Exploiting Local and Global Patch Rarities for Saliency Detection

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CVPR 2012

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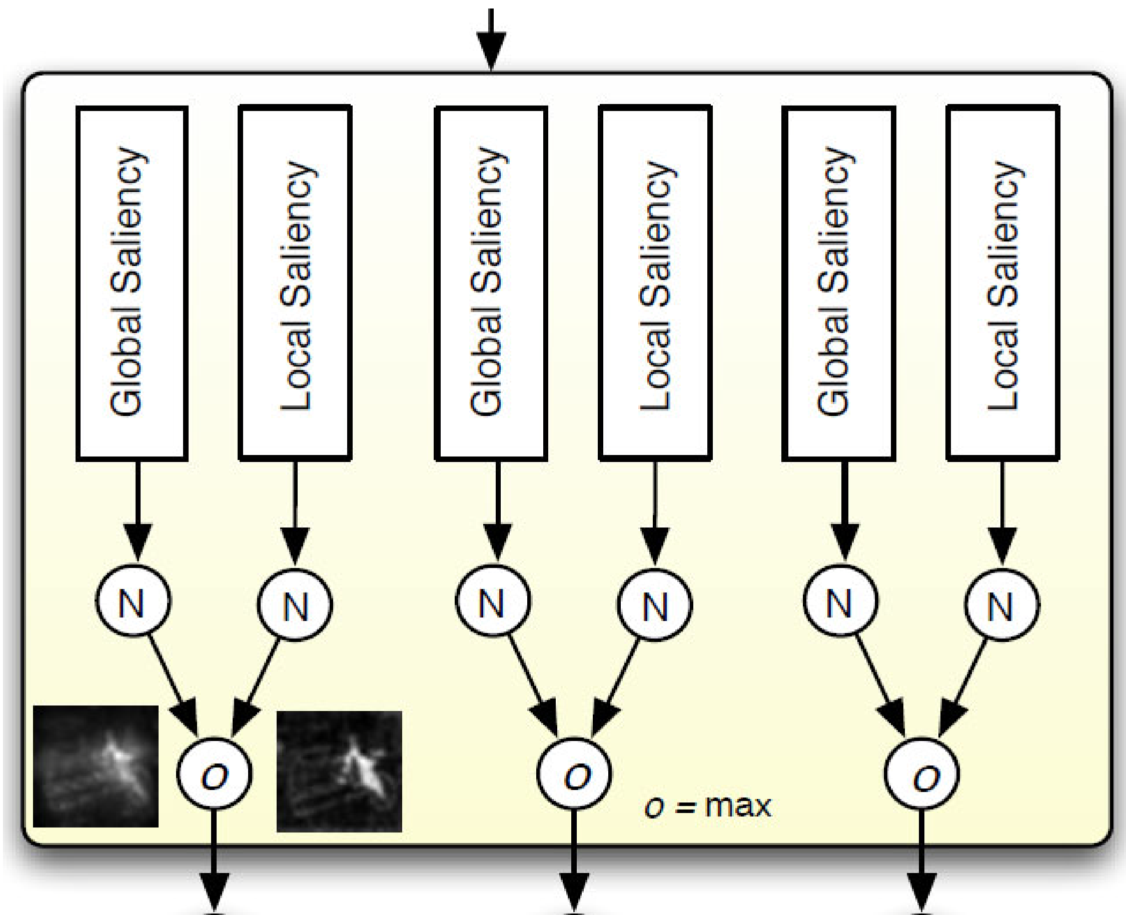
General Idea

Saliency Model based on local and global salient points



Previous Work

Feature Integration Theory (1980 by Anne Treisman and Garry Gelade)

When perceiving a stimuli:

Features (color, intensity..) are registered early, automatically and in parallel,

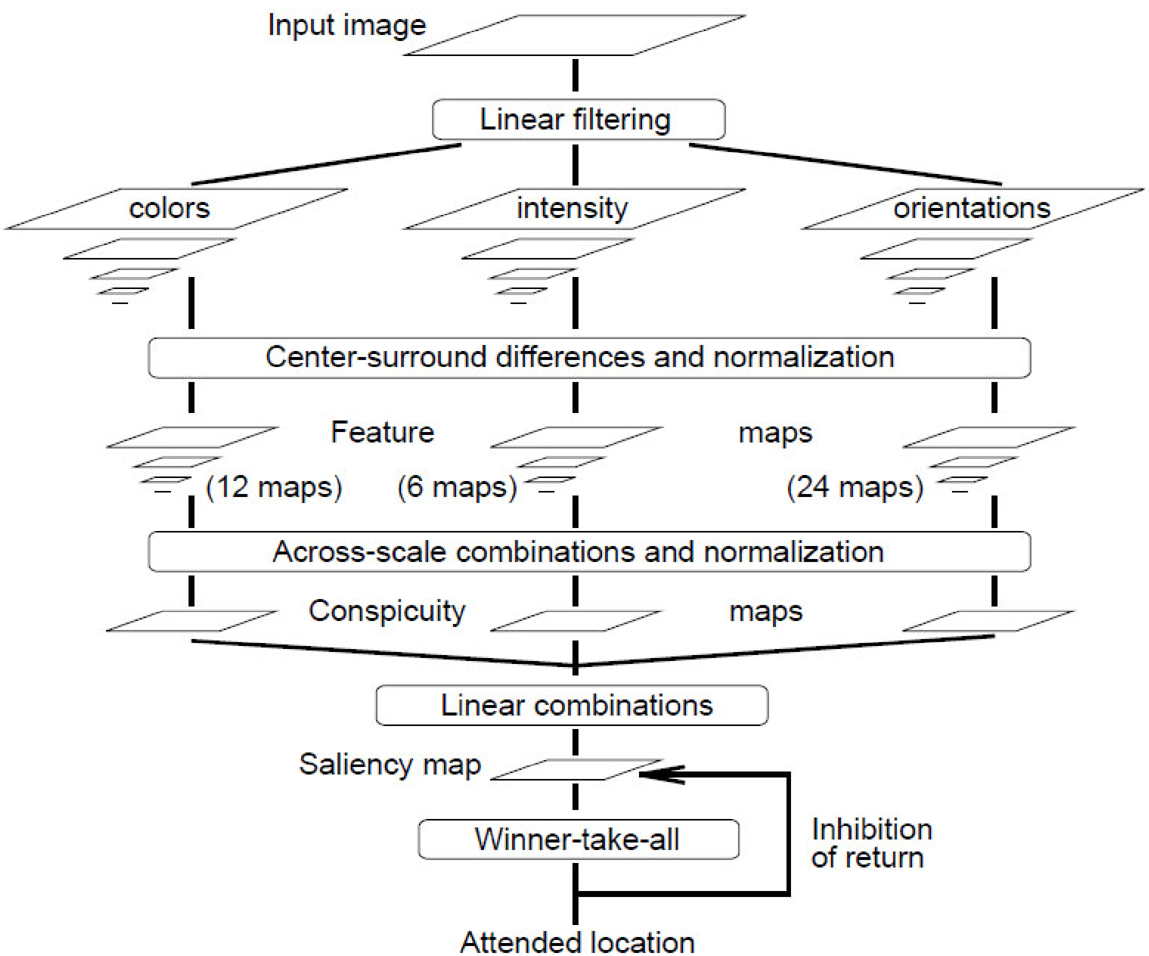
Objects are identified seperately at a later stage of processing

Guided Search Model (1989 by Wolfe JM, Cave KR, Franzel SL)

Information from top-down and bottom-up processing of the stimulus is used to create a ranking of items in order of their attentional priority

Previous Work

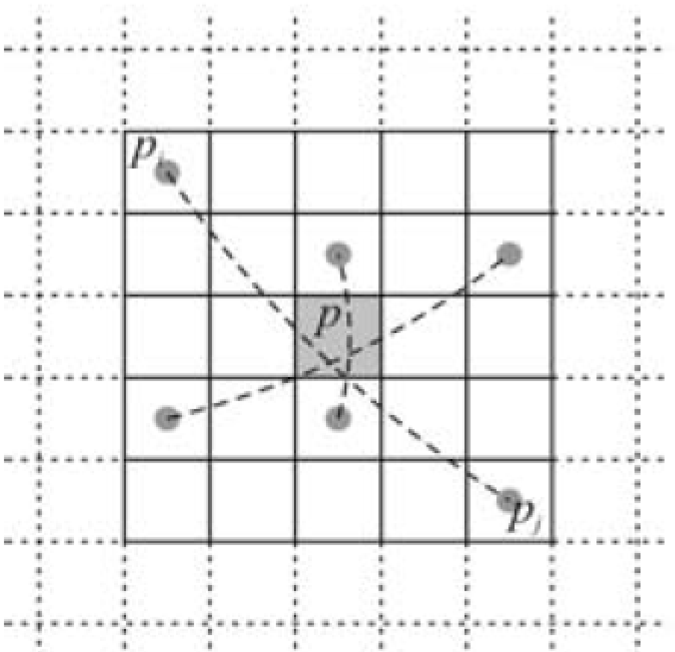
Saliency-Based Visual Attention for Rapid Scene Analysis



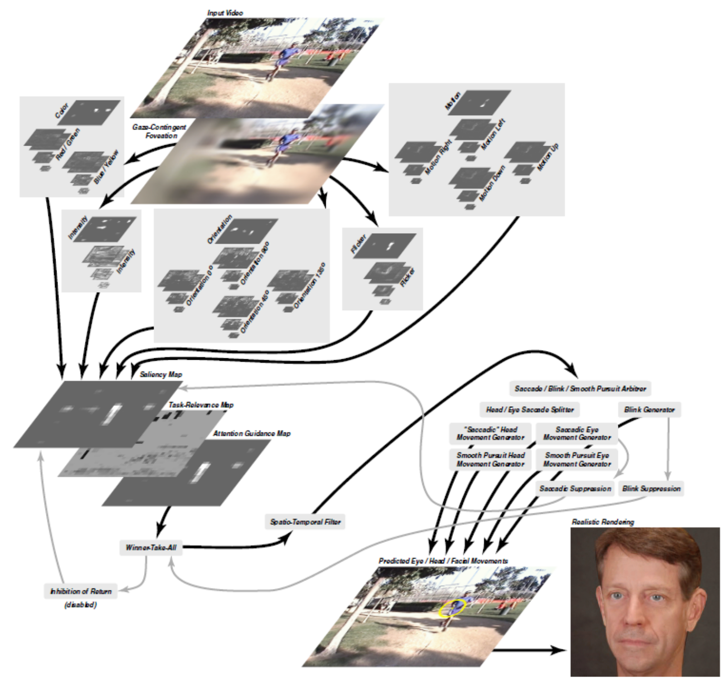
Compute saliency for simple features: color, intensity, orientation

Laurent Itti, Christof Koch, Ernst Niebur
PAMI 1998

Previous Work



Symmetry feature for saliency (2008)



Motion feature for saliency (2003)

Texture contrast (2002), Curvedness (2009)

Previous Work

Probabilistic Models

Graph Based Visual Saliency (Torralba – 2006)

Graph Algorithms and a dissimilarity measure

Saliency Using Natural Statistics (SUN) (Zhang – 2008)

Combine top-down and bottom-up info for real world object search

Saliency as Maximizing Classification Accuracy (Gao & Vasconcelos – 2003)

Measure mutual information between features

Previous Work

Saliency in Frequency Domain

Spectral Residual Approach (Hou & Zhang – 2007)

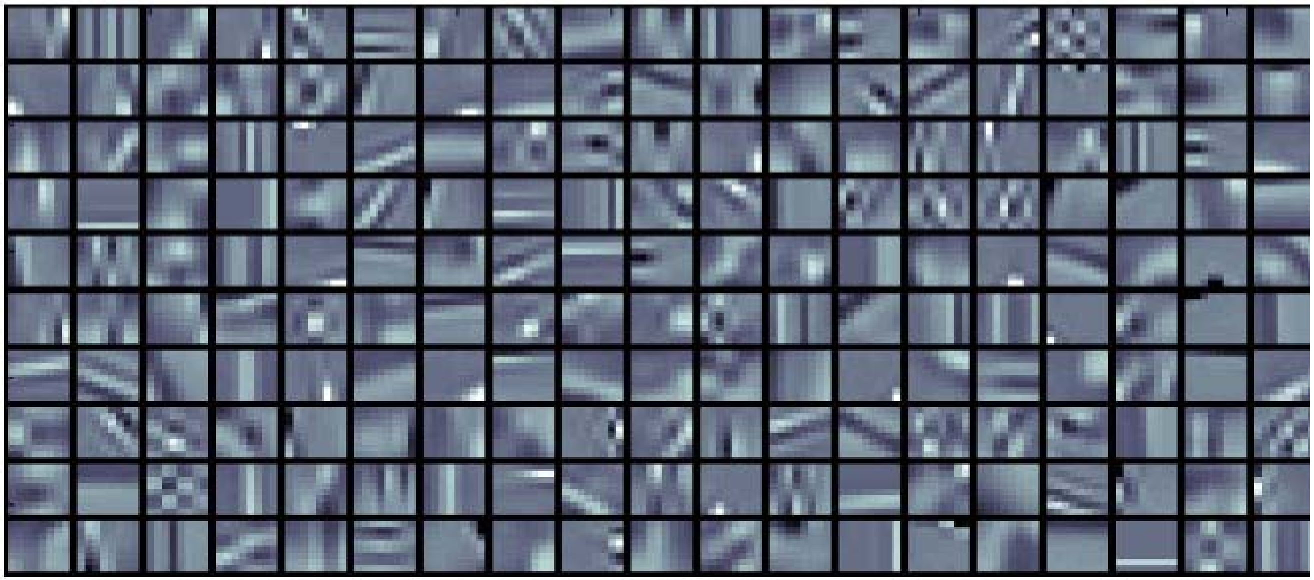
Relating extracted spectral residual features in the spectral domain

Multiresolution Spatiotemporal Saliency Detection Model (Gou– 2010)

Incorporating Phase spectrum of the Quaternion Fourier Transform (PQFT)

Details

Image Representation

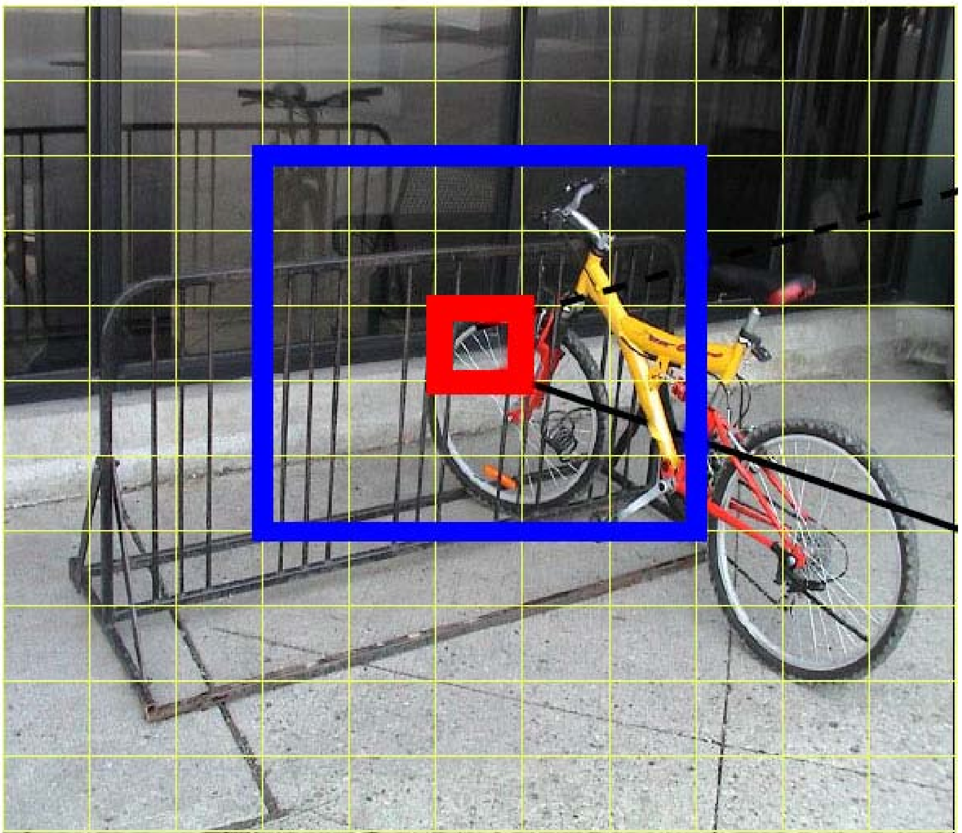


Dictionary of 200 basis functions – from natural images

$$\boldsymbol{\alpha}^*(\mathbf{x}, \mathbf{D}) = \underset{\boldsymbol{\alpha} \in \mathbb{R}^n}{\arg\min} \frac{1}{2}||\mathbf{x} - \mathbf{D}\boldsymbol{\alpha}||_2^2 + \lambda_1 ||\boldsymbol{\alpha}||_1$$

Details

Local Saliency



$$S_l^c(\mathbf{p}_i) = \frac{1}{L}\sum_{j=1}^{L} W_{ij}^{-1} D_{ij}^c$$

Avarage weighted dissimilarity

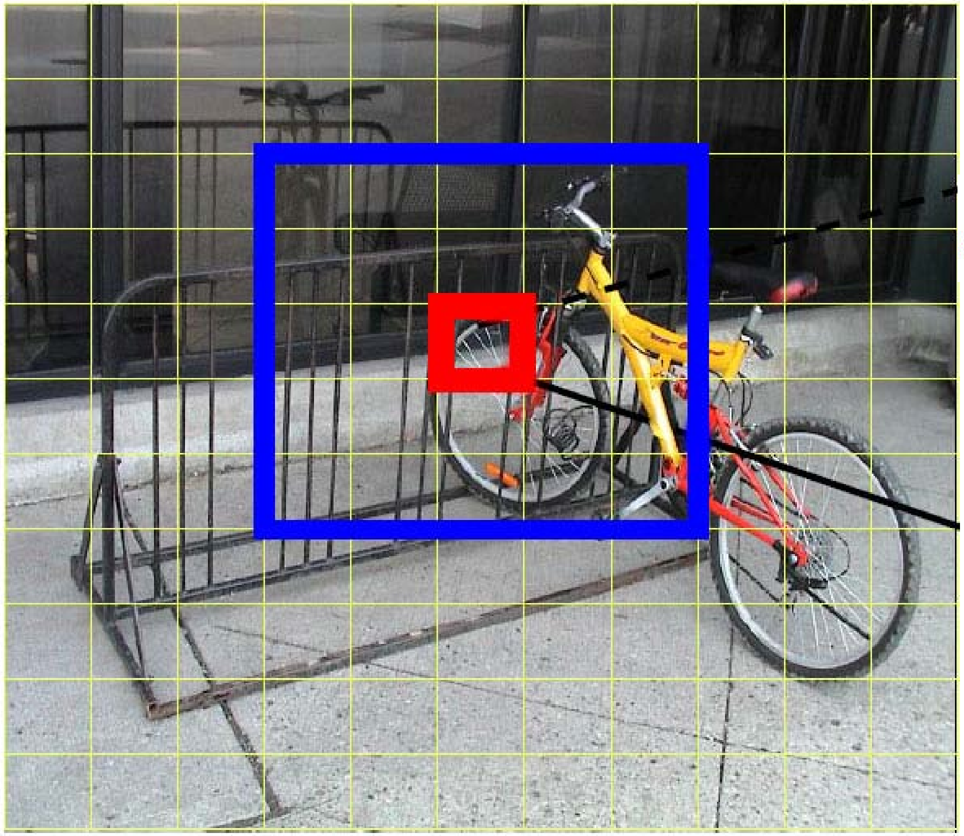
W_{ij}: Euclidean distance of patches

D_{ij}: Euclidean distance of coeff vectors

Further patches have less influence

Details

Global Saliency



$$S_g^c(\mathbf{p}_i) = P(\mathbf{p}_i)^{-1} = \left(\Pi_{j=1}^{n} P(\alpha_{ij})\right)^{-1}$$

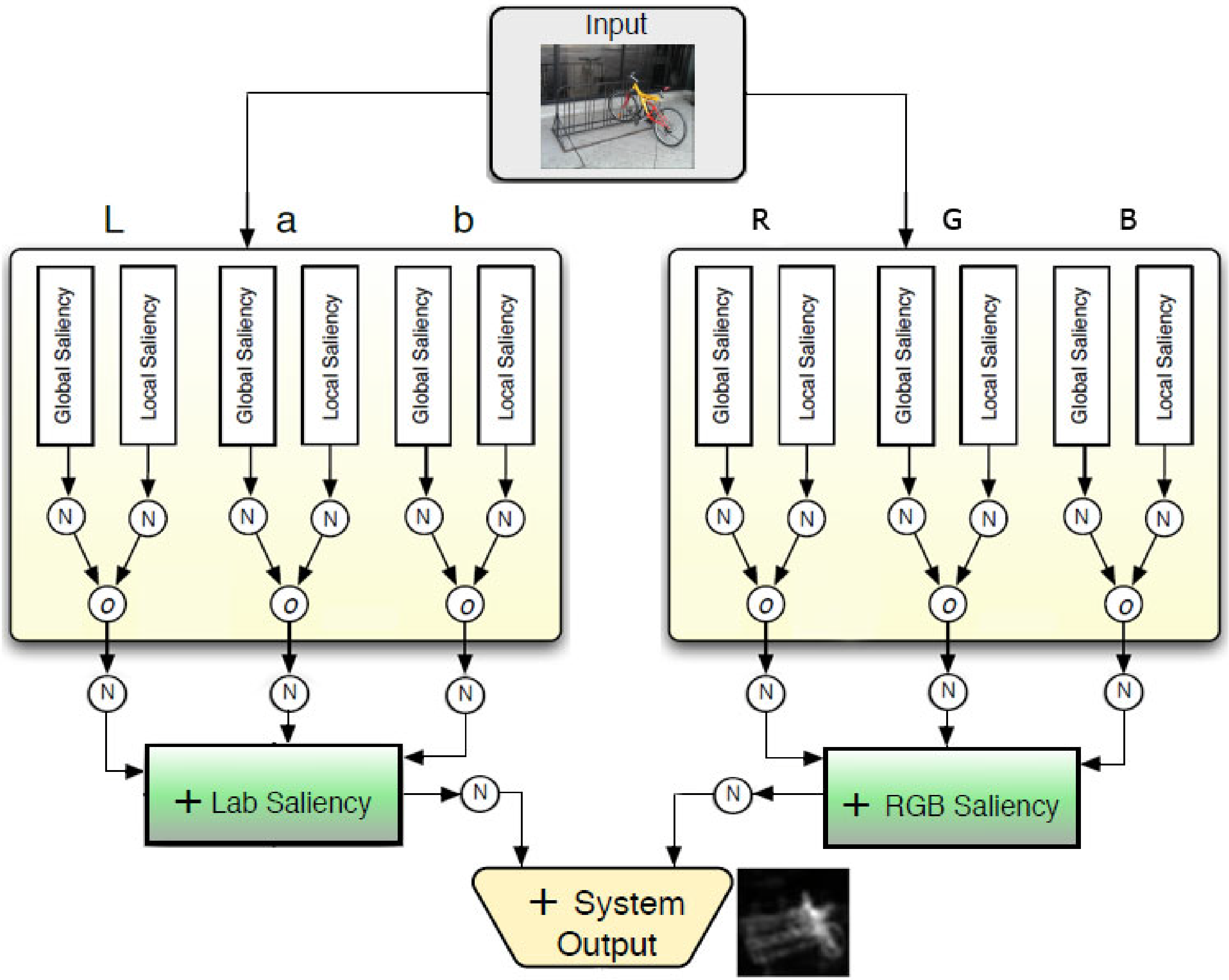
Inverse of probability of patch over scene

α_{ij}: coeff j of patch i

$P(\alpha_{ij})$: probability density function

Details

Combined Saliency



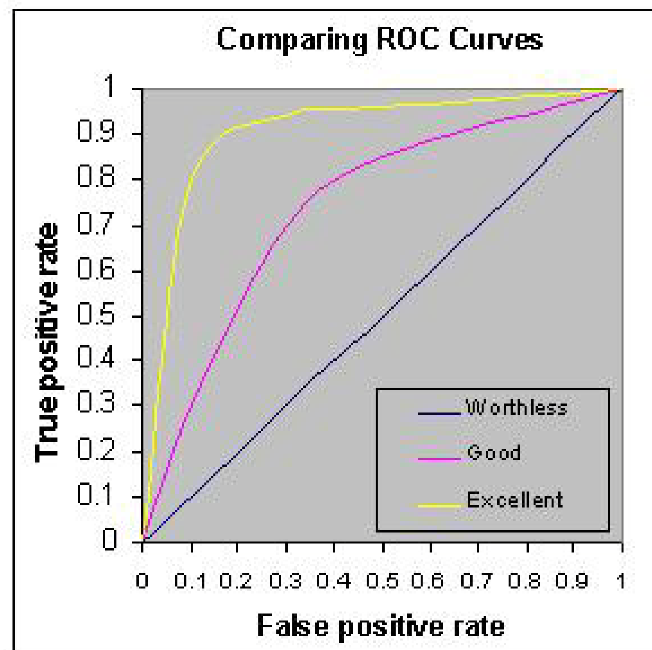
Experiments & Results

AUC (Area Under Curve) Metric

Positive Set : human selected saliency points
Negative Set : uniform random chosen points
shuffled AUC: all human fixations – positive set

Saliency Map : binary classifier

ROC Curve : threshold over map and plot true positive rate vs false positive rate



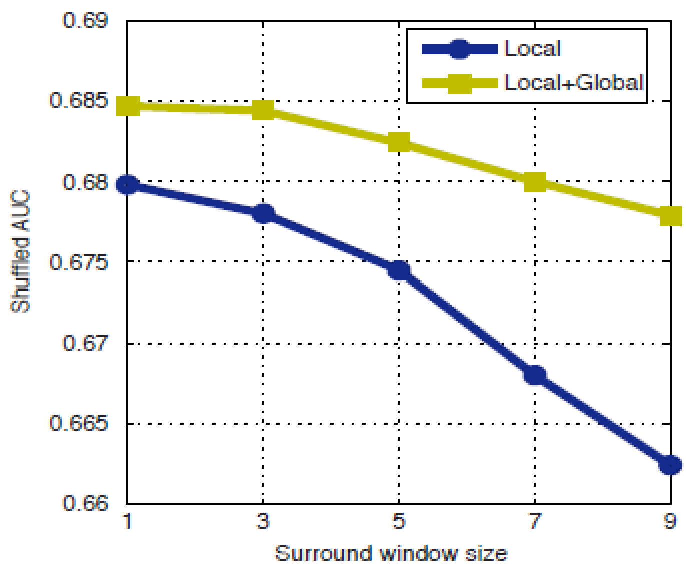
Experiments & Results

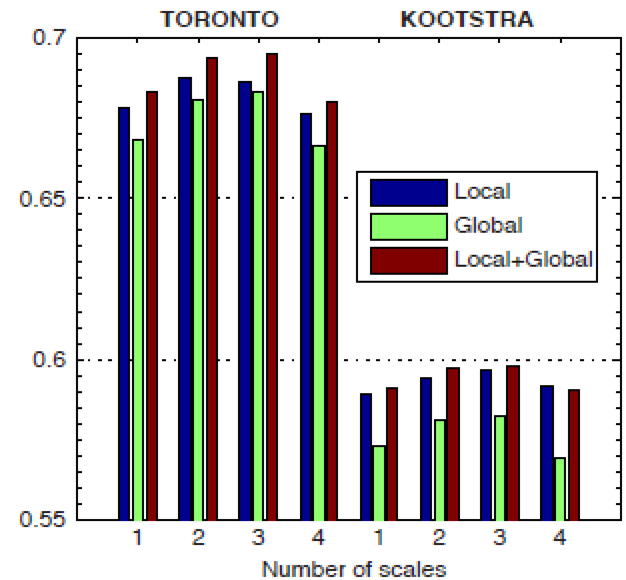
Dataset	AIM	GBVS	SRM	ICL	Itti	Judd	PQFT	SDSR	SUN	Surprise	Local S_l	Global S_g	LG S_{lg}	Gauss	IO
TORONTO	0.67	0.647	0.685	**0.691**	0.61	0.68	0.657	0.687	0.66	0.605	**0.691**	0.69	**0.696**	0.50	**0.73**
Optimal σ	0.01	0.02	0.05	0.01	0.07	0.03	0.04	0.05	0.03	0.06	0.04	0.03	0.03	-	-
MIT	0.664	0.637	0.65	**0.666**	0.61	0.658	0.65	0.646	0.649	0.62	0.653	**0.676**	**0.678**	0.50	**0.75**
Optimal σ	0.02	0.02	0.05	0.03	0.06	0.02	0.04	0.05	0.04	0.05	0.04	0.04	0.03	-	-
KOOTSTRA	0.575	0.563	0.576	0.589	0.57	0.587	0.57	**0.59**	0.55	0.566	**0.591**	0.578	**0.593**	0.50	**0.62**
Optimal σ	0.01	0.01	0.04	0.01	0.07	0.02	0.03	0.03	0.02	0.07	0.03	0.02	0.03	-	-
NUSEF	**0.623**	0.595	0.62	0.614	0.56	0.61	0.60	0.60	0.60	0.58	0.583	**0.627**	**0.632**	0.49	**0.66**
Optimal σ	0.04	0.01	0.06	0.03	0.09	0.03	0.05	0.04	0.04	0.06	0.05	0.04	0.05	-	-

Experiments & Results

Dataset	RGB			Lab			RGB + Lab		
	S_l	S_g	S_{lg}	S_l	S_g	S_{lg}	S_l	S_g	S_{lg}
TORONTO	0.646	0.647	0.653	0.670	0.660	0.660	0.678	0.668	**0.683**
MIT	0.627	0.639	0.640	0.646	0.644	0.651	0.658	0.663	**0.667**
KOOTSTRA	0.574	0.572	0.578	0.572	0.555	0.570	0.589	0.573	**0.591**
NUSEF	0.599	0.610	0.610	0.556	0.596	0.592	0.569	0.614	**0.616**

Experiments & Results





Thank You