Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Dmitry Popov

PhD Program: Engineering Systems

Title of Thesis: Topology and parameter optimization for additive manufacturing based on function representation

Supervisors: Professor Iskander Akhatov, Skoltech

Dr. Alexander Pasko, Skoltech

Name of the Reviewer: Igor Shishkovsky, Associate Prof.

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 05-09-2022**

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:

The development of additive manufacturing (AM) technologies enables engineers to build shapes with complex geometry and topology. It provides more design freedom for customers to solve various purposes. Particular, the design for AM (DfAM) and topology optimization (TO) play a major role in designing lightweight and high-performance components required in industries such as aerospace, automotive, and medicine. Typical approaches to optimizing the topology of the components involve discretization of the design domain and allocating a fraction of the density to elements. And here the researchers and industry experts have been widely used a commercial software based on traditional boundary representation (BRep) approaches.

The thesis of Dmirty Popov devotes to the architecture and implementation of the CAD - CAM system based on function representation (FRep), establishment the connection between FRep and the level set methods for structural optimization.

This thesis is clearly written and well organized. The Chapters 5 and 6 describe the practical implementation and experimental validation of the proposed system. Special interest has opportunity multimaterial applications of author's approach.

My major comment connect with Conclusion section. The author lists what he did. However, the narration does not contain the main conclusions of the dissertation, the provisions of which the author issues to defense and guarantees their novelty and/or exclusivity.

Other remarks:

Page 13. 'CSG Constructie Solid Geometry ' instead of 'CSG Constructive Solid Geometry'

Page 25. 'the pseudo-time variable' . - What is means?

Page 30. 'For example, we use the exact value of the material Young's modulus for elements 1, 2, 3, 4, 5 and 6 in Figure 2-1(b), but it is reduced proportionally to the volume occupied by the solid body Ω for elements 7 and 8.' - Where did the authors get the exact values of the Young's modulus ?

Page 58. 'We can conclude that mechanical testing results repeat the theoretical results within the elastic field region, where the computational model was applied. At the loads exceeding 15 kN, the contribution of plasticity starts to grow, and it becomes impossible to compare the computational and experimental results obtained during optimization. At the same time, this experimental validation showed that the proposed approach can be freely used for 3D printed parts that are made up of ceramics [Safonov et al., 2020] and other materials without plastic deformation.' - It is not clear how the conclusions obtained on the elastoplastic material (SS316L) can be transferred to fragile material (ceramics)?

Overall, the study should be evaluated as the high achievement deserving the PhD degree. No issues to be addressed further.

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*