Towards Active Image Segmentation: the Foveal Bounded Irregular Pyramid

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• Introduction

• Cartesian Foveal Geometries. Foveal polygon

• Foveal representation using the Bounded Irregular Pyramid

• Segmentation and visual attention

• Experimental results

• Future work
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• **Segmentation** in computer vision is the process to divide up an image into non-overlapping and compact regions.

• **Perceptual segmentation** approaches try to divide up the image into pre-attentive objects (proto-objects) in the same way that a human does.

• **Problems:**
  
  • The accuracy of a segmentation depends on the application
  
  • What are we looking for in the image? What is the object of interest?

**Attention** provides the object of interest
In biological vision systems, attention pre-selects relevant information from the sensed field of view.

In computer vision, attention mechanisms extract the relevant information from an image by computing saliency maps.

Problems:

- Most artificial systems work at pixel resolution

**Segmentation** provides the proto-objects as the units where the attention is deployed

**Segmentation** can be modulated by attention.
Introduction: goals of the presented work

Reduce the computational load associated to the segmentation process:

• Resembling the spatial geometry of the images captured by the human retina: capturing only the region of interest at high resolution (fovea) while the rest of the scene is captured at lower resolution (periphery).

FOVEAL VISION

• Performing foveal segmentation

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Cartesian Foveal Geometries (CFG)

- Fovea-centered CFG
- Adaptive fovea CFG

- Fovea
- First ring
- Second ring
Foveal Polygon
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Foveal Bounded Irregular Pyramid

1. Levels from $l_0$ to $l_m$ with $l < \text{waist}$ are built using color information: Distance between to nodes $x_i$ and $x_j$:

$$\psi^\beta = \sqrt{(L_{x_i} - L_{x_j})^2 + \beta(a_{x_i} - a_{x_j})^2 + \beta(b_{x_i} - b_{x_j})^2}$$

2. Levels $l > \text{waist}$ are built using color and edge information: Distance between to nodes $y_i$ and $y_j$:

$$\varphi^\alpha(y_i^{(l)}, y_j^{(l)}) = \frac{d(y_i^{(l)}, y_j^{(l)})}{\alpha \cdot c_{y_i^{(l)}} y_j^{(l)} + \min(b_{y_i^{(l)}}, b_{y_j^{(l)}} - c_{y_i^{(l)}} y_j^{(l)})}$$

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Segmentation and visual attention

Foveal image acquisition

Foveal segmentation

ROI Selection

Saliency computation
Segmentation and visual attention

Foveal image acquisition → Foveal segmentation → ROI Selection → Saliency computation → t+1
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• Future work
• Bounded Irregular Pyramid with dual graph
• Evaluation with the attention mechanism presented in:

Merging attention and segmentation: active foveal image representation

Thanks!
Any questions?