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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Dmitry Shadrin

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Data-driven modeling of plant growth dynamics in controlled environments

Supervisor: Professor Maxim Fedorov

Name of the Reviewer: Mikhail Belyaev

	Signature:
I confirm the absence of any conflict of interest	
	Date: 18-09-2020

Reviewer's Report

The thesis is a sizeable high-quality work. Within this work, Dmitry created several useful data-science based tools for precision agriculture, which seems to be a significant and timely contribution as the field needs modern digital methods. The overall structure provides a good overview of the achieved results; Dmitry split his works into several sections:

- pure physical-based modeling ("Bottom-up" in the thesis, chapter 2)
- data-driven estimation of some physical parameters (chapter 3)
- completely data-based models (chapter 4)

This order is reasonable as it provides the natural evolution of methods in many different scientific and engineering areas. At the same time, the fourth part, modeling of environmental parameters (chapter 5), seems to be somewhat disconnected from plant growth prediction in controlled environments, the central part of the thesis. Moreover, this part also does not correspond to the title of the dissertation work. Finally, according to the co-authorship statement, the personal contribution for this part is lower than for the previous ones. Taking into account the high number of publications, this part could be excluded from the thesis without sufficient losses, in my opinion.

Dmitry demonstrated substantial experience in many data science areas as the spectrum of applied methods varies from classical tools such as Kalman filtration and Support Vector Machines to modern deep neural networks for instance segmentation & object detection. The thesis contains an impressive set of data science projects, and the majority of them includes not only data processing but the whole pipeline: design of experiments, data collection (including the creation of special devices!), machine learning part and, finally, data analysis and extraction of information useful for the community. I especially like the section about seeds germination monitoring, where Dmitry created an embedded computer vision system. It's an illustrative example that characterizes the whole thesis as an excellent example of engineering research driven by specific applied problems. The community recognized the

results as Dmitry has published an impressive number of articles, including several Q1 journal papers, a couple of workshop papers at well-established conferences (BMVC, ICLR), and a moderately competitive (acceptance rate was 66% in 2017) but relevant I2MTC conference. These articles cover all the thesis; roughly, each section contains one article. Surprisingly, this is the main weakness of the work. Different tools and approaches are used in various projects, so a reader cannot directly compare these methods. I believe that a thesis should be a research work itself (not a collection of papers), and different parts should be interconnected. More specifically, I'd like to see a direct comparison of three different types of methods (physical, hybrid, or data-driven based) for a couple of plant modeling problems.

Overall, despite a couple of drawbacks, my overall impression is strictly positive. Due to several reasons beyond his control, Dmitry had to work with several advisors during his Ph.D. studies. Considering this fact, I believe that the work's final high-level structure is much better than one can expect. Dmitry himself has done a tremendous amount of work, published several Q1 papers, and demonstrated great research skills. Without any doubt, Dmitry proved his superior qualification and I recommend the highest grade.

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*