WAVELET BASED NONLINEAR SEPARATION OF IMAGES

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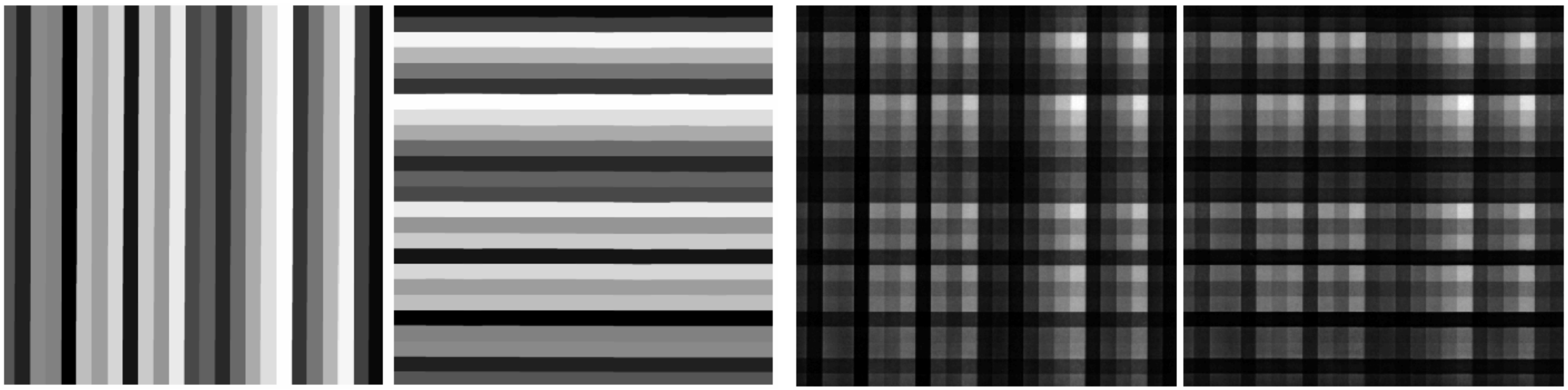
Outline

- Nonlinear mixture of images
- Separation method
- Results
- Conclusions

Mixing problem

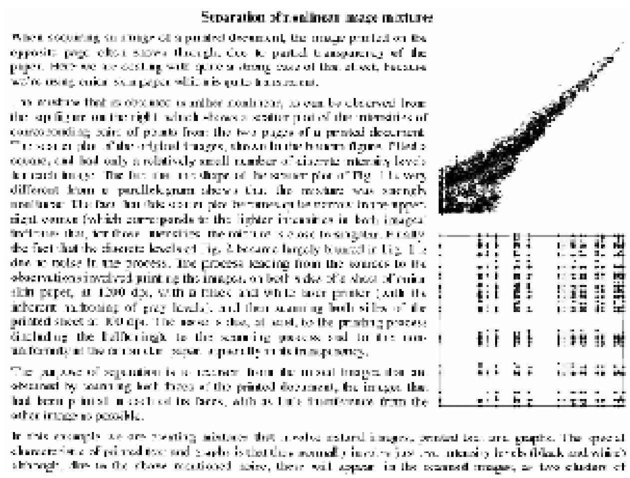


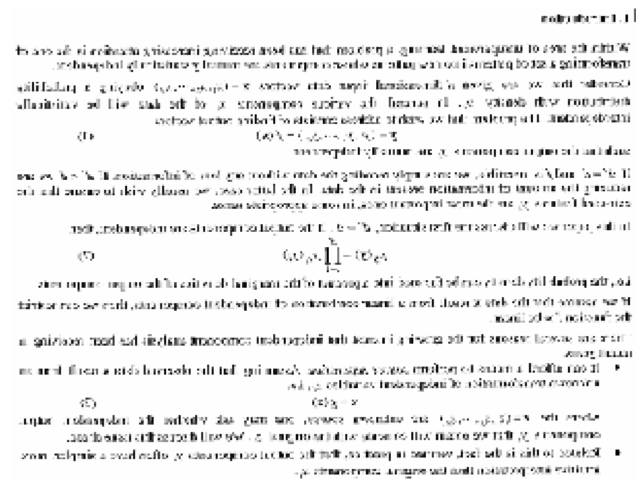
Sources Mixtures

- Mixture of the front- and back-page images of a document when acquired with a scanner
- The mixture is nonlinear and noisy
- Five different pairs of mixtures were studied.

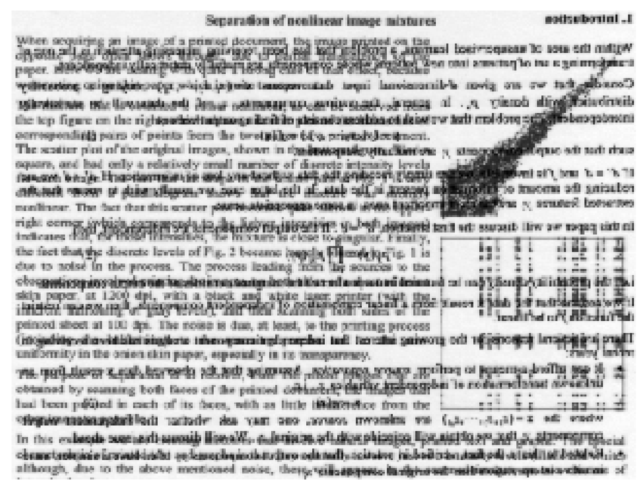
Mixing problem

Mixing problem


Separation of nonlinear image mixtures

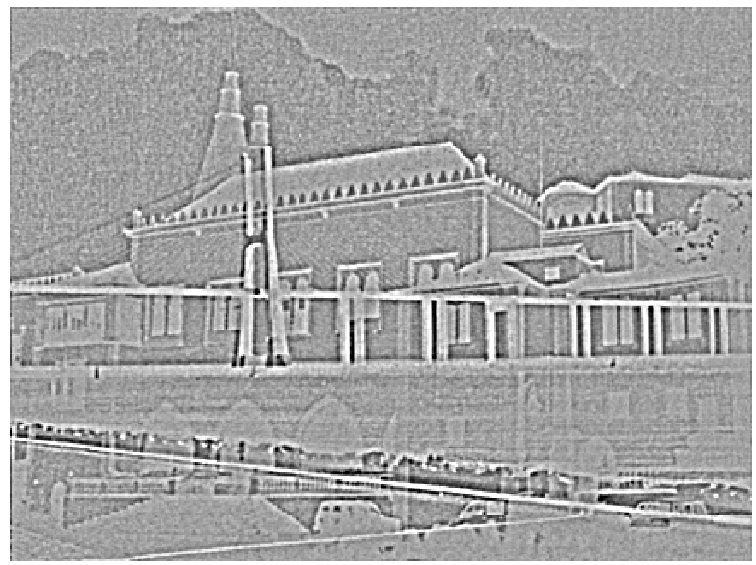



Separation of nonlinear image mixtures


Separation of nonlinear image mixtures

Separation method - motivation

- Image edges are sparse
- Almost no superposition between edges of two different images
- In each mixture one of the sources (and its edges) is more intense than the other

High frequencies of a pair of mixture images

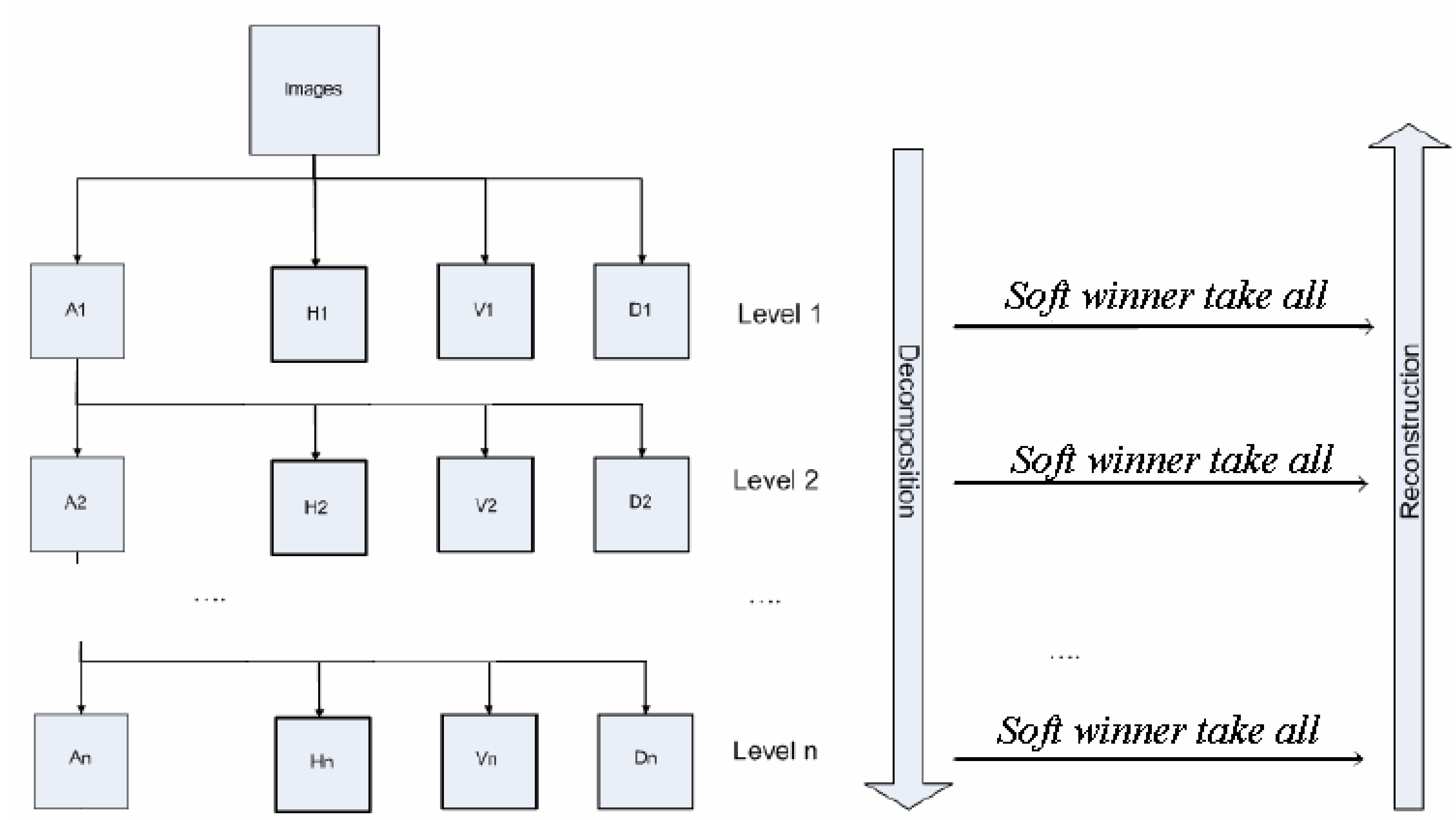
Separation method - motivation

High frequencies after a *soft winner take all* operation

Edges are almost completely separated

Separation method

- *Soft winner take all* is applied to high frequency wavelet coefficients



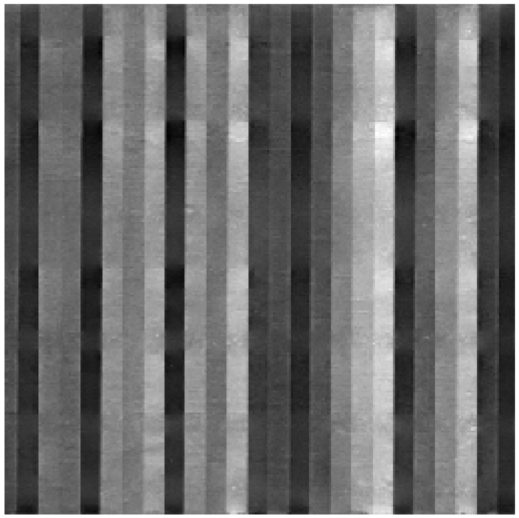
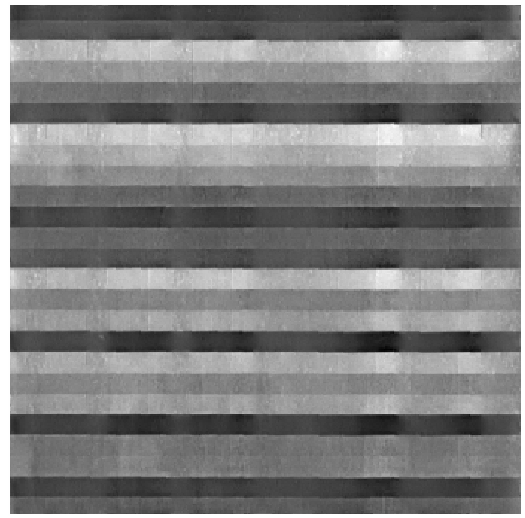
Separation method

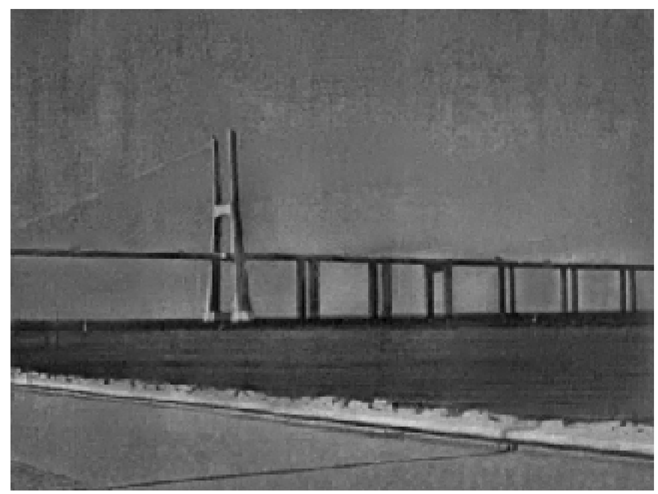
- Two different wavelets were considered
  - Complex wavelet transform (faster processing)
    - Almost shift-invariant
    - Relatively large support wavelets
  - Stationary wavelet transform (better results)
    - Shift-invariant
    - Small support wavelets (“Haar”)
- A linear pre-processing “decorrelates” the data

Experiments

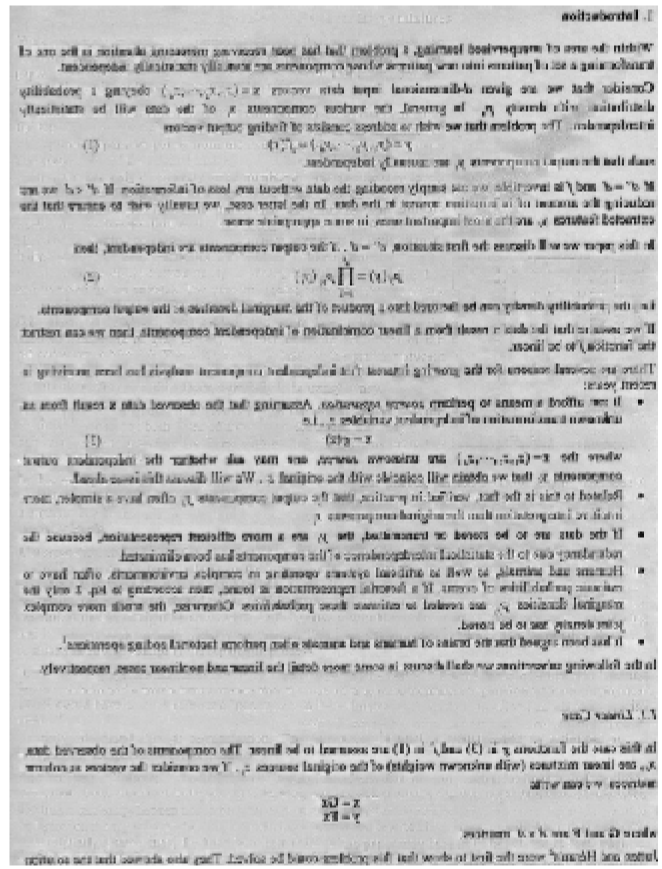
- Best results (from visual evaluation)
  - Shift-invariant “Haar” wavelets
  - Linear preprocessing of the mixtures (decorrelation)
  - 7 wavelet decomposition levels (image size 400x400)
  - 8 wavelet decomposition levels (image size 800x800)

Results (1)



Results (2)



Conclusions

- Method for separating a real-life nonlinear mixture of images
- Non-iterative and fast
- Exploits the sparsity of the image edges
- Yields good perceptual separation quality
- We plan to evaluate the separation quality of the images by MOS (Mean Opinion Score) tests