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URSI GASS 2023, Sapporo, Japan, 19 – 26 August 2023

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Microwave imaging (MWI) is a technology that exploits the non-invasive and innocuous nature of microwaves jointly with the existing high-performance microwave hardware to generate dielectric maps (images) of the body's internal structures, relying on the contrast of the dielectric properties, i.e., permittivity and conductivity, between two scenarios, when illuminated by low-power waves. Hence, research groups and companies have started to use it as an alternative in medical applications such as breast cancer diagnosis and brain stroke monitoring, showing promising preliminary results in lab-controlled experiments and pre-clinical trials [1, 2]. However, the technology underhood presents the major challenge of solving an ill-posed non-linear inverse problem using measured data as input, which is usually the S-parameter matrix gathered via an array of antennas surrounding the domain of interest, as well as a-priori information about the problem incorporated in the imaging operator through electromagnetic (EM) numerical models. In this context, the operator should include all the details of the measuring setup in the ideal scenario. However, it is non-possible due to uncontrolled variables such as noise, manufacturing tolerance, and antenna placement errors. Then, calibration techniques are applied to deal with these issues.

Here, we present two types of calibration techniques. First, an approach that renders the measuring setup closer to numerical models employing known reference scenarios, thus, mitigating multiplicative inaccuracies while acting directly on the S-parameters. Second, a hybrid calibration technique acts directly on the imaging kernel, i.e., the operator, adjusting the operator using pre-computed simulated and in-time measured data. Overall, for the numerical part, we employ EM high-fidelity models simulated via an in-house finite element method (FEM) solver [3], and test both approaches experimentally on MWI for brain stroke imaging [4], but they can be extrapolated to other systems.

Acknowledgments

This work was supported in part by the European Union's Horizon 2020 research and innovation program under the EMERALD project, Marie Skłodowska-Curie grant agreement No. 764479, in part by the project PON Research and Innovation "Microwave Imaging and Detection powered by Artificial Intelligence for Medical and Industrial Applications (DM 1062/21)," funded by the Italian Ministry of University and Research (MUR), and in part by the Agritech National Research Center, funded by the European Union Next-GenerationEU (Piano Nazionale di Ripresa e Resilienza (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022).

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