Saliency Detection in Images using Graph-based Rarity, Spatial Compactness and Background Prior

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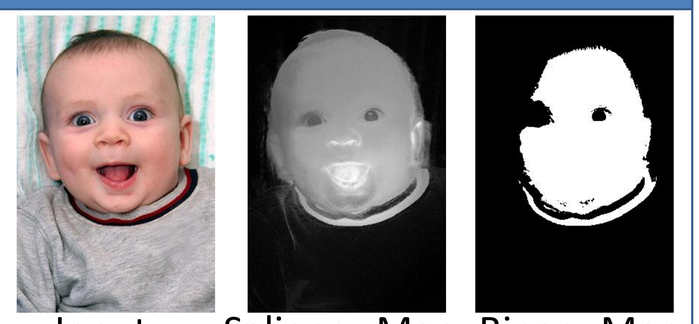
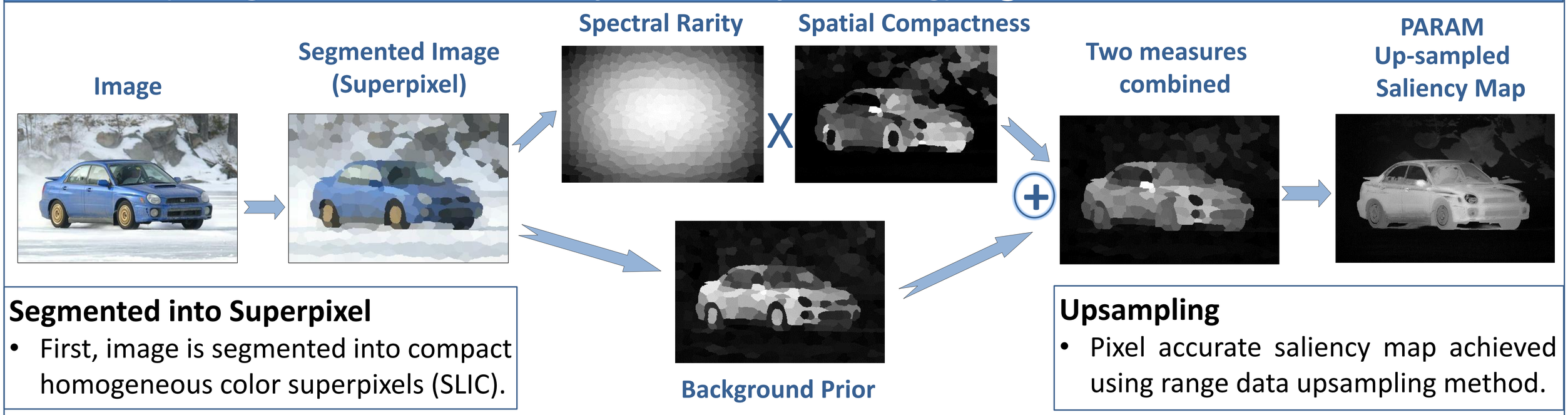
Abstract

- The proposed saliency detection method identifies regions in an image, containing prominent objects, which pop out from the background and helps to focus attention.
- We use rarity of feature based approach based on graph-based spectral rarity and spatial compactness of color, as well as boundary prior constraint using Gaussian mixture model.
- Combination of these two complimentary concepts gives better result in terms of both accuracy and speed.



PARAM (background Prior And RArity for saliency Modeling) Algorithm Overview



Segmented into Superpixel

- First, image is segmented into compact homogeneous color superpixels (SLIC).

Upsampling

- Pixel accurate saliency map achieved using range data upsampling method.

Graph-based Spectral Rarity

- Eigen vectors of the Laplacian matrix of the superpixel graph form the descriptor (x_i) for each superpixel.
- Rarity of superpixel i is calculated as,

$$r_i = \sum_{j=1}^{N} \left|\left|x_j - x_i\right|\right|^2 . \exp(-k_r \left|\left|p_j - p_i\right|\right|^2)$$

i.e., sum of Eucledian distances of the descriptors of spatially near superpixels.

Spatial Compactness

- A salient color c_i is spatially compact and close to the spatial mean position (μ_i) of the colors similar to c_i.
- Spatial variance of superpixel i is,

$$v_i = \sum_{j=1}^{N} \left|\left|p_j - \mu_i\right|\right|^2 . \exp(-k_c \left|c_j - c_i\right|\left|^2\right)$$

- Thus, spatial compactness of color is formulated as , $\exp(-k.v_i)$.

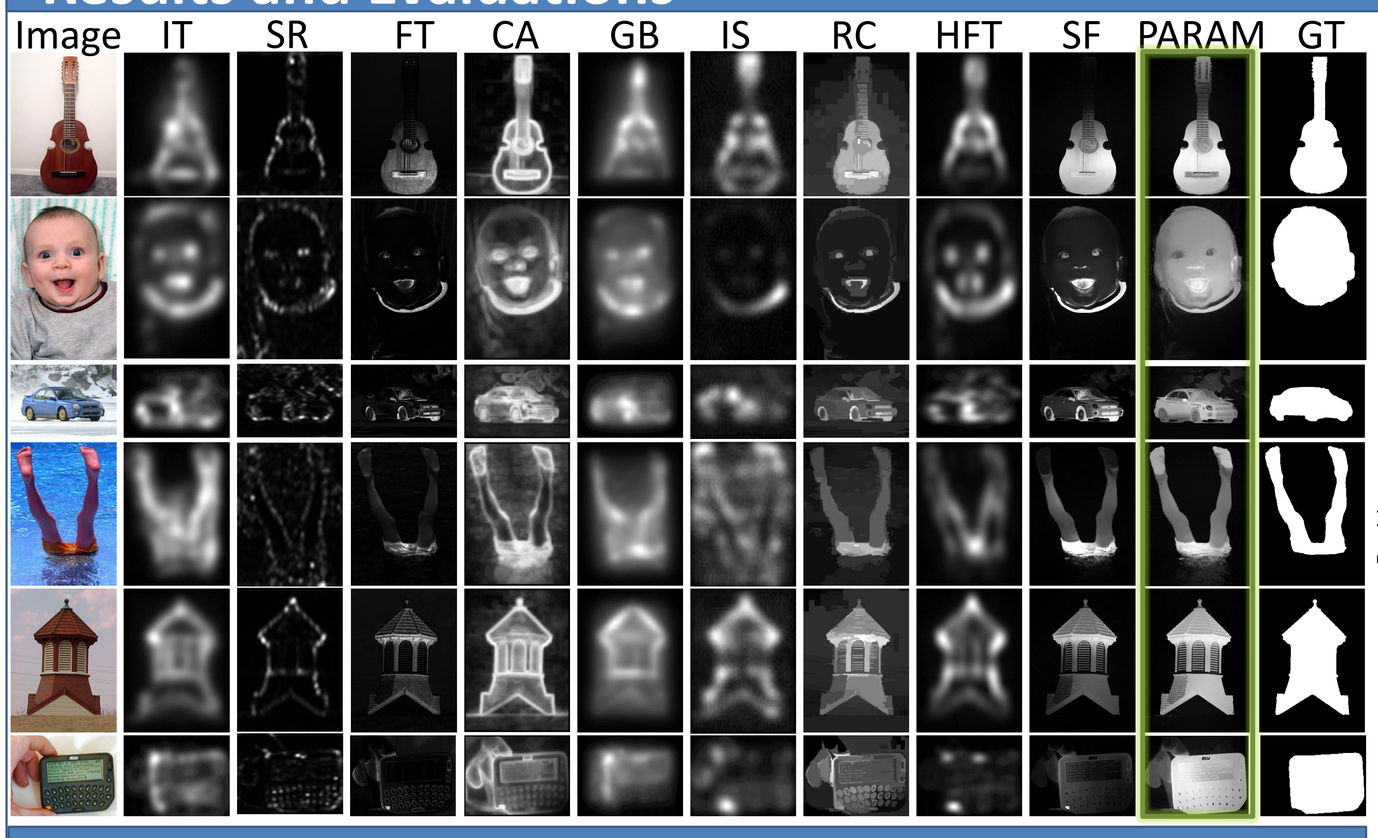
Background Prior

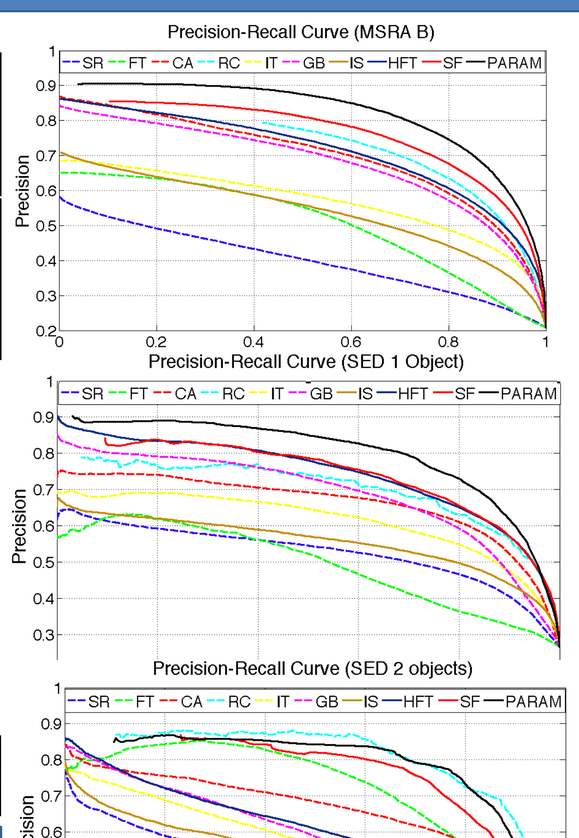
- Boundary superpixels are modeled by GMM (K modes) in Lab color space.
- Saliency given by background prior,

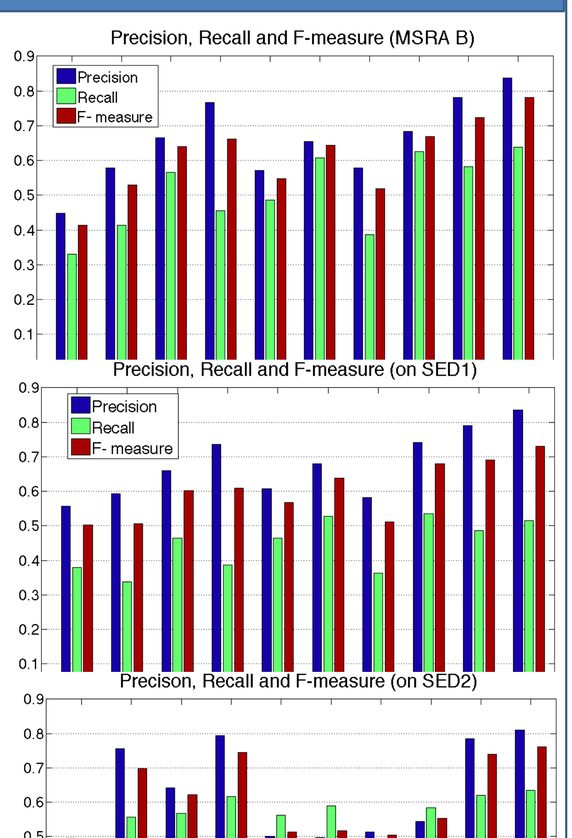
$$B_i = \sum_{j=1}^{K} \pi_j . D_M(c_i, \mu_{Gj})$$

- Non-salient superpixels are similar to the large modes depicting background, with low Mahalanobis distance (D_M).

Results and Evaluations







Conclusion

- Autonomously finds salient regions, thus the prominent objects.
- Fast - can be used as preprocessing step to reduce search space.

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