DETECTION OF BRAIN STROKE BY MICROWAVE TOMOGRAPHY USING STRUCTURAL INVERSION AND LEARNED DICTIONARIES

Natalia Irishina* and Aurora Torrente*

* Instituto Gregorio Millán, Universidad Carlos III de Madrid, Avenida de la Universidad 30, 28911 Leganés, Spain, E-mail: nirishin@math.uc3m.es, etorrent@est-econ.uc3m.es

Abstract

Microwave tomographic imaging is an imaging modality of noninvasive reconstruction of media dielectric properties. The fact that tomographic imaging is an inexpensive technique which uses a low-energy radiation presents the advantage that it can be used as a screening method in several clinical applications, among them, the breast cancer detection and the detection of hemorrhage or stroke inside the brain. Previously, the iterative algorithm of structural inversion for breast cancer detection has been reported in [1]. It uses at each new stage of reconstruction submodels of increasing complexity. The shape-based approach with level sets offers several advantages compared to more traditional pixel-based approaches, such as well-defined boundaries and the incorporation of an intrinsic regularization, which permit to detect small lesions in breast. However, in case of brain lesion the inverse problem is much more difficult because of the scull, which causes lower penetrance of microwaves and leads to noisy data and lower resolution. At the same time, the contrast in the conductivity and permittivity values in this situation is significant due to blood higher dielectrical values compared to those of surrounding grey and white matter tissues. The authors have applied the structural reconstruction method to detect brain stroke, regarding the types of tissues composing the brain, in 2D numerical phantom created from real MRI images. The method permits to detect lesions larger than 1 cm diameter if the prior information about dielectric properties of brain tissues is used. To improve the resolution, the recently reported technique using learned dictionaries [2] for brain structure has been applied. The real MRI data from American Brain Institute database have been used to create a learned brain dictionary and the numerical phantom.

References

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