**Motivation**
- Construct a robust image contrast measure for saliency region detection.
- Design a contextual saliency measure for salient object detection.
- Improve object segmentation and image retargeting by saliency detection.

**Contribution**
- We introduce hypergraph modeling into the process of image saliency detection for the first time. A hypergraph is a rich, structured image representation modeling pixels (or superpixels) by their contexts rather than their individual values.
- The problem of saliency detection is naturally cast as that of detecting salient vertices and hyperedges in a hypergraph at multiple scales. The hypergraph structural information enables more accurate saliency measurement.
- We formulate the center-surround contrast approach to saliency as a cost-sensitive max-margin classification problem. Consequently, the saliency degree of an image region is measured by its associated normalized measurement.

**Max-Margin Saliency Detection**

**Hypergraph Saliency Overview**

Mathematically, the hypergraph $\mathcal{G}$ is associated with a $|\mathcal{V}| \times |\mathcal{E}|$ incidence matrix $H = (H(v,e))_{v \in \mathcal{V}, e \in \mathcal{E}}$

$$H(v,e) = \begin{cases} 1, & \text{if } v \in e, \\ 0, & \text{otherwise}. \end{cases}$$

(3)

The saliency value of any vertex $v_i$ in $\mathcal{G}$ is defined as:

$$HSa(v_i) = \sum_{e \in \mathcal{E}} \Gamma(e) H(v_i, e),$$

(4)

where $\Gamma(e)$ encodes the saliency information on the hyperedge $e$.

**Hypergraph Saliency Formulation**

The saliency value of the hyperedge $e$ is computed as:

$$\Gamma(e) = w_e \cdot \left( \| M_e \circ M_e(e) \|_1 - p(e) \right).$$

(5)

Here, $w_e$ is a scale-specific hyperedge weight (a larger scale leads to a larger weight), $\| \cdot \|$ is the 1-norm, $M_e(e)$ is a binary mask (illustrated in Fig. 3) indicating the pixels (within a narrow band) along the boundary of the hyperedge $e$, $\circ$ is the elementwise dot product operator, and $p(e)$ is a penalty factor that is equal to the number of the image boundary pixels shared by the hyperedge $e$.

**Experimental Results**

**Figure:** Illustration of hypergraph modeling for saliency detection using nonparametric clustering.

**Figure:** Comparison of contextual saliency measures for salient object detection.

**Figure:** Quantitative PR and ROC performance of all the thirteen approaches on the two datasets. The left two columns show the PR curves while the right two columns display the ROC curves. The rows from top to bottom correspond to MSRA-1000 and SOD, respectively.

**Figure:** Examples of salient object segmentation. From left to right: input images, ground truth, saliency maps, segmentation results. Clearly, our approach obtains visually consistent segmentation results with ground truth.

**Figure:** Qualitative image retargeting performance comparison between [18] and ours.