

Image Webs

Discovering structure in large image collections



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Motivation

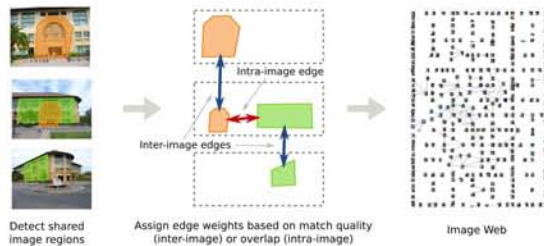


Pervasive imaging devices like camera-phones and camera sensor platforms allow the creation of vast quantities of private and public visual data

- Large image collections are being created and shared, but are hard to utilize.
- Meta-data makes images more useful but is expensive to obtain from human input.

Image Web

An image web is a **graph** where **vertices are regions of an image** corresponding to similar objects and **edges specify relations between the regions**.



Detect shared image regions

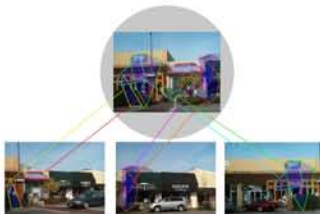
Assign edge weights based on match quality (inter-image) or overlap (intra-image)

Image Web

Applications

Browsing - Navigate image collection using "visual hyperlinks" like text hyperlinks are used in webpages

Auto annotation - Propagate meta-data from a sparse set of human labeled images to annotate many unlabeled images

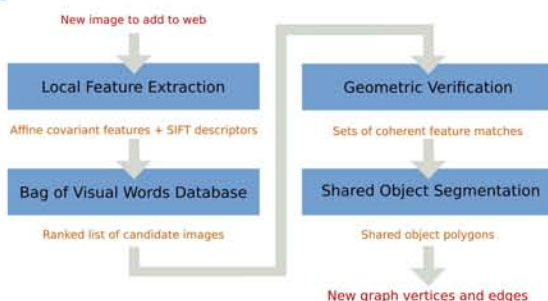


Application: Browsing an image collection using visual hyperlinks



Application: Auto-annotating images with Wikipedia articles

Approach Overview



Local Feature Extraction

- Detect affine covariant feature regions (Harris, Hessian, MSER affine regions)
- Compute SIFT descriptors



Detect affine covariant regions

Normalize regions

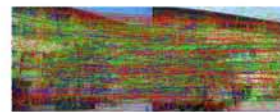
Compute SIFT descriptors

Bag of Visual Words Database

Fast approximate feature matching returns a ranked list of images that contain similar SIFT feature descriptors.

Geometric Verification

- Find subsets of matching features that are geometrically consistent
- Use RANSAC to fit an affine model



Matches before geometric verification



Matches after geometric verification

Shared Object Segmentation

Segmentation methods find boundary of the common object given a sparse set of corresponding regions.



Method A: Union of feature support



Method B: Dense correspondence growing

Example

- Image web built from 300 VGA images of storefronts along a street
- Computation accelerated on an HPC cluster



Close-up view of an image web built from images of an urban environment.