THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Improving Sampling-Based Motion Planning Using Library of Trajectories**
Author's name:	**Michal Minařík**
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Cybernetics
Thesis reviewer:	Dr.-Ing. Martin Rudorfer
Reviewer's department:	Research Fellow at School of Computer Science, University of Birmingham, UK

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **extraordinarily challenging**

How demanding was the assigned project?

- Project requires strong theoretical background in two different areas: sampling-based motion planning including variants like using guiding paths and inhibited regions, and 3d shape matching including shape similarity measures
- The developed method combines state-of-the-art approaches from both areas in a novel way

Fulfilment of assignment **fulfilled**

How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.

- All items have been addressed and completed

Methodology **correct**

Comment on the correctness of the approach and/or the solution methods.

- The approach is clear and reasonable, critical challenges to join sampling-based motion planning with guiding paths from similar shapes have been identified and solutions have been found
- A more in-depth discussion about how shape transformations affect the motion planning would have been desirable. The used isometric transformations and geodesic distances are a great start but they include transformations that could arguably impair the suitability of the guiding path (e.g. reflections, limbs pointing in different directions).
- The evaluation proves that the method works and demonstrates the usefulness of precomputed guiding paths compared to many other state-of-the-art methods. However, it fails to make a point that guiding paths from similar objects are beneficial compared to arbitrary guiding paths. Also, it seems that the guiding paths are for scaled-down versions of the objects – this again compromises the idea of shape similarity and the considered transformations (as scaling is not an isometric transformation). Instead, library should contain paths for original sizes – as intuitively the actual planning query can then much easier exploit the existing paths.

Technical level **A - excellent.**

Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?

- The thesis is technically sound.
- Michal not only explains what he is doing but also clearly describes his requirements for the individual components and his arguments to choose one approach over another.

Formal and language level, scope of thesis **A - excellent.**

Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?

- The structure follows a logical line of thought and all relevant aspects are described in a sufficient extent, only with minor complaints:
  - Relevance of subsections 5.2 and 5.4 should have been pointed out more clearly.
  - Exact conditions regarding object sizes should have been stated more explicitly in the experiments section.

- The language is very clear and Michal achieves to describe complex things in a very understandable manner. When necessary, well-designed figures have been used for illustration.
- He also gives formal description of his method, the equations are technically sound and make proper use of formalisms and notations.

Selection of sources, citation correctness **A - excellent.**

Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

- References to earlier work on the topic are adequate, the selected literature is up-to-date and relevant.
- Michal clearly points out his contribution over existing approaches and how he utilized state-of-the-art methods as components of his overall approach.
- Bibliographic citations meet the standards, although a minor complaint is that a few references are incomplete, showing only authors, title and year.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

The grade that I award for the thesis is **A - excellent.**

Michal submitted an excellent thesis in which he demonstrated that he is able to combine state-of-the-art methods from two previously unrelated fields to create a new approach of sampling-based motion planning exploiting guiding paths of similar shapes.

The document is on a consistently high level, it is well-written and very understandable and thus allows to focus on a purely scientific discussion of his approach.

Questions to be asked during the defense are the following:

- You chose isometric transformations and geodesic distances to determine the similarity of objects. Discuss the impact of included transformations on the motion planning problem. Which particular transformations are considered similar by this definition but could arguably have a strong negative effect on the suitability of the guiding object?
- In your thesis, you evaluated your approach against a variety of other motion planners. However, none of them used guiding paths or exploited object similarities. Please discuss how you would design an experiment to advance on the following questions:
    - How does your approach compare to an approach using a guiding path for a) an arbitrary object or b) a scaled-down version of the query object?
    - How can we assess the suitability of an existing guiding path for a particular query? Can we gain any insight over which transformations will worsen the performance and which others might facilitate the problem?

Date: **1.6.2021** Signature: