Learning-based symmetry detection in natural images

Stavros Tsogkas, Iasonas Kokkinos

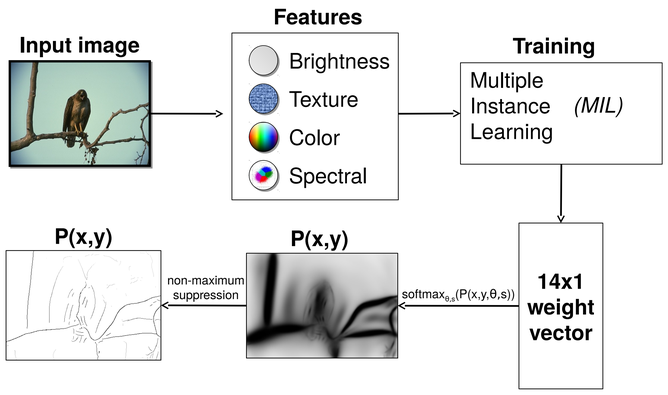
École Centrale Paris-Center for Visual Computing, Chatenay-Malabry, 92290, France

stavros.tsogkas@ecp.fr, iasonas.kokkinos@ecp.fr

1. Outline – Contributions

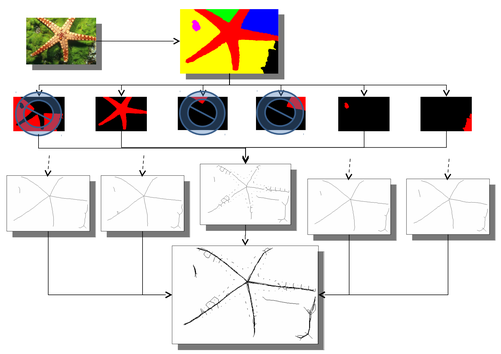
- Automatic ridge detection in natural images.
- Learning-based approach allows flexibility; our detector can be tailored to a specific task.
- Exploitation of color, brightness, texture and spectral cues.
- Frontend for higher-level tasks such as object detection and shape representation.

2. Algorithm pipeline

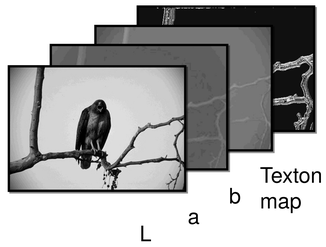


3. Ground-truth construction

- Berkeley Segmentation Dataset (BSDS300).
- 5-6 segmentations by different human subjects per image.
- Human-assisted selection of symmetric segments.
- Combination of skeletons for selected parts gives the final image ground-truth.

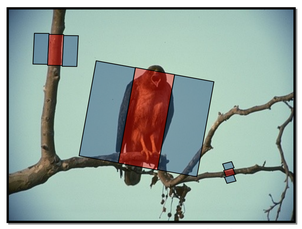


4. Feature Extraction – Training

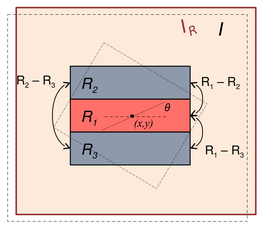


Four channels of histogram features. A total of 3·4 = 12 histogram features are used.

- Color: CIE Lab color space
- Texture: texton map.
- Hard binning (32 bins for 3 color channels, 64 textons).
- Differences of histograms ("gradients") of color and texture content ▭ symmetry indication.
- Rectangle filters extract features at multiple scales and orientations.
- Integral images for fast extraction.

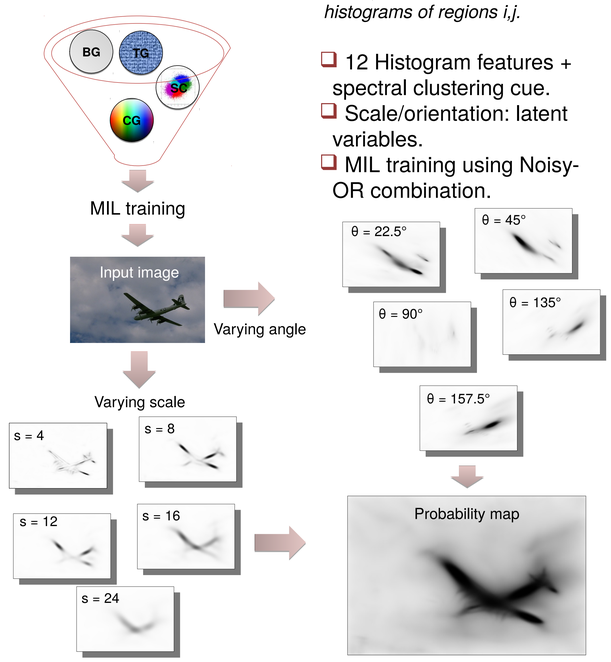


Feature extraction at multiple scales.

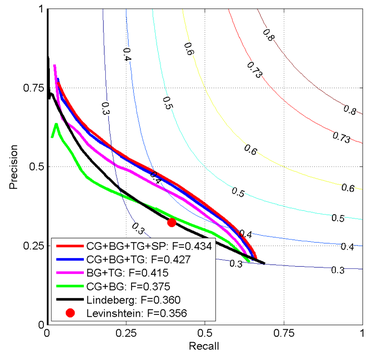


$R_i - R_j$: χ^2-distance between histograms of regions i,j.

- 12 Histogram features + spectral clustering cue.
- Scale/orientation: latent variables.
- MIL training using Noisy-OR combination.



5. Results



- Improved performance with respect to alternative methods.
- Color, texture and spectral cues enhance gray-scale information.
- Effective detection of curved contours.

6. References

1. Lindeberg, T.: Edge Detection and Ridge detection with automatic scale selection. IJCV (1998).
2. Arbelaez , P. et al: Contour detection and hierarchical image segmentation. PAMI (2011).
3. Levinshtein, A. et al: Multiscale symmetric part detection and grouping. ICCV (2009).

Code available here: http://www.centrale-ponts.fr/personnel/tsogkas/