A Class of Non-iterative Methods Applied to Microwave Tomography at a Fixed Frequency

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The imaging problem at study consists into finding the location and the shape of inhomogeneous and possibly anisotropic inclusions embedded into a homogeneous medium from electromagnetic measurements at a fixed frequency. We consider the cases where the wavelength is of the same order of magnitude as the inhomogeneities size. We shall investigate imaging techniques based on the sampling method formalism: the inhomogeneities are visualized by constructing an indicator function whose evaluation at a given point (sampling point) requires to solve an ill posed linear problem.

The first one is the classical linear sampling method that requires the computation of the Green tensor for the background medium, which may turn out to be numerically very costly, even for simple configurations where analytical expressions can be derived. The second one is an alternative approach based on the reciprocity gap functional [2, 1] that avoids the computation of this tensor. However, it requires the knowledge of both the electric and magnetic field at a given surface. This method is also shown to have a more general setting than the linear sampling method, allowing for instance a large flexibility in the choice of the indicator function. This choice can be exploited to enhance the performance of the method if some a priori information is known about the type of inhomogeneities.

The numerical efficiency and limitations of both methods will be discussed in the talk.