

To:

**Study department of FME BUT Brno**  
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## EXTERNAL EXAMINER REPORT

**PhD Candidate:** *Ing. Miloš Fojtlín* (BRNO UNIVERSITY OF TECHNOLOGY)

**Thesis title:** ASSESMENT OF THE THERMAL ENVIRONMENT IN VEHICULAR CABINS

### SCOPE AND TOPIC OF THE DISSERTATION

The thesis of **Ing. Miloš Fojtlín** addresses the assessment of the thermal environment in vehicular cabins, which has long been a subject of fundamental and applied research. The rise of electric mobility with the reduction of energy consumption and emissions have contributed to putting this topic back on the foreground of research areas that are enabling the disruption of the transportation sector.

In the context of electrical vehicles, cabin thermal management is the major contributor to reducing an EV's range on a single charge due to the absence of the waste heat of internal combustion engines. Therefore, optimizing the energy consumption of the HVAC system while maintaining its vital safety, health and thermal comfort functions becomes paramount. In addition, automotive OEMs are pushing user-centric technologies onboard, but personalized occupant thermal comfort remains a laggard, for the moment, due to the lack of essential tools and technologies.

This is an active area of international research with substantial scientific and technological challenges to provide practical applications.

The candidate has demonstrated a clear awareness of the importance of the research topic and has provided high quality scientific building blocks that contribute to the feasibility of the technological solution. Therefore, I consider that the topic of the dissertation is up to date and of high scientific and technological importance.

### CONTENT OF THE DISSERTATION

This research effort aims to develop and validate a set of experimental and numerical tools that predict the interactions between the human body and its thermal surroundings, in a seated car cabin environment, in order to demonstrate an advanced thermal sensation-driven control of local conditioning technologies combined with the conventional HVAC system.

The background, motivation and literature survey of all relevant research fields were well covered. The candidate clearly showcased the concepts of the proposed methodology to predict seated occupant thermal sensation in vehicular cabins, through numerical simulation and experimental approaches.

He also identified and summarized the knowledge gaps limiting the development and deployment of the proposed methodology, and took them into account to translate the aim of his work into a set of specific scientific objectives covering: seat contact area prediction using anthropometry, assessment of approaches for the determination of local clothing parameters for the seated position, development and experimental validation of a heat transfer model between the seat and the human body, identification of the best performing transient, heterogeneous and local thermal sensation model in a car cabin, development of a simple sensor system capable of assessing the equivalent temperature and the validation of the hardware demonstrator against a complex and expensive thermal manikin used as a reference.

The candidate was able to attain all the stated objectives and provided the building blocks of the proposed methodology through the results that were presented in 5 papers published by highly ranked international peer reviewed journals. Excellent!

The papers showcase original and interesting results, with a good contribution to the scientific understanding of the field. I am looking forward to having live exchanges and discussions with the candidate on some of the used methodologies and obtained results on the day of the defence.

### ARRANGEMENT OF DISSERTATION AND ITS LINGUISTIC LEVEL

This thesis is organised into two parts. Part A covers:

- An introduction to the research topic
- A thorough literature review of all areas related to this work
- A clear statement of the aims and objectives of the work
- A summary of five scientific publications produced throughout this research effort
- Brief conclusions, limitations and future work
- A reference table

Part B serves as an appendix to attach five scientific, journal published, papers to which the candidate contributed as the first author.

The arrangement of the dissertation and attached scientific papers is in agreement with the structure of scientific works including *Introduction, Background, State of the art, Aims, Results* and *Discussion* sections. It has been proof-read, tables and figures are well organised and referenced, and there is a good nomenclature section.

I would have preferred a more specific dissertation title, and a result-oriented abstract that focuses on the detailed breakthroughs and achievements of the work rather than using broad terms and concepts to summarize the results.

### STATEMENTS ON THE THESIS BOOKLET

The shortened version of the PhD dissertation covers all the important sections of the original dissertation, although it has a slightly different organisation.

### SUMMARY AND RECOMMENDATION

In conclusion, the dissertation of **Ing. Miloš Fojtlín** addresses important topics and challenges for the assessment of the thermal environment in vehicular cabins. The objectives are clear, the research methodology is adequate, and the results of the work were showcased via 5 scientific papers published in renowned peer reviewed journals. The presentation of the work is at high standards and the weaknesses are minor.

Therefore, I recommend that the candidate **Ing. Miloš Fojtlín** be **approved** for the oral defence, to be awarded the academic degree of Ph.D.



**Roch EL KHOURY**, Ph.D.

**10 October 2019**