

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: ROBERTO PASSERONE

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	Signature:  Date: 04 September 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

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

The thesis reports the candidate work on implementing and evaluating resource constrained embedded systems in the context of precision agriculture using machine learning algorithms and UAVs. The topic is very interesting and relevant, especially since the methods described in the thesis have been implemented and tested in a real environment. The availability of the data in the public domain is also appreciated. The candidate has published the results in suitable journals and conferences.

In general, I have found the results satisfactory, although the presentation is at times a bit confusing and its structure can be improved, perhaps because the manuscript was put together starting from individual papers. Below are some more detailed comments on parts of the thesis that need to be revised.

Some references are broken. Section 3.1.1 is not finished.

On page 55, it is mentioned that "performance is more than six times higher with the same power consumption.". However, looking at Table 3.3, the power consumption for RPi + NCS (3.675 W) is significantly higher than that of RPi alone (2.659 W).

In general, Section 3.1 looks a bit confusing. It starts with a discussion of the platforms. One then expects that all the experiments are conducted on all platforms. However, there is no result for the Jetson Nano, nor for RPi + NCS2. It is confusing, for instance, that FPS is analyzed twice (once on page 51, and then again on page 54). I suggest that this section be reorganized to make it more systematic. Also, what are the conclusions after these experiments?

In the following Section 3.2, you mention the Myriad GPU. This appears to be the same as the NCS? If so, you should use consistent terms. If not, then you should explain the differences.

Figure 3-9 is not very clear. I would use more contrasting colors for the windows with respect to the image.

Page 62: what are "containers #8-11"?

In Figure 3-11: blue is the ground truth, and green the estimated bounding box?

In general, for Section 3.2 it would be interesting to see if the RPi alone (instead of using the NCS or Myriad) could be able to handle the data.

Page 65: there is no discussion about the accuracy of germination detection. Does the proposed algorithm perform well?

Page 72: the Hardware section repeats the characteristics of the Movidius. These should be collected only once somewhere at the beginning of Section 3. Is this the same architecture as the previous section? In the same section, it is mentioned that the Movidius consumes 1 W, and the battery is only 2550 mAh, which certainly won't be able to support the operations for two months if the system is constantly operating. I suggest that the duty cycle technique is already mentioned here. In fact, later on in Table 3.7, the operation time is limited to 7.5 hours.

I don't understand why you have results at the end of Section 3.3.2, and then again Experimental Results in Section 3.3.3. Reading Section 3.3.3 it sounds like there is one more prototype, or is this simply a repetition of what was said before? In general I would try to better structure the text. On page 78 you say that "The mean power consumption during the investigation is 2.23 W; the median is 2.184 W, and the modal value of power consumption is 1.7578 W". These values are different from what is reported on Table 3.9 on the previous page. Do they refer to different systems? The same goes for CPU load and RAM.

Please give the details of how you find 180 days of continuous operation.

Page 85: using the term "crops" to indicate the size of the image, in the context of precision agriculture, is dangerous, since "crop" can also refer to a plant!

Please explain Figure 3-23 better. How does it represent "performance"? What do the colors mean?

Page 88: you say that the platform has 4 GB of RAM, and that 4K input frame with all the rest takes 100 MB. Now, this is a tiny fraction of the 4 GB. Why do you have to divide it in smaller chunks?

The last paragraph of page 94, and the first of page 95 repeat what was said earlier in the thesis. In particular, the first of page 95 seems exactly identical to what is written between page 34 and 35.

The material in Section 3.5 is interesting, however it falls outside my area of expertise.

Page 108: "Thirdly, they are easy to substitute in case of the brake.". What does "in case of the brake" mean? Perhaps it means "in case they break"?

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*