Bachelor's Thesis Review
Using Symmetries in Solving Minimal Problems in Computer Vision
submitted by *Viktor Korotynskiy*

The topic of Viktor Korotynskiy's bachelor thesis is symmetries in polynomial systems. This is an interesting problem since finding the symmetries of a given polynomial system may significantly simplify the solution of the system. Many problems in computer vision require solving systems of polynomial equations. Therefore, using symmetries may result in the improved efficiency of existing solutions to many computer vision problems or may lead to efficient solutions of unsolved problems. Symmetries are well studied in algebraic geometry but have only recently been used in computer vision [9]. Their obscurity in computer vision applications is likely due to the deep knowledge of algebraic geometry that is required to understand the concept of symmetries.

The thesis presents several contributions and demonstrates that the author has a very good and fundamental understanding of advanced concepts from algebraic geometry, which might be expected from a graduate student of mathematics. In particular, the thesis proposes two methods for finding stability matrices of a given polynomial system. While the state-of-the-art methods can find only some diagonal stability matrices, the thesis proposes a method based on linear algebra that can be used to find all diagonal stability matrices. Furthermore, the thesis proposes a more general method that finds all stability matrices of a general form (not just diagonal) of the given system. Finally, the proposed methods were used on the interesting and practical problem of estimating the pose of a weak-perspective camera, and all stability matrices of this problem were found.

The thesis is very well written, and even though the presented topic requires a non-trivial mathematical language and significant background in algebraic geometry, most of the theorems and proofs are clear and easy to follow. The only text that was challenging to understand is in Section 10, which requires a good understanding of papers [7,8]. However, this section is part of an ongoing work, and it presents results beyond the original goals of the thesis. Despite the fact that the thesis contains a huge number of non-trivial mathematical expressions, I found only a few errors. The thesis is well structured and is technically excellent. The clarity could be improved by a table defining denotations at the beginning of the thesis and a more detailed description of state-of-the-art methods (Section 1.2). This section was clear only after reading the whole thesis (e.g. stability matrices were not well defined before Section 1.2).

The thesis is an excellent submission and it fulfills all the its stated goals. The author demonstrates a deep understanding of algebraic geometry, and he mastered advanced methods for finding symmetries of polynomial systems. In summary, the topic of the

thesis is of importance to the field; the goals of the thesis were met, and interesting results were achieved. I recommend the thesis for defense and propose the grade of **A (excellent)**.

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