

## Jury Member Report – Doctor of Philosophy thesis.

**Name of Candidate:** Svetlana Illarionova

**PhD Program:** Computational and Data Science and Engineering

**Title of Thesis:** Deep learning for remote sensing of environment and land cover analysis

**Supervisor:** Professor Ivan Oseledets

**Name of the Reviewer:** Prof. Dmitry Dylov

I confirm the absence of any conflict of interest

**Date: 12-01-2023**

*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**

The dissertation work is of high quality and the overall structure of the dissertation is good and sound, although some artifacts from copy-pasting the text from the publications remain. The topic of the dissertation is highly relevant to its actual content and the methods used are satisfactory and serve the purpose of deep learning for remote sensing of environment and land cover analysis. The results obtained are of unquestionable significance in the field and are in compliance with the international level and current state of the art for this application. The relevance of the results to land cover analysis applications is well demonstrated. Overall, the dissertation is of a high quality and the awarding of Ph.D. is recommended.

Specifically, thesis studies the current state of computer vision techniques applicable to the analysis of forest ecosystems through remote sensing observations. Of special value are some new augmentation methods proposed by the author. The thesis highlights the importance of developing reliable and up-to-date systems for environmental monitoring and analysis on both local and global scales in order to properly inventory resources and plan for their sustainable use. The text further discusses the need for

advanced approaches to address tasks such as forest areas mapping, tree species classification, and canopy height estimation. It also explores the challenges of dealing with data imbalance, weakly markup, specific labelled data limitations, and model transferring to new geographical regions. Overall, the thesis provides a comprehensive study of the current state of computer vision techniques for the investigation of forest ecosystems, and offers potential solutions for the challenges posed by remote sensing data.

The quality of the published papers in this list of publications is very high. These are all good journals, with the publications appearing in Remote Sensing, Sensors, IEEE Journal of Selected Topics in Applied Earth Observations, IEEE Access, and IEEE/CVF International Conference on Computer Vision (Workshop). There are nine publications in total, with Svetlana Illarionova having first-authored eight of them.

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

*Statistical rigor.* Results in Tables (e.g., 4.5 and 4.6 and others) need to include StDev values, to make it easier to tell apart the best performers and gauge statistical significance (also missing). Speculation about uncertainty in data, noise in the labels/mark-up and their relation to uncertainty in the downstream classification/detection results is missing.

*Generalizability.* Although the thesis candidly stresses its application-oriented content, it is still advised to discuss generalizability of the proposed methods to data beyond environmental/land cover analysis. For example, is the new augmentation technique functional only for satellite data or is it also useful for general image domain and/or medical? What are the assumption about the data?

*Reading.* Some fonts and contours in the maps are poorly visible in Figures; consider switching to vector graphics format. Left-overs from the copy-paste from papers remain in the text (e.g., “The main contributions of this paper are”). Some additional polishing of transitions between subsections is recommended.

#### **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*