TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
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M A S T E R ' S T H E S I S
for
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Input Image Adaption for Robust Direct SLAM using Deep Learning

Problem description:

Deep learning based approaches excel in robustness when interpreting visual images of the scene, hence achieving invariance with respect to the illumination conditions that pose the biggest challenge to direct SLAM methods. Recently, Ref.[2] proposed to train deep convolutional neural networks to translate raw images to a representation that is better suited for direct SLAM methods in two respects: *first*, a representation that translates brightness values into semantic labels that, for instance, bring together deviating projections of the same object or keep apart different objects of the same appearance; and *second*, a representation that enhances the input data to remedy other limitations of direct methods like their limited basin of attraction (*i.e.*, their sensitivity to an accurate initial pose estimation). In this sense, the original RGB/Black-white image could be replaced with multi-channel features inferred from Deep neural network, in order to give a more robust presence of scenery under different lighting conditions or even different wetter.
In this work we aim at reimplementing the GN-Net, adapting its auxiliary losses to improve the input data for direct SLAM methods, tailoring it to the current direct SLAM approach being developed at the Institute of Robotics and Mechatronics of DLR[1].

Tasks:

- Literature review on deep learning for metric inference
- In-depth study of the direct RGB(-D) SLAM method at the Institute of Robotics and Mechatronics[1]
- Generation of representative ground-truth datasets for supervised deep learning
- Reimplementation of the GN-Net in a manner that is suitable to the above direct SLAM method
- Experimental validation on different datasets

Bibliography:

[1] Jakob Engel, Vladlen Koltun, and Daniel Cremers. Direct sparse odometry. *IEEE transactions on pattern analysis and machine intelligence*, 40(3):611–625, 2017.
[2] L. von Stumberg, P. Wenzel, Q. Khan, and D. Cremers. Gn-net: The gauss-newton loss for deep direct slam. *preprint*, 2019.

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