## Alignment

Can be used to estimate translation

Find parameters or interest points/feature points use as anchor. Check between translated picture and original

Text, letter

Description automatically generated

**Building panorama**

* Detect feature points
* Find corresponding pairs
* Find a parametric transformation (homography)
* Warp (right image to left image)

**Image matching**

* Find distinct points, similar points in both pictures but which differs from the rest of the surrounding pixel values.
* Check geometrically consistent, meaning feature points are detectable in both images after transformations.

**NB:** Be careful of sliding edges like shadows, because they are similar as you slide a box []. Sides of a mountain for example. Rather pick top point of it.

Text

Description automatically generated with low confidence

**Common transformations**

Zoom, rotation, blur, change in POV, change in light

**Properties of good features**

* **Repeatability**
  + given two images of the same object or scene, taken under different viewing conditions, a high percentage of the features detected on the scene part visible in both images should be found in both images
* **Distinctiveness**
  + the intensity patterns underlying the detected features should show sufficient variation so that features can be distinguished and matched
* **Locality**
  + the features should be local, so as to reduce the probability of occlusion and to allow simple model approximations of the geometric and photometric(change of light)deformations between two images taken under different viewing conditions
* **Quantity**
  + Number of detected f.p’s should be high such that small objects also contain a lot of f.p.’s
* **Accuracy**
  + the detected features should be accurately localized, in image *location* and with respect to *scale*
* **Efficiency** 
  + the detection of features in a new image should allow for time-critical applications

**Scale invariance too** The ability to detect interest points at multiple scales, which allows for detection of objects at different distances and orientations.

High derivatives in all directions 🡪 Corners

Text

Description automatically generated with medium confidence

Calendar

Description automatically generated

## SIFT

Local image feature extractor. Histogram based

Comparing SIFT descriptors

Hellinger kernel : d(s,q)= sum(sqrt(si,qi)), wher si,sq are bins in each hist

This method detects and describes interest points by identifying local extrema of the Difference of Gaussian (DoG) function. The SIFT descriptor is based on the gradient information at each interest point.

## RootSIFT

1. normalise using l1 norm
2. element wise square root normalised bins
3. match rootsift descriptors with Euclidian distance

ORB (Oriented FAST and Rotated BRIEF): This method is a combination of the FAST corner detector and the BRIEF descriptor. ORB uses a binary descriptor that is robust to rotation, scale and affine changes.

**Binary**

* **Comparison based**

Use xor to match binary vectors

Hamming distance: sum of xor vector, where xor vector is xorred two binary vectors

**Image matching techniques**

1. Feature-based matching: This method involves extracting distinctive features, such as keypoints or interest points, from the images and then matching the features between the images. Examples of feature-based methods include SIFT, SURF, ORB, and BRISK. These methods are robust to changes in viewpoint, scale, and illumination, and can be used to match images taken at different times or by different cameras.
2. Template matching: This method involves using a small image patch or template, and sliding it over the image to find the best match. The method can be used for images that have a small amount of rotation, scaling, or translation.
3. Optical flow: This method estimates the motion of pixels between two images, and can be used to align the images. Optical flow methods are based on the brightness constancy assumption, that the brightness of pixels in an image do not change between two consecutive frames.
4. Mutual information and cross-correlation: These methods align images by maximizing the similarity or correlation between the images. They are usually used to align images that are already well aligned, but have small misalignments due to noise or other factors.