special course

week-1

Content

1. wikipedia on rotation representation: quaternion, euler angle, rotation matrix, axis-angle; 附件旋转表达
2. useful tools:
   - LaTex for paper writing;
   - Github for code version control and review;

Assignment

1. writing a library for conversion among different kinds of representations of rotation, e.g. q2r transforms a quaternion (input) to the corresponding rotation matrix. Ideal package should include (but not limited to):
   1. q2r: quaternion to rotation matrix;
   2. r2q: rotation matrix to quaternion;
   3. e2r: Euler angles to rotation matrix using ZYX order;
   4. r2e: rotation matrix to Euler angles using ZYX order;
   5. q2e: quaternion to Euler angles;
   6. ......
2. create a Github account and submit your implementation to your first repository.

Reading materials:

1. representation of 3D rigid motion;
2. wikipedia on Euler angles, quaternion, rotation matrix;

week-2 & 3

Content

1. Fundamentals of Computer Vision: camera model and calibration principles (perspective camera);
2. Correspondence problem;
3. image features: corner and blob features.

Assignment

1. implement the Harris corner detector;
2. implement the Fast feature detector;

Reading materials:

1. Introduction to Autonomous Mobile Robots:

- 4.2.1-4.2.3,
- 4.3.1,
- 4.4 Feature Extraction
- 4.5 Image Feature Extraction: Interest Point Detectors: **Harris**, **FAST**.

2. https://www.edwardrosten.com/work/fast.html

3. camera and image (相机与图像).

4. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_3_2_0_introduction_to_keypoint_features_annotated.pdf

5. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_3_2_1_corner_features.pdf

6. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_3_2_2_blob_features.pdf

week-4

Content

1. feature descriptor and feature matching;
2. strategy: brute-force, k-nearest-neighbor;

Assignment

1. Introduction to Autonomous Mobile Robots:
   - 4.2.5: correspondence problem
   - 4.3.3

1. extract FAST features and describe them using BRIEF descriptor.
2. feature matching using brute-force strategy.

Reading material

1. https://www.cs.ubc.ca/~lowe/525/papers/calonder_eccv10.pdf: brief.
2. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_4_0_from_keypoints_to_correspondences.pdf
3. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_4_1_feature_descriptors.pdf
4. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_4_2_feature_matching.pdf

week-5

Content

1. robust estimation: RANSAC;

Assignment

1. Use RANSAC for line and plane estimation;

Reading material

1. Introduction to Autonomous Mobile Robots:
   - 4.7.2.3
2. http://www.cse.psu.edu/~rtc12/CSE486/lecture15.pdf
3. https://en.wikipedia.org/wiki/Random_sample_consensus
4. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_3_3-robust-estimation-with-ransac.pdf

week-6

Content

1. Two view geometry: essential, fundamental, **Homography**;
2. DLT for homography estimation;

Assignment

1. extract features, matching, use DLT for homography estimation;
2. use RANSAC to find inliers and outliers;
3. image warping;

Reading material

1. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_4_3-estimating-homographies-from-feature-correspondences.pdf
2. https://www.uio.no/studier/emner/matnat/its/UNIK4690/v16/forelesninger/lecture_6_1_basic_epipolar-geometry.pdf

week-7 & 8

Content

1. misc: filter, IMU, attitude estimation, etc (**only week 7**).

Assignment

1. panarama: image-stitching
   - try with SIFT and FAST+BRIEF as feature for matching without RANSAC for outlier removal;
   - try with RANSAC and use homography for outlier removal;
2. Spherical image stiching: same with previous but project points into a sphere.

Reading material

TBD

week-9&10&11

Assignment

1. benchmark of feature detectors, descriptors and matching strategy;
2. benchmark different kind of matching outlier removal strategy;

Reading material

TBD

week-11-13

report writing.