Thesis advisor review of a master thesis

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Title: Object Scene Flow in Video Sequences
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All current benchmarks for optical flow (OF) and scene flow (SF) estimation measure the quality of the flow given two consecutive video frames. Consequently, most of the methods take as their input just those two images and output corresponding optical/scene flow estimate. However, when applied in real world, the input to the method is usually a continuous stream of frames. Computing a new flow from scratch in every frame is obviously suboptimal as the scene and thus the flow changes slowly from frame to frame. The main goal of the thesis was to extend one of the best existing state-of-the-art methods, Object Scene Flow (OSF), so that it becomes aware of this temporal consistency in the data.

The thesis proposes a method to propagate the motion in the scene between frames, evaluates it on a standard benchmark and improves the state-of-the-art results (first place on the KITTI scene flow benchmark over non-occluded pixels). It also provides a complementary evaluation of detection accuracy of independently moving objects showing that the proposed modifications significantly improve the original algorithm. For this evaluation the original annotation was extended and new protocol defined. Besides this main line of research, the thesis presents an analysis of robustness of the original method, identifies weak points and proposes two modifications increasing the robustness of the motion hypotheses generation. Another aspect tackled by the thesis is the time complexity of the algorithm. A thorough analysis of the time complexity of all components is provided. A speed-up of the most time consuming part, motion assignment optimisation, is proposed by reducing the search space to moving parts of the scene only. Unfortunately, the proposed speed-up leads to slightly worse results in terms of independently moving object detection, but reporting even not perfect results is valuable especially when the idea is interesting. Similarly the idea of propagating the flow on the level of super pixels is interesting even though some more research is needed to show its real potential. Overall, I am very satisfied with the amount of work and the results presented by the thesis.

A bigger part of the thesis was already published at 22nd Computer Vision Winter Workshop 2017 (CVWW'17), where Michal Neoral had an oral presentation.

Already from the amount of work it is probably clear that Michal is hard working student and is able to efficiently manage several experiments running days in parallel on several grid machines. After learning the original method and getting familiar with the code, it was him who often came with an idea for an improvement and who brought interesting visualisations of the obtained results. My main work was to keep him focused on the project priorities as he is able to forget the main goal when inspired by an interesting idea. But that happens to nearly everyone deeply involved in one topic. Michal has no problem reading and understanding the relevant literature and transferring the learned knowledge into the form of a working code.

The only problem with the thesis which troubles me, is the language and occasional weak reasoning in the text. There are still parts of the text which are not completely clear and where English is somehow broken. Although Michal has improved a lot also thanks to the CVWW'17 paper, this is still his main weakness and

he needs to work on it.

I recommend the thesis for defence and suggest the mark A - excellent.

In Prague, 5 June 2017, Jan Šochman