Bachelor's Thesis Review

# Minimal Problem Solver Generator

**by Pavel Trutman**

The bachelor's thesis of Pavel Trutman is concerned with efficiency and accuracy of minimal problem solvers that appear in geometric problems in computer vision (and elsewhere). In the context of the thesis, a solver is a procedure that solves a system of (possibly dependent) polynomial equations of a certain sparse and fixed structure that is specific for the problem at hand. The problems of interest are difficult, typically with a number of feasible solvers. In computer vision these solvers are important in data-driven randomized algorithms for solving the correspondence, structure-from-motion, and camera calibration problems, i.e. the core problems of geometric vision. These algorithms proceed by randomly selecting minimal data samples that are used as proposals for (geometric, calibration) parameters being estimated. The proposals are embedded in a robust inference mechanism like the popular RANSAC or, generally, in MCMC methods. Automatic *generators* of these solvers had been developed in the computer vision community. A generator derives the solver (or a subset of feasible solvers) from a generic description of the task at hand. This is still an area of active research. Pavel Trutman's work was done within a team that has gained considerable expertise while performing research in this area for a long time.

The bachelor's project dealt with benchmarking several major choices in a problem solver generator. The assessment was based on relative speed of the generated solver and on its numerical precision. To be able to perform this assessment, the student had to understand the methods all the way from the theory to the implementation level, which, by itself, is not a small feat in this area. He then implemented several major improvements whose performance was to be evaluated. The implementations are original. The results are of interest to the community.

The thesis is written in a very good English, with very few errors, typos or transgressions against the technical style. The structure of the thesis is flawless, those parts that document the student's work are sufficiently detailed for the reader to be able to link the explanations to the actual implementation and choices (options) therein. The reader would perhaps appreciate more examples and illustrations in the introductory chapters but I acknowledge that this would be quite demanding for the writer, since there is hardly any clear level of complexity at which to stop explaining the concepts. Regarding the style, I would only comment on writing the numbered references, for instance instead of 'in the chapter 2' one should write 'in Chapter 2,' instead of 'in section 3.1.4' one writes 'in Section 3.1.4' (both on p. 27). This appears several times in the thesis.

In summary, the topic of the thesis is of importance in the field, the goals of the project were met, interesting results achieved, and a high-quality thesis has been submitted. I do recommend the thesis for defense and propose the **A-grade (excellent)**.

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