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Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Ivan Kalinov

PhD Program: Engineering Systems

Title of Thesis: Development of a heterogeneous robotic system for automated inventory stocktaking of industrial warehouse

Supervisor: Associate Professor Dzmitry Tsetserukou

Name of the Reviewer: Riichiro Tadakuma

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:**  **Date: 17-11-2020**

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

- Brief evaluation of the thesis quality and overall structure of the dissertation.

This thesis has excellent quality and its structure is quite clear. This thesis provides strong solution for humanity to handle the present difficult situation with the pandemic of COVID-19. It realizes the appropriate social distance between the human workers in industrial warehouses by supporting them physically to take products from shelves.

Here are the trivial corrections of the sentences.

In the 16th and 29th lines of the chapter of Abstract, abbreviation of unmanned ground robot should be UGR, not URG.

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

The topic of the dissertation work is quite relevant to its actual content. The physical cooperation of heterogeneous robotic system is a strong method to solve the unpredictable problems that can happen in human environments like industrial warehouses. The actual content of this dissertation includes simulations and experiments of the heterogeneous robotics system. It is relevant to its topic.

- The relevance of the methods used in the dissertation

The hardware and control software of the heterogeneous robotic system used in the dissertation are the actual robots that can be used in the real environment of industrial warehouses. So the methods used in the dissertation can be considered quite relevant.

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

The results obtained in the dissertation is quite significant scientifically. The combination of the unmanned aerial vehicles and the unmanned ground robots is quite unique and the experimental results shown in the dissertation can be referred by many researchers who study automation of warehouses, factories, and hospitals.

It is also very compliant compared with the international level and current state of the art. For example, one Japanese researcher is also trying to combine an unmanned aerial vehicle and a mobile robot to acquire large eyesight for the good visual feedback of the mobile robot that works in the external environment for rescue operations. However, the hardware and control methods of this dissertation are much better than the example of Japanese research group.

- The relevance of the obtained results to applications (if applicable)

The obtained results of this dissertation is quite relevant and it can be applied to real environment of industrial warehouses. The actual unmanned aerial vehicles and the unmanned ground robots that can work in the real industrial warehouses and factories are used in this dissertation. It is quite impressive and inspiring.

- The quality of publications

The quality of the publications of Mr. Ivan Kalinov is quite excellent because it includes two scientific papers and one patent. His doctoral thesis is quite clear and readable.

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

There is not any issue to be addressed before/during the thesis defense. If there are some more videos that recorded the real motions of the unmanned aerial vehicles and the unmanned ground robots used in this dissertation, they will enhance its academic contents. But of course the present video of WareVision introduced in YouTube is quite enough to understand the scientific significance of the results obtained in this dissertation.

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*