講演番号： P4

A Fuzzy Inference Method Based on Saliency Map for Visual Attention Region Prediction

注視領域予測のための顕著性マップに基づいたファジィ推論法

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Introduction

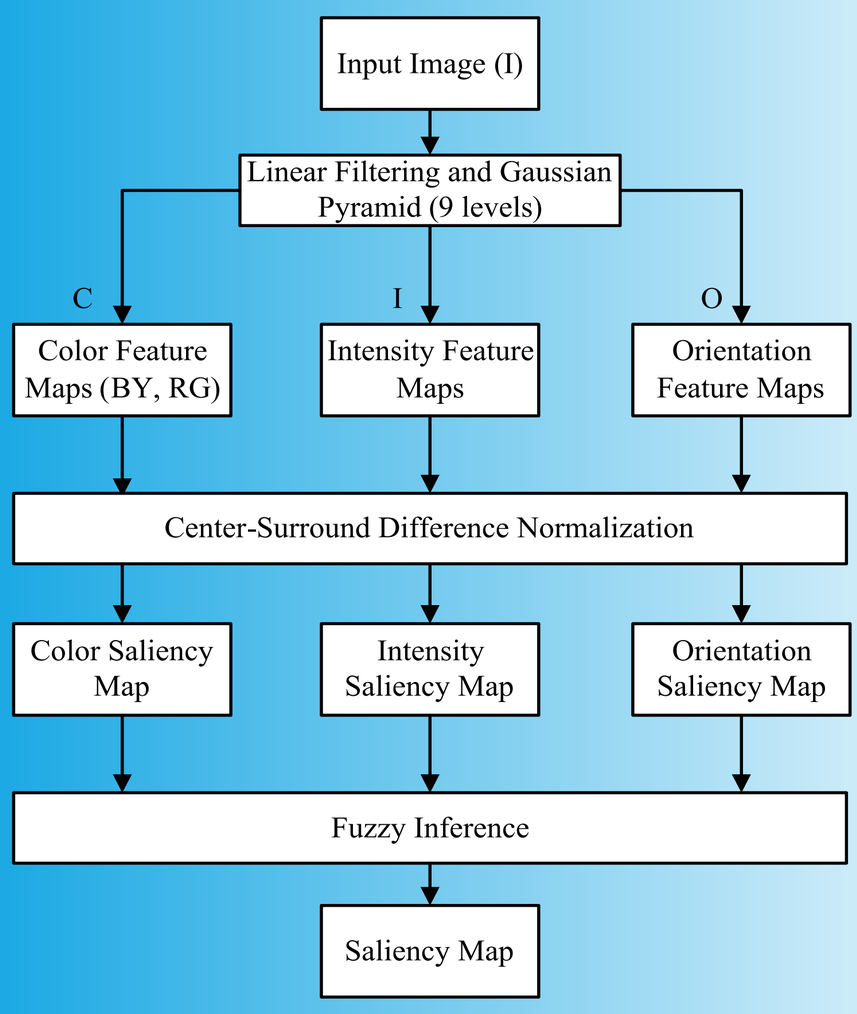
In this paper, a visual attention region prediction system inspired on saliency map is described.

The aim of this work is to present a new approach that improves the performance of attention prediction based on saliency map by using fuzzy inference.

In this research, fuzzy inference employing features of graphics as input allows us to combine features and infer with great flexibility some intuitive decision rules based on the visual perception principles.

Overall Procedure

We propose a new approach to predict visual attention region based on graphics's saliency map which got by using fuzzy inference.



Overall Procedure for Proposed System

Feature Maps

In this research, the saliency map is based on the three features of a graphics which are color, intensity and orientation[1][2].

$$M_{r-g} = \frac{r-g}{max(r,g,b)} \quad (1)$$

$$M_{b-y} = \frac{b-min(r,g)}{max(r,g,b)} \quad (2)$$

$$M_i = \frac{r+g+b}{3} \quad (3)$$

$$F_{l,c,s} = N(|M_l(c) - M_l(s)|)$$
$$l \in L = L_C \cup L_I \cup L_O \quad (4)$$

$$C_c = F_l$$
$$C_i = N(\sum_{l \in L_c} F_c)$$
$$C_o = N(\sum_{l \in L_o} F_o) \quad (5)$$

r, g, and b are the red, green, and blue values of the input color image;

M_{r-g}: red-green opponencie

M_{b-y} :blue-yellow opponencie

M_i: intensity value of graphics

$F_{l,c,s}$: centersurround receptive fields of graphics

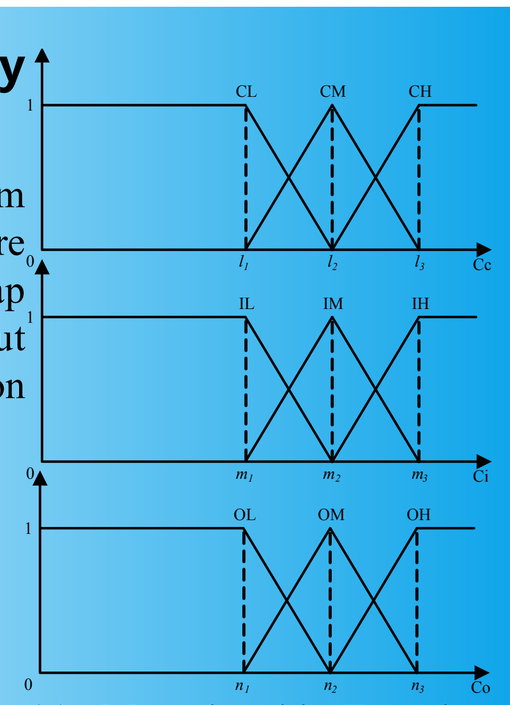
C_c, C_i, C_o: feature maps of color, intensity and orientation

Fuzzy Inference of Saliency Maps

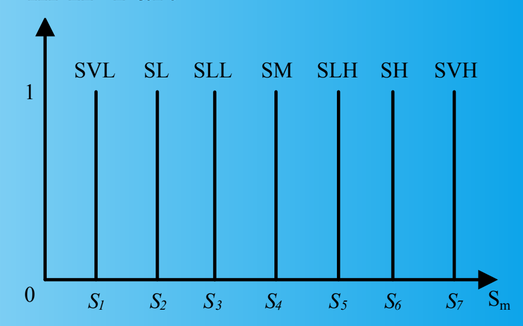
We use the feature variables from color feature map(C_c), intensity feature map(C_i) and orientation feature map (C_o) in the IF part while the output value in THEN part is value of region saliency map(S_m).

Fuzzy Inference Rules

C	I \ O	OL	OM	OH
CL	IL	SVL	SL	SLL
	IM	SL	SLL	SLL
	IH	SLL	SLL	SM
CM	IL	SL	SLL	SM
	IM	SLL	SM	SM
	IH	SM	SM	SLH
CH	IL	SM	SLH	SH
	IM	SLH	SH	SH
	IH	SH	SH	SVH



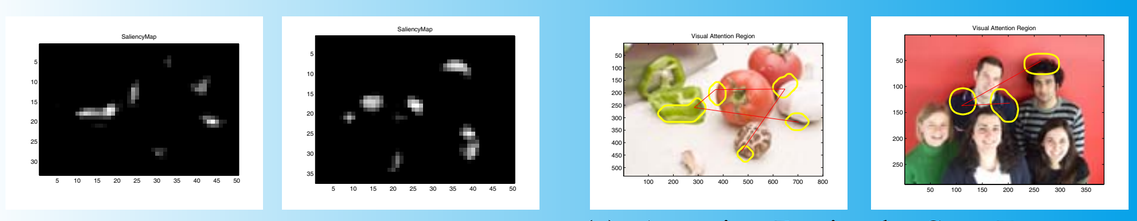
(a) Memebership Functions in IF Part



(b) Singletons in THEN Part

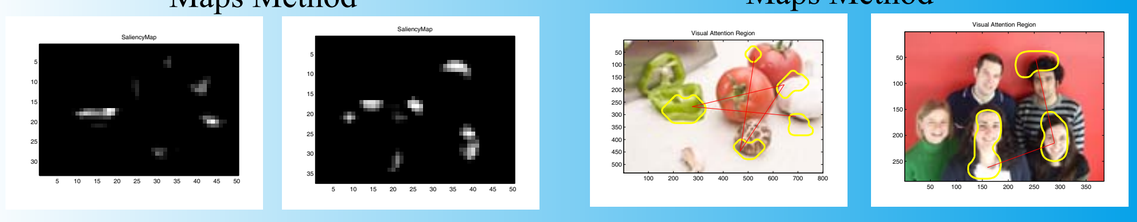
Experimental Results

After getting the feature saliency maps, the region locations in the saliency map compete for the highest saliency value by fuzzy inference



(a) Saliency Maps by Sum Feature Maps Method

(c) Attention Region by Sum Feature Maps Method



(b) Saliency Maps by Fuzzy Inference

(d) Attention Region by Fuzzy Inference

Two Examples of Feature Saliency Maps

After an experiment by asking 5 participants done an evaluation questionnaire to the effect of both two methods, we got the conclusion that our method performed better.

Conclusions

We proposed a fuzzy inference method based on color, intensity and orientation feature maps of graphics to predict the visual attention regions. We also conducted a series of attention region predict experiments.

In the future, we will work on proposing a method to get the conspicuity feature of graphics and apply to fuzzy rules.

References

[1] L. Itti, "Models of bottom-up and top-down visual attention," PhD thesis, California Institute of Technology, 2000.

[2] D. Walther, U. Rutishauser, C. Koch and P. Perona, "On the usefulness of attention for object recognition, "Workshop on Attention and Perfromance in Computational Vision, pp.96-103, 2004.