Egocentric Computer Vision

Progress Presentation

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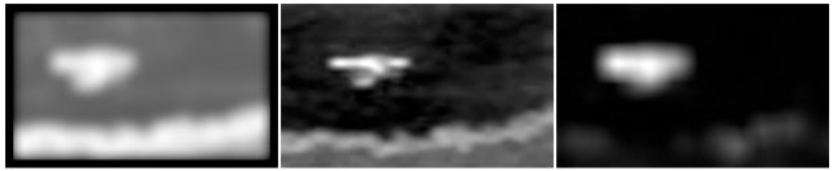
Outline

- Idea
- Final Project State
- Implemented Saliency Models
- Results
- Further Work

Idea

- Saliency maps in egocentric setting
- evaluate saliency prediction models in egocentric setting
- egocentric vs. non-egocentric saliency prediction

(a)



http://cs-people.bu.edu/jmzhang/BMS/BMS_iccv13_preprint.pdf

Final State - saliency models

PERCEPTUAL USER INTERFACES

- Working saliency prediction model
  - BMS
  - RARE
  - SCIA
  - SWD
  - GBVS
- Top ranked models from MIT Bechnmark
- 6 Videos (3 Viewers)
  - → around 1500 images with gazing data

Final State - Evaluation Software

PERCEPTUAL USER INTERFACES

- Software Framework
  - command line software
  - easy to extract images from videos

```
./saliencyEstimator -extract <video_folder_1> <video_folder_3> <video_folder_3> ...
```

  - easy to evaluate a model

```
./saliencyEstimator -nss <saliencyMap_folder_1> <fixation_data_1> <saliencyMap_folder_1> <fixation_data_2>
...
```

  - Matlab code to produce saliency models (http://saliency.mit.edu/)

Evaluation - NSS Value

PERCEPTUAL USER INTERFACES

- Different metrics to evaluate the saliency map quality
  - Receiver Operating Characteristic, Earth Mover's Distance, Similarity
  - Not applicable in egocentric setting

- → NSS (Normalized Scanpath Saliency)
  - Available data: Saliency map for video frame $\mathbf{M}_i$ & corresponding fixation data $\mathbf{F}_i$
  - standardize M_i (zero mean & unit standard deviation)

$$Z_{SM}(x) = \frac{SM(x) - \mu}{\sigma}$$

where Z_{SM} is the standardized saliency map and

$$\mu = \frac{1}{|I|} \sum_{t \in I} SM(x_t)$$

$$\sigma = \sqrt{\frac{1}{|I|} \sum_{t \in I} (SM(x_t) - \mu)^2}$$

(Olivier Le Meur & Thierry Baccino - Behavior Research Methods)

Saliency Model - BMS

Saliency Model - SCIA

PERCEPTUAL USER INTERFACES

- Bayesian Model
- Multi-scale measurement
- Need prior to get good estimation

Model - Spatially Weighted Dissimilarity Saliency (SWD)

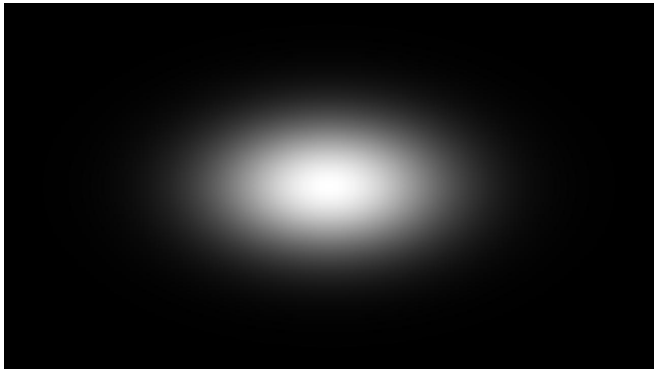
- Feature: Principal Component
- measurement
  - dissimilarity
  - spatial distance

Saliency Model - GBVS

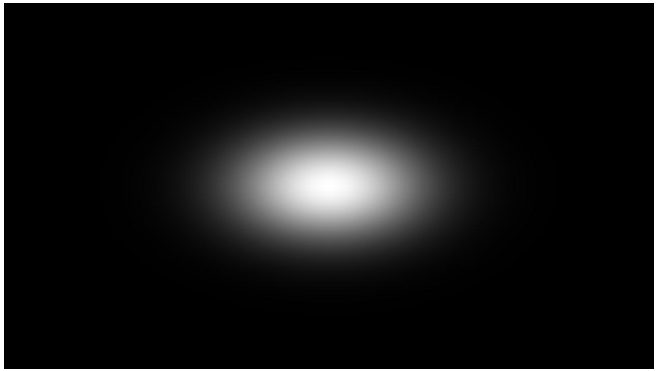
Saliency Model - RARE

PERCEPTUAL USER INTERFACES

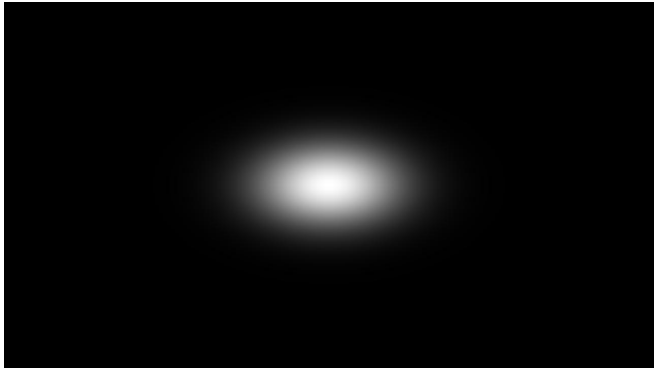
Baseline - centric



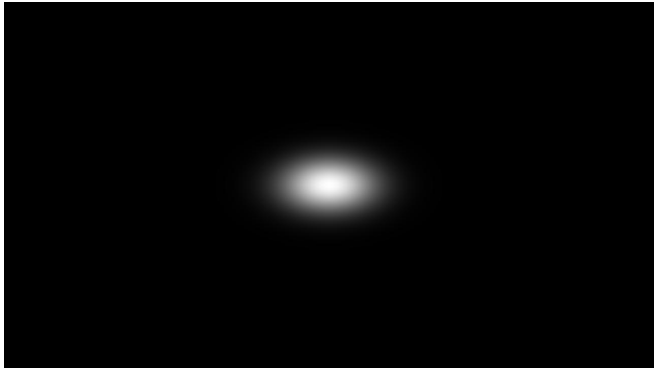
sigma = 90



sigma = 72

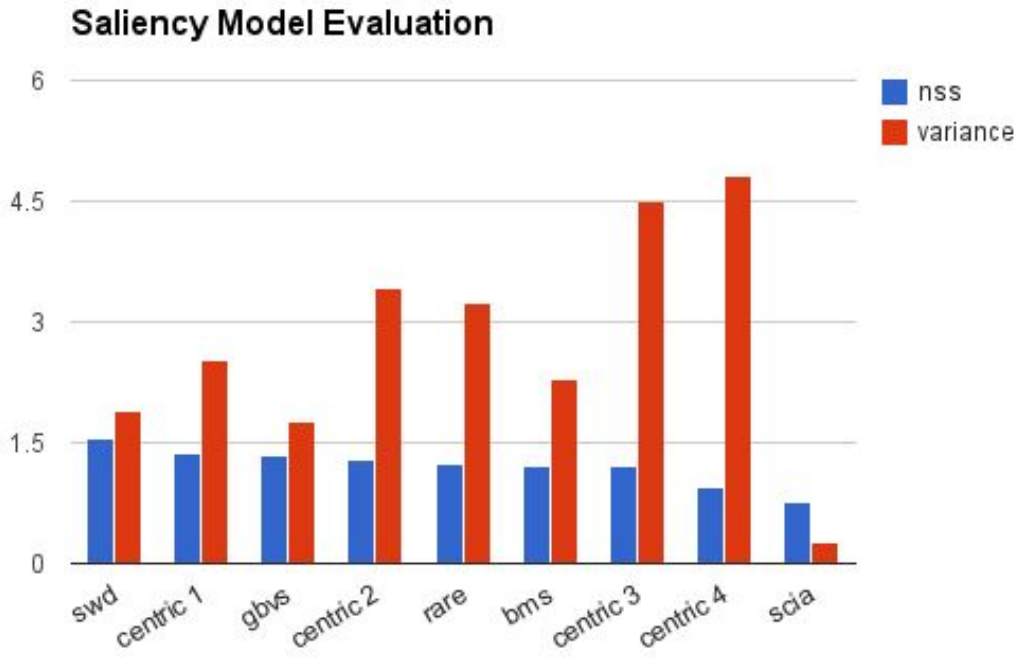


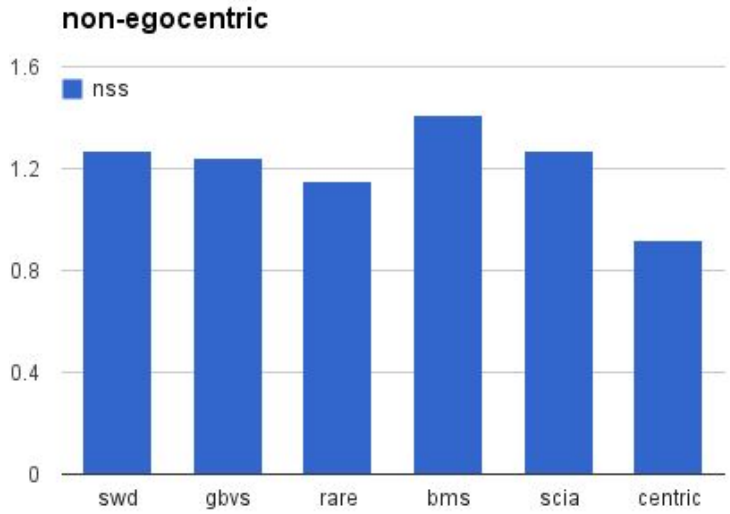
sigma = 55



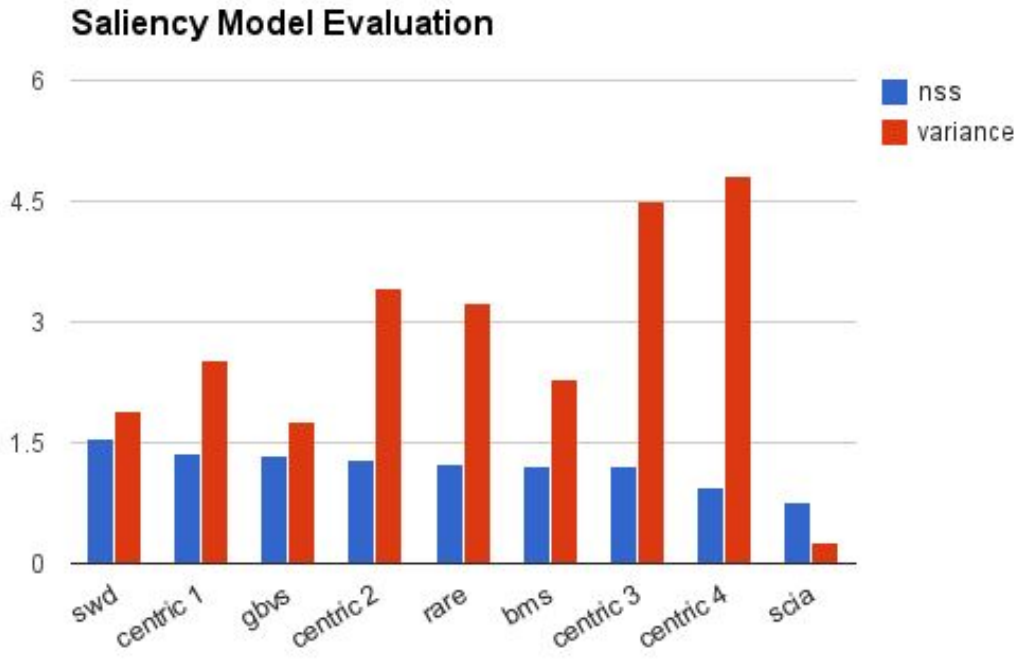
sigma = 36

Results


Saliency Model Evaluation
6
4.5
3
1.5
0
nss
variance
swd
centric 1
gbvs
centric 2
rare
bms
centric 3
centric 4
scia


non-egocentric
1.6
1.2
0.8
0.4
0
nss
swd
gbvs
rare
bms
scia
centric

Results



- users turns his head instead of moving his eyes
- → user mostly looks at the center

Further Work

- Record more data
  - more robust testing

- Build a whole eco-system for Benchmarking saliency models in egocentric setting
  - similar to MIT
  - matlab template file

Reference

- Saliency detection: a boolean map approach[ICCV2013]
- Fast and efficient saliency detection using sparse sampling and kernel density estimation [Image Analysis 2011]
- Visual Saliency Detection by Spatially Weighted Dissimilarity[CVPR2011]
- Graph-Based Visual Saliency [NIPS 2006]
- RARE2012: A multi-scale rarity-based saliency detection with its comparative statistical analysis