Math 142 Reading Week 8

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1 4.1.2 Feature Descriptors

After detecting the keypoints, we have to match them. That is, what is the correspondence between keypoints in different images? Which points map to which?

In most cases, the local appearance of features will change in orientation and scale, and sometimes undergo affine deformations. Extracting a local scale, orientation, or affine frame estimate and then using this to resample the patch before forming the feature descriptor is usually preferable. But this does not always completely solve the issue – local appearance of image patches will still vary. How to fix this?

For tasks that do not exhibit large amounts of foreshortening, simple normalized intensity patches tend to do well. This is called **bias and gain normalization (MOPS)**.

Scale Invariant Feature Transform (SIFT). These features are formed by computing the gradent in a 16×16 pixel window around the detected keypoint.

In each 4×4 quadrant, a gradient orientation histogram is formed by addding the weighted gradient alue to one of eight orientation histogram bins. To Each of the original 256 weighted gradient magnitudes is softly added to the $2 \times 2 \times 2$ histogram bins using trilinear interpolation. We get 128 non-negative values, which form a raw version of the SIFT descriptor vector. The resulting vector has its values clipped to 0.2 and then is renormalized to unit length.

PCA-SIFT. A simpler way to compute descriptors is to compute the x and y gradient derivatives over a 39×39 patch and reduce the resulting 3042-dimensional vector to 36 using PCA.

Gradient Location-Orientation Histogram (GLOH). A variant of SIFT that uses a log-planar binning structure instead of the 4 quadrants. You end up with a 272-dimensional histogram which is them projected onto a 128-dimensional descriptor using PCA.

Steerable Filters. Combinations of derivative of Guassian filters that permit the rapid computation of even and off edge-like and corner-like features at all possible orientations.

Performance of Local Descriptiors. GLOH tends to perform the best, and SIFT closely follows.

The field of feature descriptors is rapidly evolving and people combine different methods all the time.

While all of these techniques construct feature detectors that optimize for repeatability across all object classes, it is also possible to develop class- or instance-specific feature detectors that maximize *discriminability* from other classes.