Evaluating Context-Aware Saliency Detection Method

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Vision Research Lab

Funding: Office of Naval Research
Defense University Research
Instrumentation Program

What is Visual Saliency?

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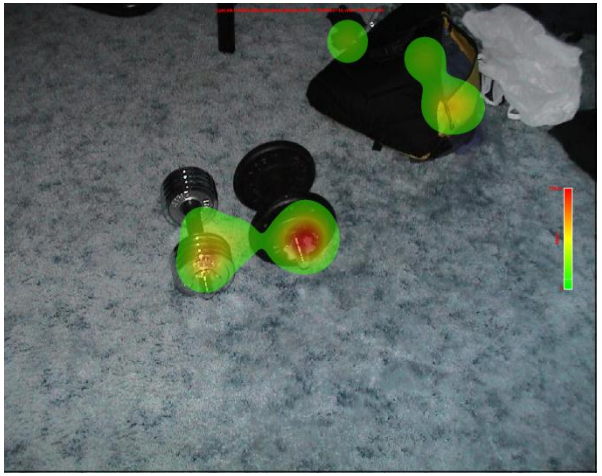
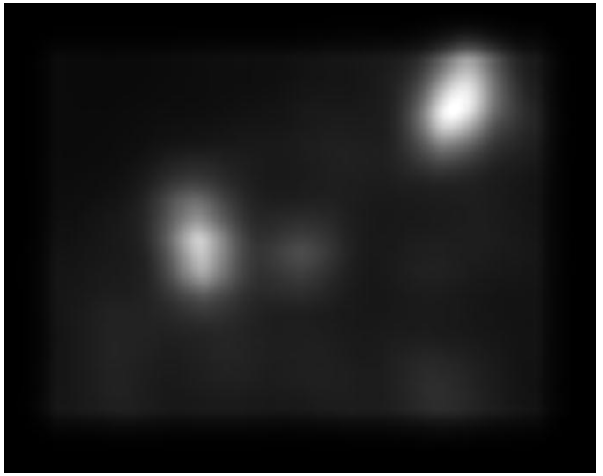
- Mimic human perception

Original Image



Human Fixations



Bruce et al.

Learning gaze patterns by tracking eye movement

- Using EyeLink1000 as a tool
  - High Speed Infrared Camera
  - Illuminator

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- Potential applications
  - Image Segmentation
  - Image Retargeting
  - Image Search & Retrieval

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Looking at the context of an image

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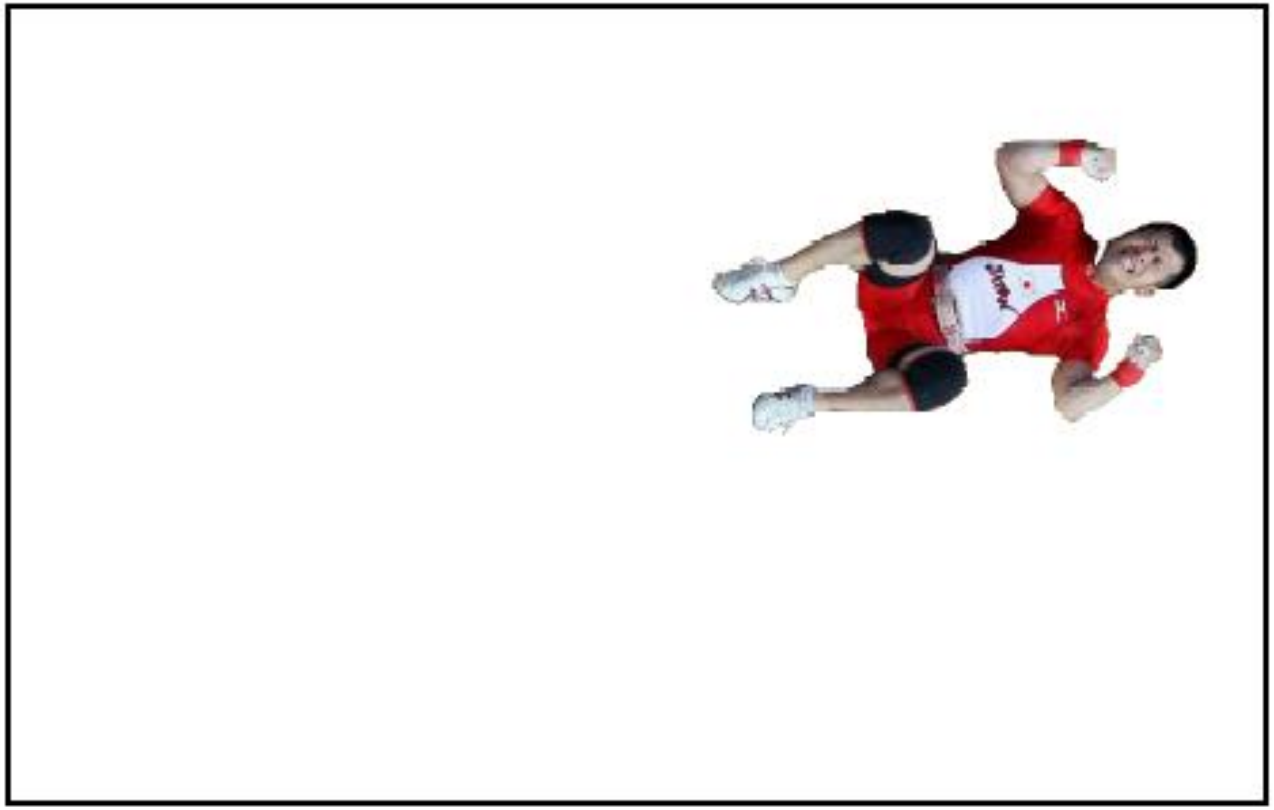
- Sometimes looking just dominant object is not enough.

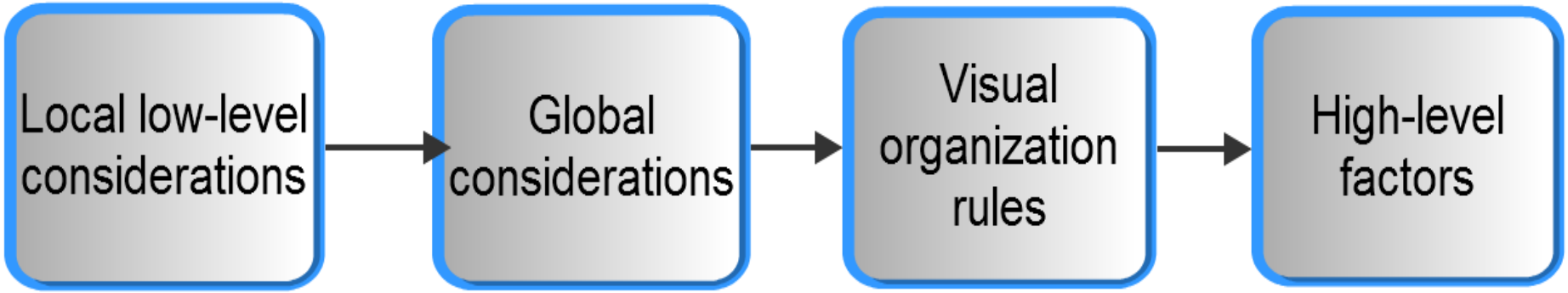


Looking at the context of an image

- Sometimes looking just dominant object is not enough.
- Context-Aware Saliency - Extract salient object with its surroundings that add meaning to image.

Context-Aware Saliency Detection

- 4 basic principles of human visual attention



[Goferman et al.]

Context-Aware Saliency Detection

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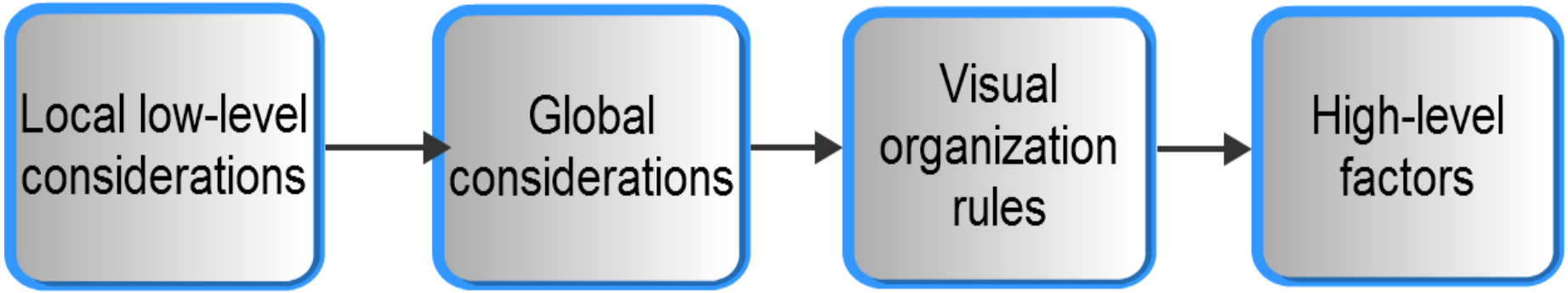

- Use eye tracker to evaluate algorithm
  - What do people look at to determine the scenario of image?

[Goferman et al.]

Context-Aware Saliency Detection

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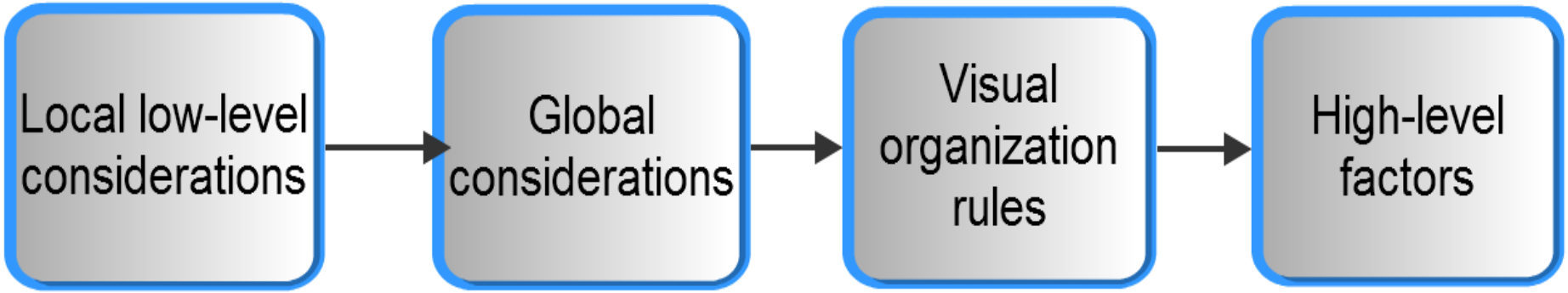


- Use eye tracker to evaluate algorithm
  - What do people look at to determine the scenario of image?
  - Viewing Time
  - Categories

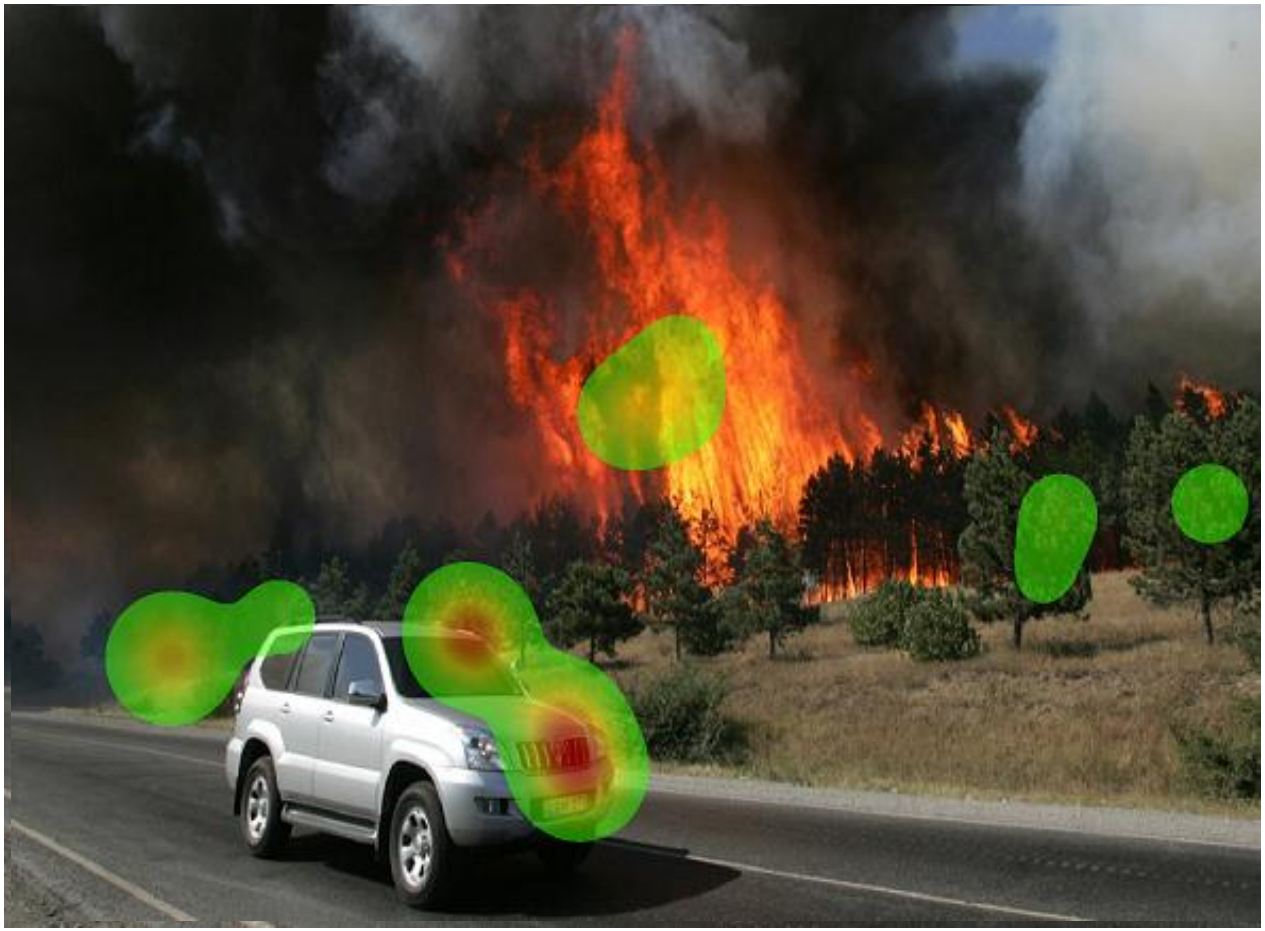
[Goferman et al.]

The effects in lengths of time

2 Seconds

The effects in lengths of time

- In depth analysis
  - Dominant object
  - Surroundings



5 Seconds

How categories affects how you look

- Sports
  - Person(s) participating
  - Sports equipment

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Insight from preliminary experiments

- Need to give test participants a specific task
  - People aimlessly search images when given no task.
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- Need to give test participants a specific task
  - People aimlessly search images when given no task.
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- Time constraints
  - 4 seconds

Experimental Process

- 60 images from various categories shown for 4 seconds to each of the 17 viewers.

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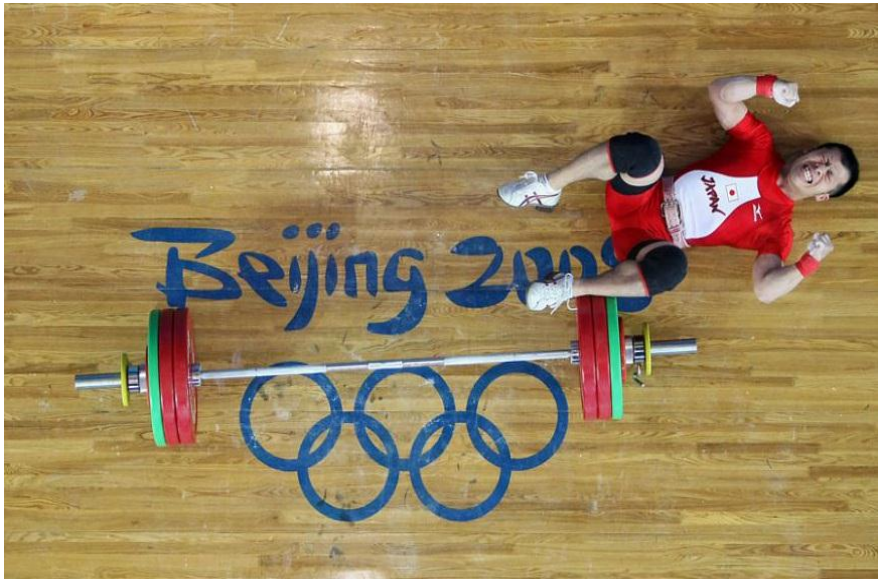
- Task: Look at the parts that best describe the image and give brief description of scene.
- Goal: Evaluate Context-Aware Saliency and create a data set that can provide ground truth data.

Categories of Results

- Algorithm matches human perception
- Algorithm partially matches human perception
- Algorithm does not match human perception

Algorithm matches human perception

- Image has simple background
- Salient portion(s) have distinct differences in color and/or texture



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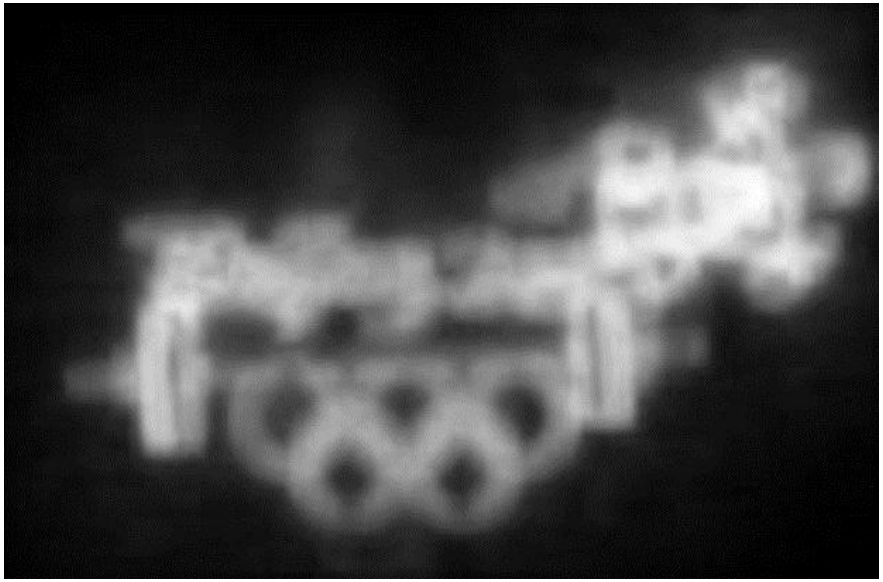
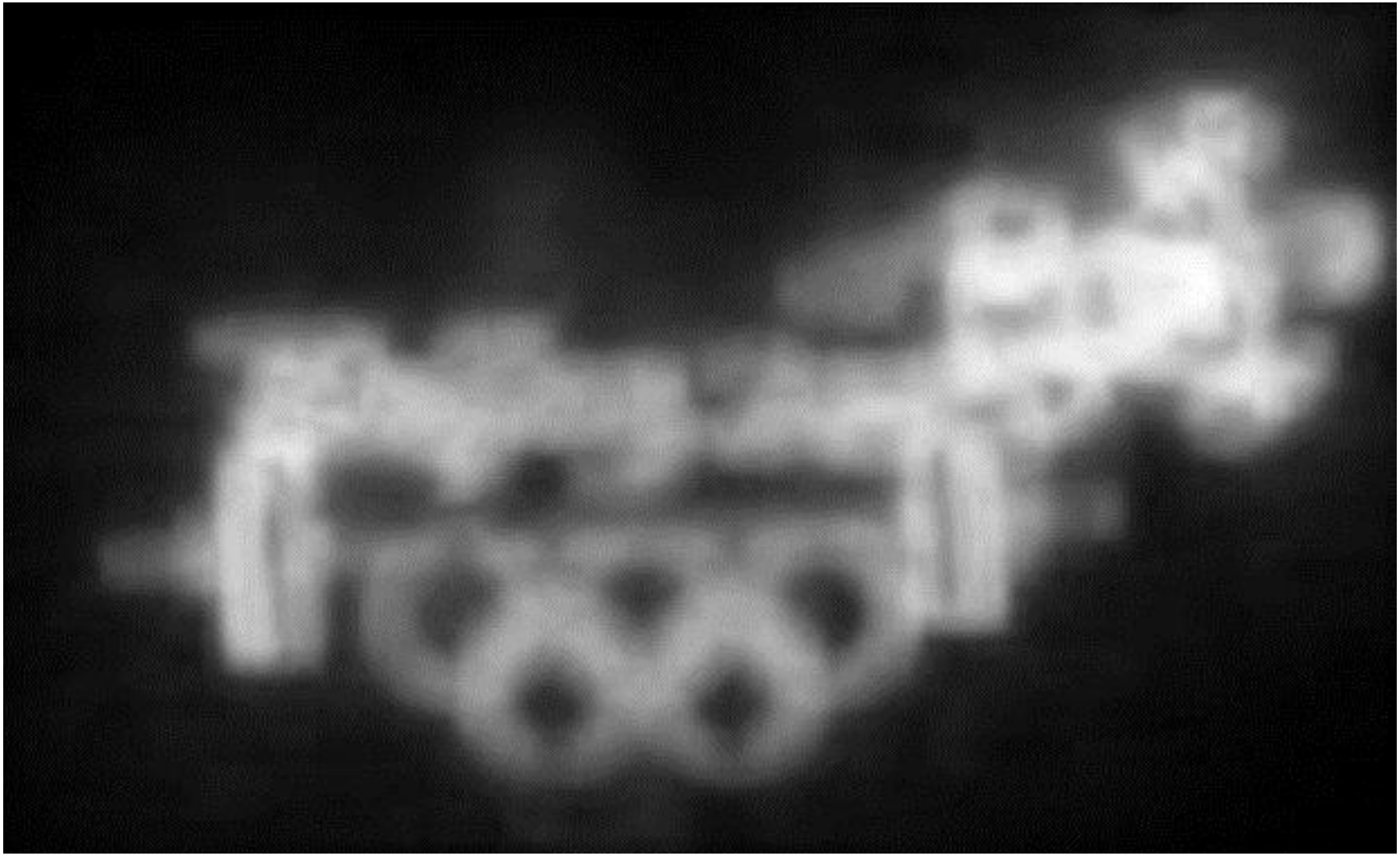


Context-Aware Saliency Algorithm

Experiment Results

Matching human perception



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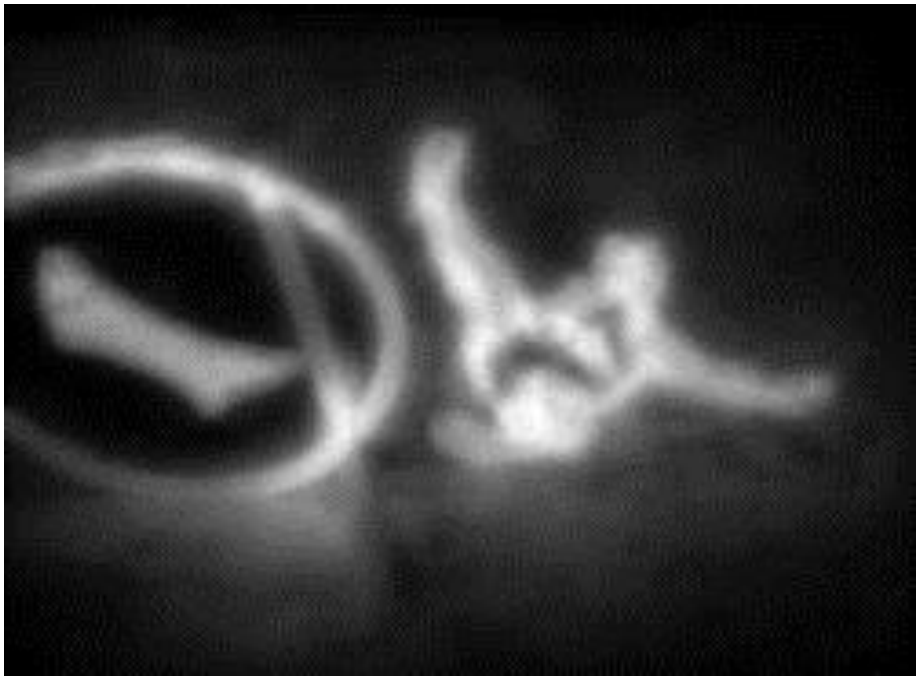


Algorithm misses part of the salient portion

- Image has simple foreground
  - People look more at high level features like faces
  - The salient portion could be a similar color and/or texture as its surroundings

Original Image

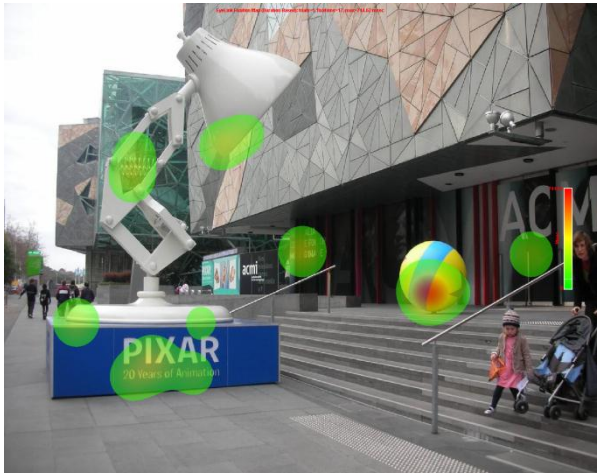
Context-Aware Saliency Algorithm

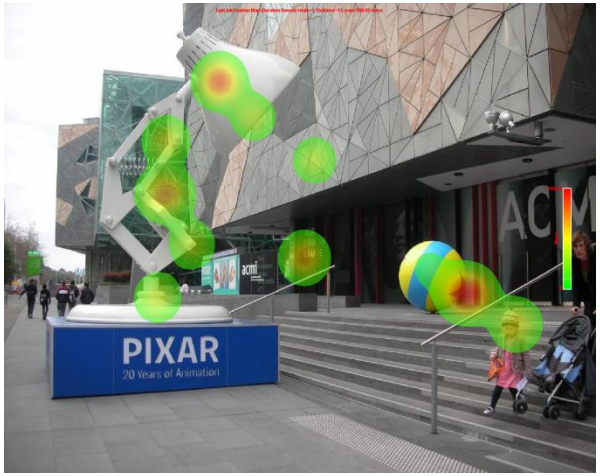
Experiment Results

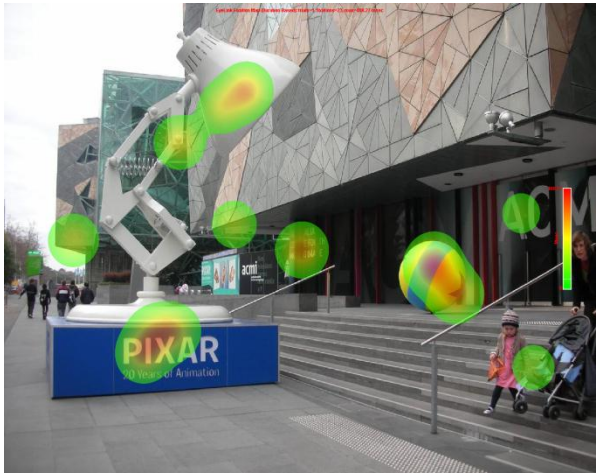
Partially matching human perception

Partially matching human perception

Partially matching human perception



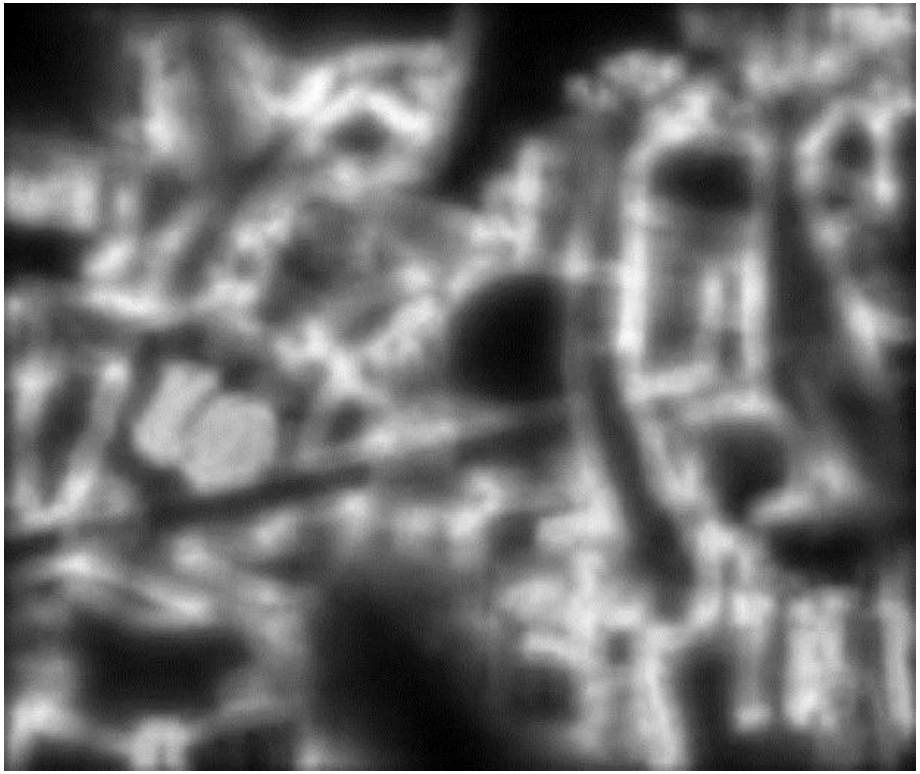




Algorithm differs from human perception

- The image is very busy
- The dominant object is not obvious

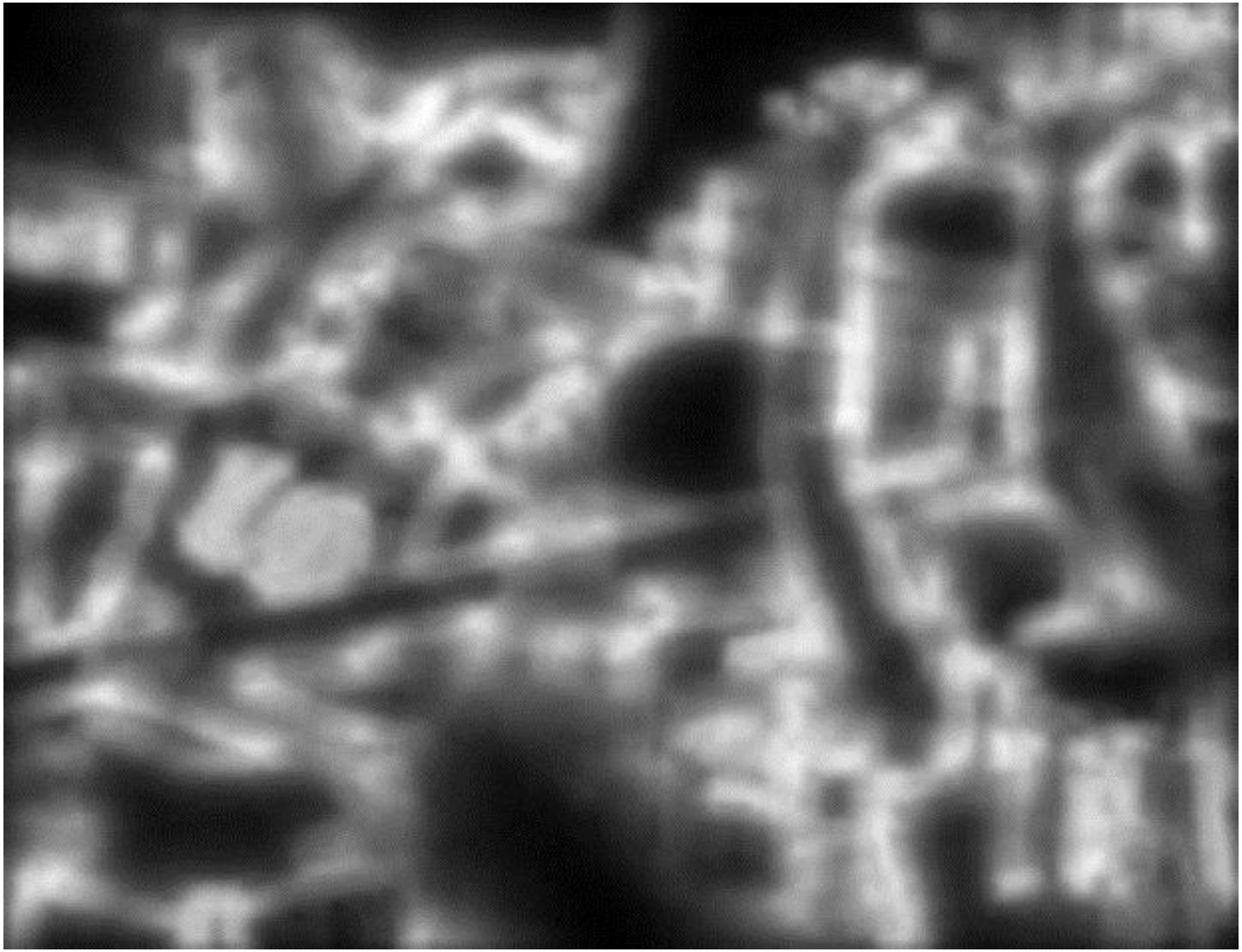
Original Image



Context-Aware Saliency Algorithm

Experiment Results

Contrasting human perception



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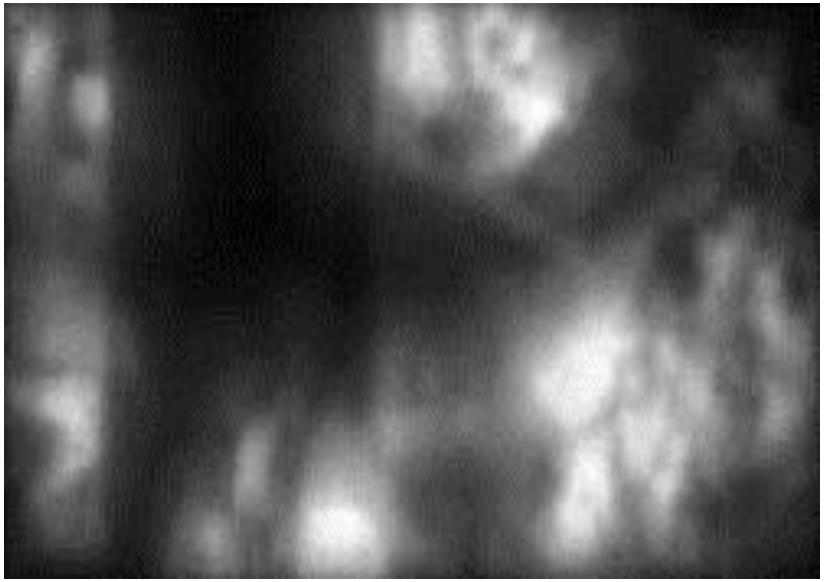

Conclusion and Future Plans

- Match to human perception
  - Simple background and distinct foreground
- Partial match to human perception
  - Plain foreground with more complex background
- Contrast to human perception
  - Busy image
  - Unclear main object

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  - Unclear main object
- Effects of...
  - Blurring and noise in image
  - People's prior knowledge/background

References

[1] Stas Goferman, Lihi Zelnik-Manor, and Ayellet Tal, "Context-Aware Saliency Detection", IEEE International Conference on Computer Vision and Pattern Recognition, 2010

[2] Wei Wang1,3,4, Yizhou Wang1,2, Qingming Huang1,4, Wen Gao, “Measuring Visual Saliency by Site Entropy Rate”, IEEE International Conference on Computer Vision and Pattern Recognition, 2010

[3] L. Itti, C. Koch, and E. Niebur. A model of saliency based visual attention for rapid scene analysis. IEEE TPAMI, 1998

[4] N.D. Bruce and J. Tsotsos. Saliency based on information maximization. NIPS, 2006

[5] J. Harel, C. Koch, and P. Perona. Graph-based visual saliency. NIPS, 2006

[6] X. Hou and L. Zhang. Dynamic visual attention: searching for coding length increments. NIPS, 2008

Acknowledgements

- INSET
- Prof. Manjunath
- Jiejun Xu & Zefeng Ni
- Vision Research Lab
- Volunteers for my experiment
- Professors, Family, & Friends