THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Sampling-based Motion Planning under Constraints**
Author's name:	**Petr Zahradník**
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	David Oertel, Ph.d.
Reviewer's department:	External (Robert Bosch GmbH)

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

The assigned project required, on the one hand, to acquire thorough understanding of essential concepts in the field of topology and its role in state-of-the-art motion planning under constraints. On the other hand, a substantial technical aptitude was necessary to convey that theoretical knowledge into implementation of respective algorithms for successfully tackling state-of-the-art benchmarks from the motion planning community.

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.

The student was assigned with a clear task of tackling a specific motion planning field using and extending upon an algorithm from literature while practically comparing it to other methods. This primary goal has been achieved and all necessary means to reach it have been explained – including potential shortcomings and room for future work.
In essence, this is the ideal result of an assigned thesis task.

Methodology **correct**

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

A major part of the work concerned understanding, interpreting, analyzing and then implementing a planning method from referenced literature whilst completing gaps that are present in the reference papers. On top of that, suggestions for improvements of these methods are made and examined for practical usefulness.
As is typically the case in works about motion planning, the quality of the methodology here is ultimately judged by their practical application and performance on relevant benchmarks which were performed in chapter 5 of this thesis.

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' project has been carried out well, thoroughly, and technically sound. The student has proven to be able to deep-dive into advanced mathematical fields while at the same time maintaining a sufficiently application-driven focus for successfully implementing those abstract ideas within practically useable code. Keeping this balance is among the most essential skills to master within the studies of Cybernetics/Computer Science/Robotics.

Formal and language level, scope of thesis **B - very good.**

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 thesis is well organized in logically stringent manner, presenting the topic in clear way using understandable English and maintaining a suitable scope. Some very minor and almost negligible occasional flaws in language and formal thoroughness are well compensated by illustrative and consistent examples which greatly simplify grasping the thesis by the reader.

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?

The thesis is heavily based on earlier work on the topic while making extensions and surveying several other methods from the literature. As such, it is very well embedded into providing relevant progress to the scientific community within the scope of a bachelor thesis and beyond. The sources were referenced adequately and formally correct while keeping the focus on the most relevant and impactful works in the field and providing meaningful further references whenever necessary.

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.

The thesis provides high-quality content in the context of motion planning under constraints. Its greatest strength is the well-held balance between theoretical mathematical explanations and considerations on the one hand and hands-on technical implementations and evaluation on the other hand. The thesis' impact on the field is two-fold: 1) provide a guideline on how to use rather abstract literature methods in detail and practice. 2) provide suggestions and for improving upon that method as well as giving valuable hints on where to possibly continue research within this topic.
All in all, these are very relevant contributions in the context of a bachelor thesis.

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 thesis is written fluently with decent technical and mathematical depth while providing suitable examples whenever needed. Overall, the work gives an excellent impression and provides a high-quality entry point for further research in the field of motion planning under constraints – in case the student wishes to pursue this specialization.

Potential questions for the presentation:

1. Are there planning scenarios where the proposed methods may not be applicable due to the specific nature of the relevant manifolds?
2. How relevant is the smoothness constraint of the original manifold with respect to applicability? E.g., is the surface of a cube a smooth manifold?
3. Provided a search space constraint is technically not a "fully" smooth manifold and there are some exceptional non-smooth points or edges: can you come up with theoretical and/or practical modifications of the algorithm such that – at least an approximate solution – could be found in such cases?
4. If you had the choice to continue research on motion planning under constraint: what is your current impression on where to proceed algorithmically? Would you continue trying to improvements on atlasRRT or would you prefer to explore other or hybrid methods in detail first?

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

Date: **27.5.2022** Signature: