Applied Computer Vision for Robotics

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Features

- Normally split into a detector and descriptor
- The detector only finds points of interests
- The descriptor is extracted around a keypoint to allow comparison and matching
- Usual feature pipeline:
  - Detect features
  - Build descriptor
  - Use descriptors for matching
Features

- Exemplary applications
- Panorama stitching
- Template tracking
- Visual Odometry/SLAM
Features

- Panorama stitching:
  - Pure rotation of the camera assumed
  - Correspondences allow homography estimation

Features

- Template tracking:
  - Features of a template are matched to features extracted from video stream
  - Use correspondences to estimate homography
Features

- Visual Odometry/SLAM
  - use features to estimate relative movement between frames
  - build map of 3d features to locate yourself
  - more details in sheet 3
Sheet 2

- Sheet 2 is mainly about descriptors
- Goal: find a way to describe the keypoint in order to compare it with other keypoints
MOPS

- Multi-Scale Oriented Patches
- Rotate the patch using the found orientation and on multiple scales
- We just use the smoothed intensities for comparison (original: haar coefficients)
- To compensate for brightness changes it is a good idea to normalize the patch

Binary descriptors

- Descriptor only contains the result of brightness comparisons of patch areas
- Many comparisons get combined and form a binary descriptor
- Distance measured using Hamming distance
- Orientation also useful to consider

Binary descriptors

\[ \sum_{a} I(x_a) < \sum_{b} I(x_b) = 1 \]

\[ \sum_{a} I(x_a) < \sum_{b} I(x_b) = 1 \]

\[ \sum_{a} I(x_a) < \sum_{b} I(x_b) = 0 \]
Binary descriptors

1011000....

1011010....

0101101....
Binary descriptors

- Bit string length depends on the number of tests (e.g. 64, 128, 256)
- Hamming distance expresses how many tests gave the same result and how many differed (depends only on the values and not their position)
- ORB extends BRIEF by choosing uncorrelated tests and rotating the whole pattern according to an estimated orientation

ROC Curve

- is a graphical plot which illustrates the performance of a binary classifier system
- plot of the true positive rate against the false positive rate for increasing descriptor distance thresholds

ROC Challenge

- Competition between the teams
- Experiment to find best performing descriptor