Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Alexander Menshchikov

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Mathematical Modelling and Analysis of Intelligent Monitoring Platform for Precision Agriculture

Supervisor: Assistant Professor Andrey Somov

Name of the Reviewer:

I confirm the absence of any conflict of interest	**Signature:**  **Date: 09-09-2020**

Reviewer's Report

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

The Ph.D. Thesis by Alexander Menshchikov is devoted to the development of intellectual monitoring platform for precision agriculture. The investigation consists of two general parts: development of Convolutional Neural Networks for semantic segmentation task; and development of morphing wing and control algorithms. These two topics are inherent parts of the Unmanned Aerial Vehicle (UAV), specially designed for the precise monitoring of harmful plants in precision agriculture. The quality of the dissertation is high, and publications in reputable journals and conferences support it. The information is well structured, then even not specialists in the area of precision agriculture can understand the material behind the investigation.

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

The topic and the content of the Ph.D. Thesis coincide. Even though the dissertation consists of two studies: one in the area of machine learning and another in the field of fluid mechanics, they demonstrate different aspects of the agro monitoring task. The author outlines these two aspects logically such that they complement each other.

- The relevance of the methods used in the dissertation

Alexander proposes the method of localization of the hogweed, which implies data collection using UAV, training of the neural network, optimization of this network for embedded devices, and consistent

testing in the laboratory and then in the field. As for the development of the morphing wing, Alexander goes consequentially from the computer modeling to the experiment in the wind tunnel. Both methodologies used in the dissertation are relevant.

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

To the best of my knowledge, the results of the dissertation have a significant impact in the area of UAV development for agricultural monitoring. They comply with world-class researches in the field. The development of the neural networks and their optimization to low power devices allows us to bring data-intensive analytics onboard of the UAV; the development of the morphing wing allows more extended flight and controllability under various weather conditions. Both methods expand the capability of modern UAV platforms for smart agriculture: the first grants to dramatically reduce the overall time of post-processing of the aerial data; the second allows to increase the range of the monitoring.

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

Since Alexander in the dissertation initially focuses on the development of the intellectual flying platform for monitoring of harmful plants, all the studies behind the thesis direct to the proposed application.

- The quality of publications

As far as I know, Alexander has three journal publications as the first author. Two of them are in the Q1 journals with an impact factor greater than 2. Besides, he has publications in 3 conference proceedings. All of them are in the IEEE conferences. However, Alexander also participated in 5 more conferences with posters. Moreover, he also has one patent related to the area of computational fluid dynamics. The quality of all publications is high; all of them are relevant to the dissertation.

During the thesis defense I propose that the candidate comment more on how he UAV with the proposed wing can be manufactured, which type of the UAV should be used with such wing, where the camera should be mounted, etc.

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*