Fast registration of special points of images with the help of a Bigraph

Detection and recording of image features has many applications in robotics, video compression, etc. Fast and accurate registration is still an unattainable dream for many programmers and users. It's either fast, or neat...

The general idea of existing relatively fast algorithms is as follows:

1. Feature detection - Find any particular points on each picture, preferably with subpixel precision.

   Varieties:

   a) Corner detection (Harris, FAST ...)

   b) Blob detection (Laplacian of Gaussian, Difference of Gaussians, Determinant of Hessian)

2. Feature description - Build a certain array of characteristics for each point, fully or partially satisfying the following requirements:

   Invariance to:

   Physics noise, shutter speed changes (brightness and contrast), compression artefacts
   2D geometry (rotations), shifts, scaling, 3D geometry to projection distortion
   Compactness (less memory, faster comparison)

   Varieties (Near the selected point in some predefined pattern):

   a) Histogram of gradients, brightness, colours(SIFT, SURF ...)

   b) Reading the values and normalizing the level(ORB, BRIFF ...)

3. For a pair of pictures, find the correspondence of points with the minimum distance (the sum of the absolute differences (L1) or the sum of the squares of the differences (L2)) between the feature arrays, the asymptotic complexity of this step O(N^2), where N is the number of singular points.

4. Optional:

   Check the geometric compatibility of the pairs using for example RANSAC
   https://en.wikipedia.org/wiki/Random_sample_consensus and repeat step 3

Problems during step 2:

   Accuracy of determining the scale and orientation of the reference pattern.
   The number of samples in the pattern and the complexity of their subsequent processing

Problems during step 3:

   Asymptotic complexity.
   number of correctly connected points and number of incorrectly connected points / number of correctly connected points

I have been working on image processing for a long time (about 17 years), including the reconstruction of 3D mesh from video, and I even have my own company selling such products (I do not call it :)) However, I decided to lay out some of the development and put the key idea into open access without patent blocking.
https://github.com/sdima1357/bigraph_image_registration_demo

The general idea is as follows:

For each picture (detect):

1- Find the singular points with step 1

2- Divide the singular points into 2 groups based on the sign of the difference (DoG) between the value at the point and the average in a small neighbourhood.

3- For each point from the first group, find about a dozen neighbours.
At this stage we have a biographer (https://en.wikipedia.org/wiki/Bipartite_graph) from ~N 2*10 oriented edges.

4- For each edge, we sample at the points of the pattern scaled and rotated with vector A->B

5- We build the bit (26 bit) hash by comparing the samples.

To register (bind):

6- We build LUT from the edges of the right picture by hash.

7- For each edge from the left picture, look for O (1) an edge (edge) with the same hash in LUT.

8- We add 2 indexes of points from the left edge to 2 index points from the right.

9- We pass through all points of the right picture and count the number of votes.

For Full HD on i7-6900K using single core approximately 10,000 points on each side
Detect time 29.0556 ms
Bind 10.46563 ms