Visual Search using Principal Component Analysis

EE381K Multidimensional Digital Signal Processing- FALL 2000

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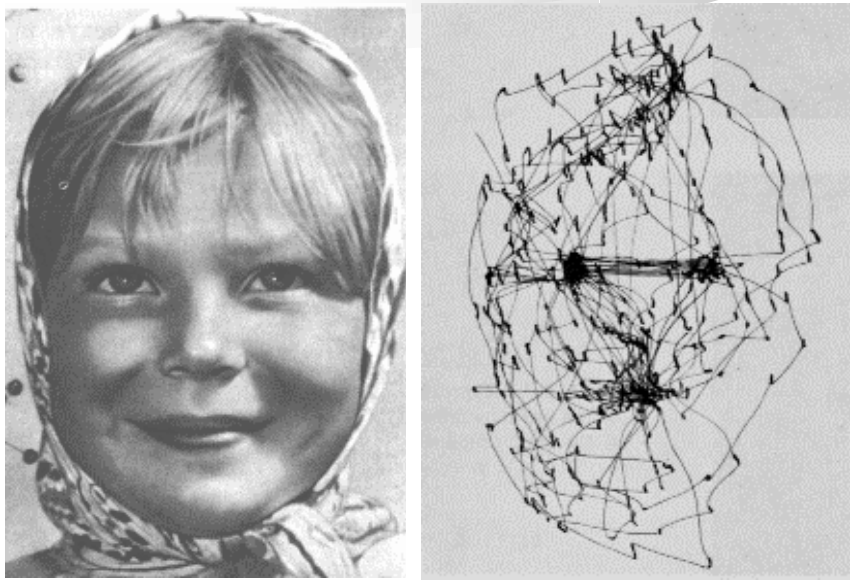
Motivation

- Retinal sampling
- Fixations and saccades
- Compression
- Can we find the area of interest?



Finding Area of Interest

- Y matrix analysis [Privitera et al 2000]
  - same picture, different subjects = 54%
- Eye tracking
- Models
  - Algorithmic ROI (Privitera et al 2000)
  - Saliency model (Henderson 1999)
  - Probability models(Klarquist et al 1998)

AOI using Visual search

- Track the eye under a “target search” constraint
- Fixations of subject are recorded
- Analyze similarity between fixation regions and target
- Analysis - edges, wavelet coefficients….

Principal Component Analysis

- Eigen faces [Turk 1991] for face recognition
- Singular Value Decomposition
  - Principal vectors for shape
  - Principal values for gain



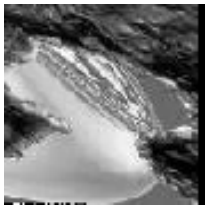
SVD analysis

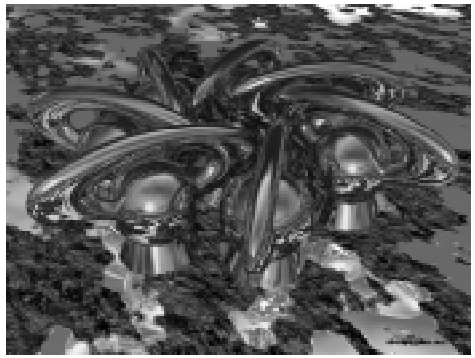
- Extract SVD values for target and each fixation region
- Normalize the values of the region with that of the target
- Recreate normalized region
- SVD index = $\Sigma\Sigma|\text{target} - \text{region}|$

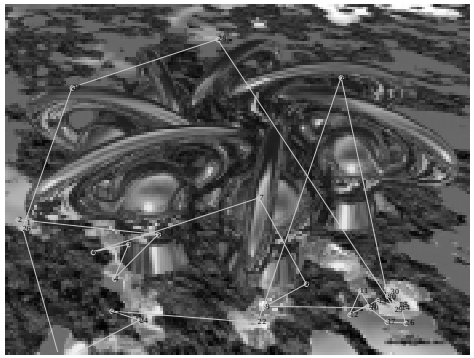
Experimental setup

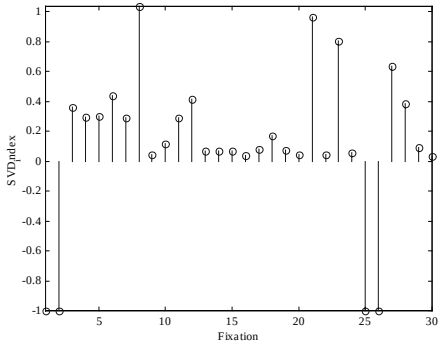
- Subjects asked to search for target quickly
  - Images 1024*760, Target 100*100
- Abstract images - no cognition factor
- Data recorded with remote eye tracker
- Analysis of eye scan path using MATLAB and eye tracker software

Results-1









Conclusions and Future Work

- Conclusions
  - SVD is a proposed as a “search” tool
  - Eye seems to search for regions with “target-like” SVD
- Future Work
  - Generation of a probability map using SVD and compare with eye tracker data
  - Predict fixation sequence using dynamic probability model