Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Igor Usachev

PhD Program: Physics

Title of Thesis: Performance of aircraft anti-icing fluids on different substrates

Supervisor: Professor Vladimir Drachev
Co-supervisor: Dr. Viktor Grishaev

Name of the Reviewer: Carlo Saverio Iorio

I confirm the absence of any conflict of interest	**Date: 10-11-2024**

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 thesis is logically organized and reflects the effort of coupling a theoretical understanding of the icing phenomena with the practical relevance of simplifying and enhancing the actual methodology for ice formation and detection according to the international standards. The overall quality is very good, and the English style is nicely edited.

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

The problem of icing on surfaces used in the aerospace sector is a complex one to the point that mitigation measures are still searched for by the major aerospace companies. The thesis tries to shed light on different aspects of the problem including the role of the surface textures, coatings and their interrelations with the standardized fluids used as de-icing in the aeronautics sector. Respect to those challenges, the topic of the dissertation is extremely relevant. Also, the possible improvements

suggested for the automatic detection of icing areas will possibly pave the way for enhanced industrial services in the domain.

- The relevance of the methods used in the dissertation

The overall methodology is convincing, especially for what concerns the reference to international standards. It is much appreciated the effort to create a numerical model that will not only avoid expensive testing but also pave the way for the creation of a digital twin allowing to predict the icing kinetic behavior in many environmental situations.

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

The thesis should be framed in the domain of applied sciences. The results obtained represent an improvement in relation to the current state of the art and are compliant with international standards. The optical methods to detect ice formation on surfaces are specifically innovative because they introduce a concept for automatization that is very much needed nowadays.

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

As stated before, the results concerning the optical methods and the numerical model have the potential to support the creation of a fully developed digital twin that will represent a unique not only in the problem under investigation but for the fully aeronautics sector

- The quality of publications

The publications are in line with the topic of the dissertation and of high quality

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

1) Please, check the quality of Figure 3.14. Also, it would be nice to show at the beginning of the thesis some images showing the actual problem (ice on wings, de-icing systems)
2) The polarimetric automatic detection gives impressive results. However, I could not find any estimation of the errors (like false positive/false negatives) that the method will provide. I understand that maybe it is difficult at this point to evaluate them, but I would add a short paragraph discussing the possible reliability of the methodology.
3) It could also be valuable if a brief discussion will be added, concerning the polarimetric method, about its potential for detecting also ice thickness. Is it possible?

Provisional Recommendation

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

X *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*