Assessment of the master thesis by Pavel Trutman

Semidefinite Programming for Geometric Problems in Computer Vision

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The goal of the thesis was to develop a solver for algebraic systems appearing in computer vision based on polynomial optimization and in particular on Lasserre's tower of semidefinite relaxations of a general non-convex polynomial optimization. This approach has been introduced in theoretical optimization literature. It advocates as an alternative to the classical methods based on elimination. The main advantage appears to be in the ability to seamlessly move between exact solving, solving over-constrained systems, and introducing additional polynomial regularization constraints. In practice however, it has never been used in computer vision or robotics for solving exact problems. I believe that it was due to the difficulties in grasping the approach on applied engineering level.

The thesis presents several contributions. The most important contribution is that it provides a practical implementation of a solver for exact systems and demonstrates its use on two classical problems in computer vision. This is an important step ahead for practical engineering of computer vision since making the theory work was not a simple and straightforward task. For instance, the examples shown in [3], which was the main source of the theoretical background, produced an ill conditioned computational problem. Despite this, the thesis presents a working method. Secondly, the thesis also presents an implementation of a classical optimization technique for solving semidefinite programs, which was instrumental to reaching full understanding of the problem. It helped to realize that the difficulties encountered in [3] are not inherent to the method but to a particular example.

I believe that the thesis is clearly going beyond the standard MSc engineering thesis by the depth and in the level of how much it was able to penetrate theoretical literature and bring it to practice. This is going far beyond master studies in classical engineering.

Pavel Trutman is a very motivated, capable, and hard-working student. Pavel is an autonomous researcher carrying out his own research including literature review, learning and verifying advanced mathematical concepts, carrying out well planned and documented experiments and clearly presenting his work.

Pavel Trutman presented an excellent work and fulfilled the goals set in the thesis assignment. He mastered advanced techniques in the field and contributed by new results. Therefore, I recommend grade the thesis by the *excellent grade*.

Prague, 24 January 2018

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