Symmetric Parts and Their Role in Object Recognition

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Perceptual Grouping
The Rise and Fall of Perceptual Grouping

Perceptual grouping papers at ICCV, CVPR, ECCV, and ICPR, as tracked by the USC computer vision bibliography.
**Classical Categorization Model**

- **Model database** (30,000 objects)
- **extract generic features**
- **verify (detect) candidates**
- **interpretation**

**Detection Model**

- **single candidate (plane)**
- **airplane bird**
- **select candidates (index)**
- **group/abstract features**
The Need for Mid-Level Shape Priors

• A detector provides a strong shape prior, precluding the need for perceptual grouping.
• But recognition as detection won’t scale to large databases.
• An informative shape index requires domain-independent intermediate shape priors: perceptual grouping!
Symmetry: A Powerful Mid-Level Shape Prior

- Many objects in our world can be modeled as configurations of symmetric parts, e.g., humans, animals, plants, and a vast array of man-made objects.
- This regularity has shaped the evolution of the human visual system, which can quickly detect symmetry as a non-accidental feature.
- How do we computationally model symmetric parts, and how do we recover (and group) them from real images?
Multiscale Symmetric Part Detection and Grouping

Levinshtein, Sminchisescu, and Dickinson (ICCV 2009)
Key Idea: Superpixels as Deformable Maximal Discs
Multiscale Superpixel Segmentation

Too coarse

Just right

Too fine
Back to Our Input Image
Superpixel Affinity
Multiscale Part Detection
Part Affinity
Final Part Groups
Conclusions

• Scaling categorization from detection to recognition from large databases will require domain-independent perceptual grouping – object-level shape priors must give way to mid-level shape priors.

• Local symmetry provides a natural, powerful basis for part decomposition that supports object categorization.

• Symmetry-based contour grouping is necessary but not sufficient, for we need to abstract the groups before they can be used to query a large database.
Challenges/Open Questions

• What are the appropriate parameters of a symmetric part? (e.g., bending, tapering, pinching, etc.?)

• What are the appropriate attachment relations between parts?

• Should recovered symmetric parts (and their attachments) be 2D or 3D?

• How do we recover abstract symmetric parts and their attachment relations from real images of real objects?