Tishk International University
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Photogrammetry-II
"Image Matching"
Third grade-Spring semester

By
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Image Matching

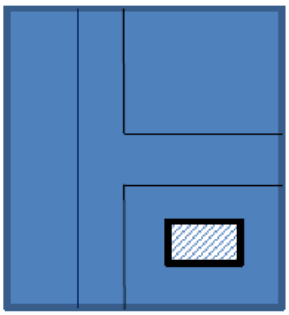
Image and template matching are probably the most important function in digital photogrammetry and also in automated modelling and mapping. Many approaches for matching have evolved over the years,

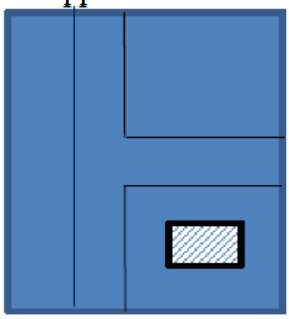
The most known methods are:

1. Feature Based Matching
2. Area Based Matching (cross correlation)
3. Area Based Matching (Least Squares Matching)
4. Semi-Global Matching

1-Feature Based Matching

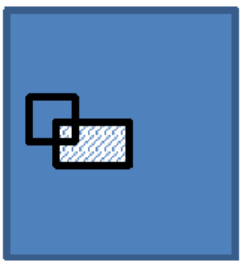
- Features are extracted in both images independently(such as corners and edges).
- Corresponding point in other image is found as nearest neighbor in descriptor space.
- High robustness, fast and needs only coarse approximation

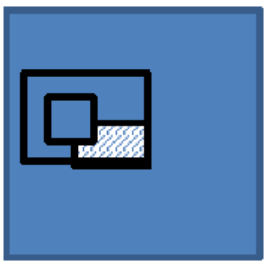




2-Area Based Matching (cross correlation)

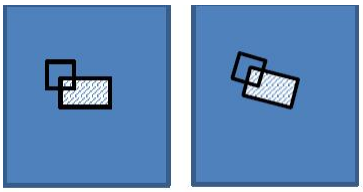
- Points are selected only in left image (feature point or every n-th pixel).
- The matching partner in the other image is found by correlation Less robust, slow and needs good approximation.





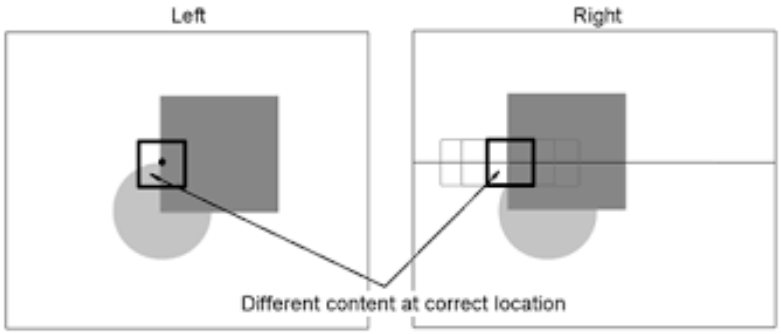
3- Area Based Matching (Least Squares Matching)

- A variant of area based matching.
- In the other image(s) the template window is not only shifted but also rotated, (affine) scaled and even gray value corrections can be considered in order to minimize the gray value differences.
- Formulated as an adjustment problem; allows for highest possible accuracy



4- Semi-Global Matching

Computes conjugate points along multiple conjugate lines hierarchically by using mutual information instead of intensity value differences as dissimilarity measure.



Why Matching algorithms may fail

Human stereo vision seems have to no problems with matching the images presented to the eyes. Computer stereo vision, on the contrary has many pitfalls that can lead to failure of the matching algorithms.

1. **Different perspective projections:** since the images are taken in different perspectives, the recorded object surfaces will undergo different perspective projections.
2. **Occlusion:** in the extreme case, the different perspectives of the images may lead to occlusion of parts of the scene in one or more of the images.

3. Different reflectance: most surfaces are anisotropic reflectors, so different perspectives will result in varying reflectance strengths of the incident light into the direction of the camera. Consequently, gray values of corresponding areas may differ.

4. Different illumination: Images that were taken under different illumination conditions will of course result in the same problem will gray value differences.

5. Incorrect Camera model: In matching tasks such as surface reconstruction the interior and exterior orientations of the images are available as input to the matching algorithms.

6. Recitative patterns: Some scenes contain repetitive patterns, so that a certain pattern in one image will match multiple similar patterns in another image.

7. Low signal-to-noise ratio: both area-based matching and feature-based matching algorithms benefit from good image contrast. A low signal-to-noise ratio will reduce the similarity between corresponding image patches and make it more difficult to extract features that can be matched.

8. Inaccurate approximate values: several matching algorithms require approximations for corresponding positions or transformation parameters.