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Skolkovo Institute of Science and Technology

# Jury Member Report – Doctor of Philosophy thesis.

**Name of Candidate:** Mikhail Kurenkov

**PhD Program:** Engineering Systems

**Title of Thesis:** Neural field-based optimal motion planning method for differential drive robots with nonholonomic constraints, robots in dynamic environment and swarm of robots

**Supervisor:** Associate Professor Dzmitry Tsetserukou

**Name of the Reviewer: Dmitry V. Lakontsev**

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| I confirm the absence of any conflict of interest | **Date: 18-11-2024** |
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*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**

*Overall Quality and Structure*

The thesis is written clearly, and its structure allows the reader to easily follow the research objectives and hypotheses. The methodology is well-explained, making the study accessible.

*Relevance of the Topic*

The dissertation's topic is highly relevant to its content. The main goal of the thesis was to develop an algorithm for solving the optimal motion planning problem for non-circular differential-drive mobile robots with non-holonomic constraints. The author successfully addressed this objective by presenting a method based on neural fields. This method effectively solves the motion planning problem. Additionally, the dissertation explores extensions of the method to motion planning in dynamic environment and motion planning for swarm of robots in chapters 5 and 6.

*Relevance of the Methods Used*

The author employed cutting-edge methods based on neural fields. The thesis demonstrates that this method not only solves the robot motion problem, but often outperforms other methods, as evidenced through numerical analysis in Chapter 4. The dissertation also showcases motion planning for dynamic environments using time profiling and non-linear velocity constraints, proving in simulations that the method provides smoother and more passenger-friendly trajectories.

*Scientific Significance and Compliance with International Standards*

Path planning is a critical task in robotics, and successfully solving this problem can expand robot applications. This work shows that the proposed method surpasses existing solutions with smoother and less convoluted final trajectories. Importantly, the method is scalable to complex environments with dynamic obstacles and swarms of robots.

*Quality of Publications*

The author has a publication in a Q1 journal, RAL, and numerous conference presentations, contributing as both an author and co-author.

As minor disadvantages, I would point out lacks a review of methods in the Background section for motion planning of a swarm of robots.

**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*