DOTTORATO DI RICERCA IN
BIOINGEGNERIA E BIOINFORMATICA

UNIVERSITA' DI PAVIA

IL COORDINATORE

PhD THESIS EVALUATION FORM
Confidential to the PhD Final Evaluation Committee

Year**	**2024**
PhD Student	**Alessia Cannatà**
Reviewer	**Dr. Lena Kranold**
Reviewer Affiliation	**University of Western Australia** **Harry Perkins Institute of Medical Research**
Date of the review	**20.12.2024**

Title of the PhD thesis*	**Addressing multiple aspects of future radar and tomographic microwave diagnostic imaging**

Overall Assessment. Please suggest a possible outcome of the evaluation among the choices:

☐ PhD thesis not ready to be defended;
X PhD awardable;
☐ PhD awardable *cum laude* (top 10%)

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Evaluation Table 1 of 2 (Please tick as appropriate: 4 – Excellent, 3 – Very Good, 2 – Good, 1 – Fair, 0 – Poor, Not App: Not Applicable). Please add a short comment if the evaluation is Fair or Poor

Scientific soundness and significance	**4**	**3**	**2**	**2**	**0**	**Not App**	**Comment**
Wide relevance/interest of the research theme		**X**					
Objectives well defined and scientifically supported		**X**					
Adequacy of the methodological approach			**X**				
Quality of the experimental setup			**X**				
Novelty of the approach			**X**				
Contribution to knowledge in the field			**X**				
Quality of the results		**X**					
Discussion and conclusions valid and properly supported		**X**					

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Evaluation Table 2 of 2 (Please tick as appropriate: 4 – Excellent, 3 – Very Good, 2 – Good, 1 – Fair, 0 – Poor, Not App: Not Applicable). Please add a short comment if the evaluation is Fair or Poor

Written Document	4	3	2	1	0	Not App	Comment
Quality of the Abstract (is it exhaustive?)		**X**					
Document organization. Suitable balance of the component parts of the thesis		**X**					
Adequacy of the references				**X**			**see special comments regarding references**
Clarity		**X**					
Communication effectiveness			**X**				
Properly supported discussion and conclusions		**X**					

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Comments/Notes

Please add here any further comments/notes that might be useful to the PhD Candidate for improving the final version of the thesis.

PLEASE NOTE THAT THE FOLLOWING SECTION WILL BE FORWARDED TO THE PhD CANDIDATE

Use additional pages if needed

An interesting and extensive thesis that investigates different applications of microwave imaging in healthcare. The extend of the work present enough for a doctoral thesis, however, a few comments should be addressed.

0. General Comments
    a. very good description of figure captions throughout thesis
1. Introduction
    a. p. 1: reference for WHO statistics missing
    b. introduction lacks specific references in several aspects of 1.1 (mammography statistics, mortality rates, ultrasound technology, microwave imaging, DAS, F-DMAS)
2. Multimodal Breast Phantoms
    a. split table 2.2 into three tables, one for each phantom type, to avoid reader confusion
    b. Sec. 2.3.1: How do you ensure that the dielectric properties of the phantoms match the properties of breast tissue at those higher frequencies that were not measured? It is mentioned that the higher frequency properties are extrapolated from a single-pole Cole-Cole model, but how can you ensure that this is accurate and what is the uncertainty of such an extrapolation, especially since errors become higher at larger frequencies?
    c. Figs. 2.15, 2.16, 2.19 b and c: Please update figures so that different traces are distinguishable.
    d. Fig. 2.18: How did you keep the tumor inclusion in place?
    e. Sec. 2.6: Why do you consider multi-layered breast phantoms by stacking the layers?
    f. Why is the skin layer on the breast phantom 5 mm and not more realistic (up to 2 mm)?
    g. discussion of measurement uncertainty of the multi-physics measurement methods would add great value
3. Radar Imaging at Micro-/Millimeterwaves
    a. p. 52 please consider and correct: ICNIRP presentation: at microwave and millimeter frequencies, SAR is of importance when regarding safety, as it directly relates electromagnetic effects to thermal effects. At even higher frequencies, Absorbed Power Density becomes the dominant measure.
    b. p. 53 please consider and correct: Having most SAR under EM exposure in the skin layer, not penetrating into the tissue, has two major effects: imaging

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deeper tissue becomes extremely challenging as in both reflection and transmission barely a signal can be picked up after it has passed through the tissue, and heating of the skin due to high power deposition (SAR).

c. Sec. 3.3.2.3 (Fig. 3.16): Please state exactly which phantom configuration was used (description and figure/schematic).
d. Tab. 3.2 should be fitted on one page.

4. MWT for Bone Health Monitoring
    a. Fig. 4.11 b and 4.12 b: Are you displaying dielectric loss tangent or imaginary relative permittivity? Either the y-axis or the figure caption should be adjusted.
    b. Figs. 4.21-4.26: What is the reason for an artifact near the top left antenna in the reconstructed images?
    c. Can the developed experimental phantoms be considered realistic? How different are shape and contents from human bone and would an inclusion of a muscle surrounding the bone compromise the image quality?
5. References
    a. referencing using IEEE formatting should be fixed to [8-17] rather than [8],[9],[10],….,[17] throughout thesis
    b. reference formatting needs to be fixed in several cases (e. g. [64, 71])
    c. references [68] and [117] are identical

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