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Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Aleksei Postnikov

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Towards seamless autonomous navigation in dense urban environments

Supervisor: Associate Professor Gonzalo Ferrer

Name of the Reviewer: Aleksandr Klimchik

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 18-09-2024**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

Brief evaluation of the thesis quality and overall structure of the dissertation:

The thesis presents a comprehensive and well-structured investigation into the challenges of autonomous navigation in dense urban environments. The dissertation is logically organized, progressing from foundational concepts to advanced methodologies. The only comment on the structure of the work is related to the large number of chapters, which can be reduced by greater abstraction in formulating the goals and objectives for each chapter of the work.

The relevance of the topic of dissertation work to its actual content:

The dissertation's content aligns closely with its stated topic, addressing key aspects of autonomous navigation including trajectory prediction, motion planning, and uncertainty quantification. The actuality of the topic is also confirmed by scientific publications published in prestigious venues and presentations at the top international events.

The relevance of the methods used in the dissertation:

The methods employed, including various machine learning techniques and optimization algorithms, are highly relevant to the field of autonomous robotics and reflect current state-of-the-art approaches. The use of generative adversarial networks (GANs) for trajectory prediction in Chapter 7 is an innovative approach, though its effectiveness compared to other methods could be more thoroughly analyzed.

The scientific significance of the results obtained and their compliance with the international level and current state of the art:

The research contributions, particularly in areas such as uncertainty-aware motion prediction and trajectory optimization, demonstrate significant scientific value and align with international standards in the field. The DDPEN method introduced in Chapter 8 for addressing local minima in trajectory optimization is a novel contribution that could have significant impact.

The relevance of the obtained results to applications (if applicable): The dissertation's content aligns closely with its stated topic, addressing key aspects of autonomous navigation including trajectory prediction, motion planning, and uncertainty quantification. The candidate's work on transformer-based trajectory prediction, as presented in Chapter 5, is particularly relevant and timely.

The quality of publications

The candidate has published in top robotics venues, which is commendable. However, most publications are in workshops and conferences. The lack of journal publications in Q1 venues is a point for improvement. The first-place achievement in the Shifts Vehicle Motion Prediction Competition (Chapter 5) is a significant accomplishment that demonstrates the practical relevance of the work.

The summary of issues to be addressed before/during the thesis defense:

1. The thesis could benefit from a more unified theoretical framework linking the various prediction and planning methods presented across chapters.
2. The comparative analysis in Chapter 7 on generative approaches could be expanded to provide clearer insights into the strengths and limitations of each method.
3. The connection between the trajectory prediction work in earlier chapters and the trajectory optimization in Chapter 8 could be more explicitly drawn.
4. A more detailed discussion on the computational efficiency of the proposed methods, particularly for real-time applications, would strengthen the thesis.
5. The candidate should be prepared to discuss how the various methods proposed in the thesis could be integrated into a complete autonomous navigation system.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*

Dr. Alexandr Klimchik | Associate Professor in Robotics

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