

Towards a ‘y0’ Fully Vector Model for 3D Reconstruction of Dielectric Scatterers

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Non-linearity is one of the main difficulties in inverse scattering problems [1]. It is mainly due to the fact that, when an incident field is impinging on a set of obstacles, the contrast source induced within each obstacle radiates a field, which in turn impinges on the other targets and modifies their radiation behavior. This also holds true among the different parts of a single extended target.

Then, non-linearity is an intrinsic characteristic of the problem that can be tackled by using different strategies, such as, for example, global or local optimizations, linearized methods, or qualitative methods [2]. Deep learning is also rapidly emerging as an extremely powerful paradigm for solving high-complexity electromagnetic inverse scattering and imaging problems [3].

Recently, in the case of the 2D TM problem, the idea of reformulating the scattering equations has been investigated in order to reduce the amount and hence the effect of non-linearity. In particular, in [4] a smart Green’s function decomposition has allowed a reformulation of the problem with a reduced ‘degree of non-linearity’ with respect to the standard scattering model usually adopted in literature. This new model, known as the Y0 model, has been successfully tested against the experimental data from the Fresnel Institute [4].

In this contribution, we aim at extending and investigating the idea underlying the Y0 model to the 3D vector inverse scattering problem. As discussed in [4], the 2D scalar Green’s function can be decomposed into homogeneous and inhomogeneous parts. In particular, the homogeneous part is able to extract the main contribution of the radiating currents from the contrast sources. The same decomposition can be carried out for the 3D scalar Green’s function [5]. Obviously, the term involving the gradient of the divergence $\nabla \nabla \cdot$ also plays a role in the internal radiation operator.

More details on the new scattering model as well as some numerical tests will be discussed at the conference.

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