

Assessment of the master thesis by Pavel Lučivňák

Visual Localization with HoloLens

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master thesis supervisor

The goals of the thesis were to adapt the existing techniques of InLoc for indoor visual localization to (1) make the InLoc methods work on data from the local environment and image acquisition based on HoloLens, (2) create new 3D data set for the local environment and evaluate the accuracy of the localization w.r.t. the ground truth in that environment, and (3) evaluate the behavior and inaccuracies of the localization on this data to find the possibility of using multiple images for improving the localization. Visual localization in indoor environments is a difficult task due to self-similarity of indoor environments, cluttered and changing scenes and changing illumination conditions. Transferring existing technology to new imaging condition is always a challenging task.

The thesis presents three main contributions. First, the thesis presents an adaptation of the existing InLoc localization technology to a new imaging system of HoloLens. This included the verification of the original method on existing data but also adapting it to new data from HoloLens and demonstrating that the technique delivers comparable results in the new environment with a new imaging system.

Secondly, the thesis presents a new data set with the ground truth obtained using a Vicon 3D measurement system. This is a very interesting data set from real environment with the ground truth obtained from highly accurate measurement system. The construction of the data set involved a number of engineering problems related to the calibration of the systems as well as alignment of the data. The thesis delivered the data and the first level of ground truth, which, however, is not completely satisfactory. Still, I believe that it could be made much more accurate if all the processing steps were made according to the state of the art. This, however, was too difficult to do in short time available. Thus, I decided to rather complete the whole technology pipeline on the level showing a possibility of future improvement of individual elements than to polish individual pieces of the data set construction.

Finally, the thesis presents an analysis of errors of existing localization techniques based on single as well as multiple images. This provides useful observation for future development and improvement of the localization techniques.

All three contributions of the thesis are useful and help to develop the technology further. Altogether, I believe that the thesis presents solid engineering work but still lacks the qualities of the best works we can produce. We would need more time to study mathematical foundations and the state of the art optimization and computation techniques to deliver excellent results.

Pavel Lučivňák was a very motivated and capable student. He was very active in designing and organizing data set acquisition, data organization and evaluation. He also has a very good engineering skills regarding management of his work and software development.

Pavel Lučivňák presented a very useful engineering work, which fulfilled the goals set in the assignment. I grade as *very good (B)*.

Prague, 31 August 2020

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