

I. IDENTIFICATION DATA

Thesis title:	Optimizing an EIT-Oxygenator Interface for Early Blood Clot Detection
Author's name:	Bc. Filip Šlapal
Type of thesis:	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Diogo Silva, MSc.
Reviewer's department:	RWTH Aachen University

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	extraordinarily challenging
<i>How demanding was the assigned project?</i>	
The project involved approaching a fairly challenging technology (Electrical Impedance Tomography) from different angles ranging from the complicated mathematics of inverse problems to the extensive search-space of injection-measurement patterns, and complex current-tissue interactions. Besides, the project is one of the first of its kind, having to rely on indirectly pertinent literature for theoretical support, and even less resources for implementational insight.	

Fulfilment of assignment	fulfilled
<i>How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.</i>	
With the exception of the validation based on the realization of real measurements, all questions were answered with a very comprehensive body of work. However, some preliminary real measurements were performed despite the short time frame and the geographical challenges natural to the collaboration effort between universities from different counties (please refer to my note on Section "Additional commentary and evaluation").	

Activity and independence when creating final thesis	A - excellent.
<i>Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.</i>	
Due to the project finding itself at the edge of the current state-of-the-art, the student often had to implement a large number of completely novel approaches, which was achieved with success and a high degree of maturity and independence.	

Technical level	A - excellent.
<i>Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?</i>	
The student developed technically sound methods, exploring the problem from different advanced angles both inside and outside the student's field of expertise. Moreover, the procedures were properly scientifically documented. This is a further testament of the student's technical capabilities and solid foundations for acquiring further scientific knowledge.	

Formal level and language level, scope of thesis	B - very good.
<i>Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?</i>	
The student complied with the scientific notation and formalism with little effort, and produced a document written at a high-level of technical English. The complexity of the topic and the amount of work done by the student caused the overall outline of the thesis to sometimes lead the reader adrift from the overarching goal, which I see as an aspect to improve in the future.	

Selection of sources, citation correctness	A - excellent.
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Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

The student delivered very extensive and pertinent literature research, which was a challenging aspect of the project considering its novelty. The distinction between related works and the student's own was also made clear.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

It was a pleasure to have worked with such a scientifically mature, diligent, and motivated young student, whose technical skill allowed him to successfully push the boundary of what is currently possible in the field.

NOTE: due to the constraints of writing the thesis under the dual studies program, the student is submitting this thesis after only four months of working on the project. Take into consideration the remaining two months for the submission of the thesis for the RWTH Aachen University during which the student will finish incomplete tasks and further optimize completed work.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

The student worked on the development of an Electrical Impedance Tomography-based system for automatic monitoring of blood clot development inside oxygenator units. The thesis' work packages involved finding optimal electrode configurations to embed on an existing oxygenator platform and optimal injection-measurement patterns to maximize the sensitivity of the system, modelling the occurrence of clots inside the oxygenator based on physical principles using the finite element method, software development for early and accurate clot detection from the measurements, and validation of the proposed system on real measurements.

The student developed complex methods to address each of these topics, with the highlights of the thesis being the comprehensive work on selecting the most sensitive measurement channels of the system, the development of a neural surrogate of the association between electrode configuration and system sensitivity, which was leverage for finding the optimal configuration, and the development of an accurate detection system with machine learning.

Based on the complexity of the project and the quality of the developed work, I recommend the grade below.

The grade that I award for the thesis is **A - excellent**.

Date: **31.8.2023**

Signature:

Diogo Silva, M. Sc.