Review of disertation:
MICROWAVE IMAGING FOR SELECTED MEDICAL DIAGNOSTIC AND MONITORING APLICATIONS, Ing. Jan Tesařík.

I read the dissertation authored by Ing. Jan Tesařík with great interest. The investigated topic has a growing trend in terms of published results during past years. Based on Google Scholar, there was 17 400 and 31 000 published papers containing words: "Microwave imaging medical application" in 2014 and 2024 respectively. It seems that the microwave devices in medical application attracts attention of commercial partners too (e.g. BrainScanner EMTensor ©, Strokefinder MD100). All together, I consider the topic investigated in the dissertation to be up to date and perspective.

The dissertation thesis aims at three main goals: 1) design and experimental validation of a suitable antenna element for MWI systems, 2) development and in-laboratory validation of multichannel 3D MWI system for brain stroke detection, and 3) feasibility study towards microwave thermometry employing a differential microwave tomography approach. There is no doubt that the dissertation reached the planned goals. However, Its difficult to follow the goals and their specific contribution due to the topic diversity in the work. The goals cover more topics as its written in the abstract: "...detection of brain stroke and to the feasibility of microwave thermometry for hyperthermia based on the differential microwave imaging approach" and as it is mentioned even in the title "...selected medical diagnosis...". Thus, also the contribution of the dissertation is distributed across more topics and rather difficult to evaluate. However, I see the main contribution of the work in development a new antenna element with systematically suppressed backward radiation. The work also pushed forward broader knowledge about the systems towards the medical applications. Any system to be applied requires significant amount of know-how to be obtained by research, design, experiments. The is the strong point of the dissertation.

The work was published in several impacted journal papers and presented on many international conferences. Thus, I consider the results formally correct. However, the only first authored paper named "Dielectric sensitivity of different antennas types for microwave-based head imaging: Numerical study and experimental verification" covers the investigated topic rather weakly while the rest of the journal papers are just co-authored by Jan Tesařík. This is the reason why I rather see the true impact of dissertation in creation and gathering know-how, which brings necessary information for appropriate application of the technology, which increase the value of the laboratory, and which can be followed by Tesařík successors. For this purpose the most possible transparency is welcome. For example, it is welcome and its recommended by the reviewer to push the implemented algorithms and related results on github.

The methods used were sufficiently rigorous, and the results are presented clearly. The text is generally understandable, though some terms are misused throughout. For example, on page 26: "The favourite parameters of the algorithm, such as high speed and robustness, were optimal parameters for our applications" would be more accurately phrased as 'The properties of the algorithm, such as high speed and robustness, were suitable for our applications.' The structure of the work is somewhat challenging to follow due to the diversity of topics covered."

I would welcome a more detailed experimental or theoretical exploration of the limitations of Born's approximation. By definition, Born's approximation imposes assumptions on tissue contrast and the number of scatterers, referring to a 'weak scatterer' in this context. However, what does this imply for practical application? Are real scatterers in patients typically of this type? If not, what approach might be taken to establish an operational range for Born-based reconstruction? For instance, could it be feasible to compare more general nonlinear iterative algorithms with linear ones and evaluate this range using developed phantoms? What are the challenges behind?

My second comment concerns the issue of back radiation from the antenna array elements. What is the primary challenge this introduces for solving the inverse problem? It may be useful to elaborate further on how back-propagated waves impact the inverse solution, perhaps by evaluating reconstruction accuracy using a Mean Squared Error metric against the level of back radiation. Is the noise caused by back radiation correlated in some way with E_{tot}? If so, could this correlation be leveraged to clean the image of this artifact, or is this correlation itself the critical factor that necessitates minimizing back radiation?

The candidate has demonstrated the capability to conduct research with sufficient rigor, contributing essential knowledge for the application of microwave imaging technology. It is therefore recommended that the thesis be accepted by the Faculty as a document satisfying the requirements for the award of a doctorate.

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