Assignment 2

Robot Vision practical

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Deadline: May 22, 2024, 23:55h
Questions: If you have any questions about the exercises send a mail with subject prefix: "[RV KU]" to marco.pfleger@student.tugraz.at.

Submission: Submit the completed assignment (code, output data and report) using the TeachCenter submission system as a **single** ZIP File. Documents need to be submitted using the PDF format.

Compulsory submission file structure:

```
assign2.zip/                                  root directory
    └ code/                                   contains all code files
        └ assign2_task1.cpp
        └ assign2_task2.cpp

    └ report/                                 contains a single PDF
        └ assign2_report.pdf
    └ fileoutput/                             stores all relevant output
```

Task 1: Feature detection and matching (20pts)

Goal of this task is to perform feature detection and matching for vehicle mounted cameras. 3 images from the KITTI benchmark data set for autonomous driving are used for this. 2 images represent a left and right image of a stereo camera and the third image is the left image after a time step.

Feature matching has to be done between the images left08.png <-> right08.png and

left08.png <->left10.png.

The image and calibration data is available in the file IMG_CAL_DATA.zip.

The following 4 feature detectors have to be used SIFT, SURF, ORB, FAST+BRIEF. The detected features have to be visualized in the image as well as the feature matches and written to file. Feature matching has to be performed for the two image pairs for each type of the 4 features.

Deliverables:

Every input image has to be written to file 4 times with the different feature detectors visualized (see Fig 1). The two image pairs have to be written to file 4 times with the different feature matches visualized (see Fig 2). The output images have to be submitted with the code but no further report is required.

Hint:

Look at the following example for ideas
https://docs.opencv.org/master/d5/d6f/tutorial_feature_flann_matcher.html

Figure 1: Example image with SIFT features visualized.

Figure 2: Feature matches visualized for an image pair.

Task 2: Fundamental and Essential matrix estimation (20pts)

This task consists of computing the fundamental matrix and the essential matrix for all the feature matching cases from Task 1 and visualizing the epipolar lines of 20 randomly selected feature matches.

Three algorithms have to be used:

- 8-point fundamental matrix (used on all feature matches)
- 8-point fundamental matrix using RANSAC
- 5-point essential matrix using RANSAC

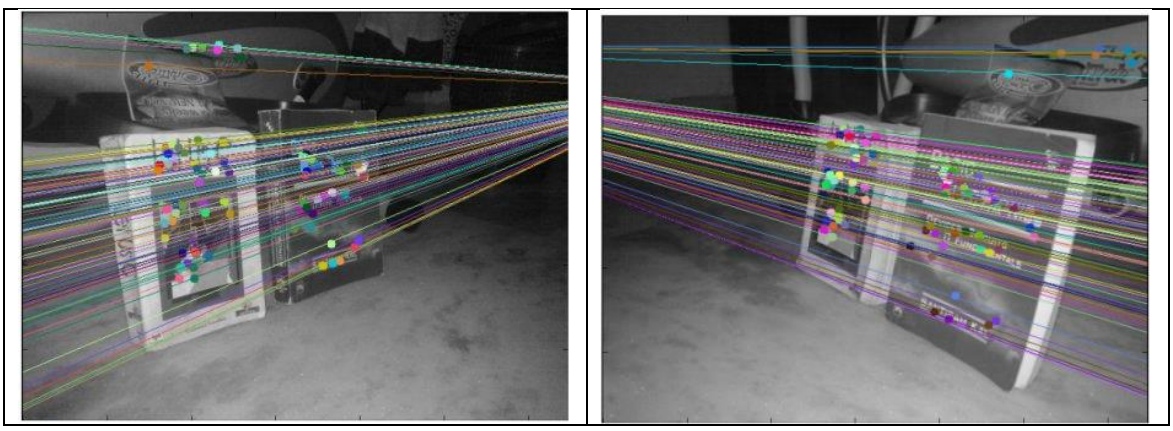

Figure 3: Example visualization of epipolar lines

Deliverables:

Output should be 4x2x3 image pairs with visualized epipolar lines similar to Fig. 3, except that epipolar lines only need to be visualized in either the left or right image. The output images have to be submitted with the code but no further report is required.

Hint:

Look at the following example for ideas
https://docs.opencv.org/master/da/de9/tutorial_py_epipolar_geometry.html

Other information:

The tasks must be solved using the OpenCV library using C/C++. It has been tested with **OpenCV 4.9**.

Important: Make sure to install opencv-contrib including the non-free module.

https://docs.opencv.org/master/d7/d9f/tutorial_linux_install.html

Please be aware of the option: OPENCV_ENABLE_NONFREE=ON

https://docs.opencv.org/3.4/d2/dca/group__xfeatures2d__nonfree.html

OpenCV works fine under Ubuntu run in Virtual Box (https://www.virtualbox.org/).

OpenCV can be downloaded from:

https://github.com/opencv

Tutorials can be found at:

https://docs.opencv.org/master/d9/df8/tutorial_root.html