

ORB-SLAM with a Generalized Camera

3D Vision Project Proposal

Supervised by: Peidong Liu and Dominik Honegger

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GROUP MEMBERS

Lukas Bischofberger



Marius Grimm



Leonard Schai



Tobias Ulrich



I. DESCRIPTION OF THE PROJECT

ORB-SLAM [3] is one of the state-of-the-art feature based simultaneous localization and mapping (SLAM) algorithms. It currently supports monocular and stereo configurations. However, due to the limited field of view (FoV) of the cameras, it would be beneficial for environment perceptions if we can have 360-degrees FoV. The idea for this project is to extend the current ORB-SLAM algorithm to support a generalized camera [5]. A sensor board with up to eight synchronized global-shutter cameras will be provided as a generalized camera to provide 360-degrees FoV.

II. WORK PACKAGES AND TIMELINE

- 1) 2D-2D motion estimation with generalized camera model (4/8 cameras) ([4], [2], [5])
- 2) 3D-2D NPnP (non-perspective n points) pose estimation ([4], [2], [1])
- 3) ORB-SLAM: ([4], [2], [3])
 - a) Tracking part
 - i) Replace current monocular 2D-2D motion estimation for initialization with "1"
 - ii) Replace 3D-2D pose estimation for re-localization with "2"
 - b) Mapping part
 - i) Modify current monocular triangulation method to support generalized camera
 - c) Other common technical issues
 - i) Modify Frame, KeyFrame, Map classes etc. to support generalized camera
 - ii) Modify Bundle-Adjustment cost function to support new feature position parametrization with Plucker line
 - iii) etc.

The minimum requirement for the system to work are 3.1.1 (with 1.), 3.2 and 3.3. After those parts are working 3.1.2 (with 2.) is going to be implemented next. Since the different work packages are all interlinked it is difficult to divide the responsibilities. Yet, Tobias and Marius are going to start working on the Tracking part while Lukas and Leonard work on the Mapping part. After those work packages are completed the group will collectively modify other common technical issues. Those minimum requirements are planned to be working by the end of April. After that the replacement of the 3D-2D pose estimation for re-localization is going to be implemented.

The monocular SLAM algorithm is provided and implemented in C++ and ROS and the operating system of our choice is Linux. For the modifications towards a generalized SLAM algorithm the library OpenGV is going to be used.

III. OUTCOMES AND DEMONSTRATION

As offline presentation we have ros bags available with recorded data of a monocular camera and multiple cameras. We will present our algorithm offline with the image data from multiple cameras. Additionally, we will demonstrate our modified algorithms online with a 8-camera-system.

REFERENCES

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