space. The RGBXY space yields local, compact and edge aware superpixels, but does not guarantee compactness. For our image abstraction we slightly modified the SLIC approach and instead use Kmeans clustering in geodesic image distance in CIELab space. Geodesic image distance guarantees connectivity, while retaining the locality, compactness and edge awareness of SLIC superpixels.

2.2 Element Uniqueness

Element uniqueness is generally defined as the rarity of a segment i given its position pi and color in CIELab ci compared to all other segments j:

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By introducing wij (p) we effectively combine global and local contrast estimation with control over the influence radius of the uniqueness operator. A local function wij (p)yields a local contrast term, which tends to overemphasize object boundaries in the saliency estimation whereas w(p) ij = 1 yields a global uniqueness operator, which cannot represent sensitivity to local contrast variation.

2.3 Element Distribution

we define the element distribution measure for a segment i using the spatial variance Di of its color ci, i.e., we measure its occurrence elsewhere in the image. As motivated before, low variance indicates a spatially compact object which should be considered more salient than spatially widely distributed elements. Hence we compute

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where w(c) ij describes the similarity of color ci and color cj of segments i and j, respectively, pj is again the position of segment j, and i = PN j=1 wij (c)pj defines the weighted mean position of color ci.

2.4 Saliency Assignment

We start by normalizing both uniqueness Ui and distribution Di to the range [0::1]. We assume that both measures are independent, and hence we combine these terms as follows to compute a saliency value Si for each element:

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In practice we found the distribution measure Di to be of higher significance and discriminative power. Therefore, we use an exponential function in order to emphasize Di. In all our experiments we use k = 6 as the scaling factor for the exponential.

As the final step, we need to assign a final saliency value to each image pixel, which can be interpreted as an upsampling of the per-element saliency Si. However, naive up-sampling by assigning Si to every pixel contained in element i carries over all segmentation errors of the abstraction algorithm. Instead we adopt an idea proposed in the context of range image up-sampling [9] and apply it to our framework. We define the saliency S i of a pixel as a weighted linear combination of the saliency Sj of its surrounding image elements

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By choosing a Gaussian weight ¡add gaussian weight equation here¿, we ensure the up-sampling process is both local and color sensitive. Here alpha and beta are parameters controlling the sensitivity to color and position. We found alpha = 1/30 and beta = 1/30 to work well in practice.

3 Work Performed

3.1 Experiments and Software programs

4 Results

4.1 Successes

4.2 Failures

4.3 Analysis of Results

5 Github link

https://github.com/deepakksingh/Contrast-Based-Filtering-for-Salient-Region-Detection

6 Task Assignment

7 Acknowledgement

- https://jayrambhia.com/blog/superpixels-slic
- How SLIC algorithm works (https://www.youtube.com/watch?v=-hmUbB-Y8R0)