1. Outline - Contributions

- Novel interpretation of Bayesian surprise in spatial domain, to account for saliency due to contrast with context
- Extension of visual attention model through the use of surprise values instead of raw feature maps
- Consistent interpretation of location and scale selection in region detection by using surprise as a saliency measure
- Validation of proposed extensions on different datasets
- Application to image quality assessment and experimental evaluation of different spatial pooling strategies

2. Bayesian surprise

- Surprise (Itti and Baldi, 2009): Kullback-Leibler divergence
- Prior model (from previous experience)
- Posterior model (updated after observing event)
- Spatial surprise from an image region: spatial pooling based on visual importance
- Extension of visual attention model through the use of surprise values instead of raw feature maps
- Maximum of patch saliency
- Scale saliency: total variation distance between scales

3. Visual attention

- Extension of attention model of (Itti and Koch, 2000)
- Independence assumption
- Similarity between estimated and ground-truth saliency maps:
  - correlation
  - normalized grayscale Hausdorff distance
- Also, overlap between produced fixations
- Validation on two datasets:
  - mouse-tracking data
  - eye-tracking data (Mancas, 2007)

4. Example and comparison

- Salient region detector (Kadir and Brady, 2001)
- Use saliency to improve quality metrics (Ninassi, et al., 2007)
- Account for saliency due to contrast with context

5. Validation

- Similarity between estimated and ground-truth saliency maps:
  - correlation
  - normalized grayscale Hausdorff distance
  - Also, overlap between produced fixations
- Validation on two datasets:
  - mouse-tracking data
  - eye-tracking data (Mancas, 2007)

6. Region detection

- Salient region detector (Kadir and Brady, 2001)
- Spatial saliency: entropy at each location
  \[ N_f(x, y, z) = \sum P(i) \log \frac{P(i)}{P_{0}(i)} \]
- Scale saliency: total variation distance between scales
  \[ W_2(x, y, z) = \sum \left| P(i|x) - P_{0}(i) \right| \]
- Replace spatial saliency with surprise
  \[ S_f(x, y, z) = \sum \frac{P(i|x) - P_{0}(i)}{P_{0}(i)} \]
- Both saliency terms are distance measures

7. Comparison

- Surprise favors centers of homogeneous regions
- Surprise makes regions sensitive to context

8. Validation

- Repeatability under transformations (Mikolajczyk, et al., 2005)
- Correlation 1-Hausdorff overlap
- Mean-square error
- Normalized grayscale Hausdorff distance

9. Image quality assessment

- Use saliency to improve quality metrics (Ninassi, et al., 2007)
- Spatial pooling based on visual importance:
  - average of patch saliency
  - maximum of patch saliency
- Weighting fixed regions (Moonfly and Bovik, 2009)
- Indirect validation of saliency algorithms

10. Validation

- Use saliency maps with SISM (Wang, et al., 2004)
- Comparison with DMOS values (LIVE dataset, Sheikh, et al., 2006) after logistic regression:
  - Correlation
  - Mean-square error

Relevant work


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For further information

More information can be found at http://cvsp.cs.ntua.gr/research/surprise/