Electromagnetic Inverse Scattering via Deep Learning Enhanced by Virtual Experiments

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Abstract— In this contribution, authors propose a new method for electromagnetic inverse scattering problem, which gains advantages by deep learning as well as the paradigms of ‘virtual experiments’.

Inverse Scattering represents a relevant problem in applied electromagnetic, as witnessed by the significant number of applications. Unfortunately, the non-linearity and ill-posedness of the problem makes it difficult to achieve accurate and reliable solutions. Hence, the development of innovative procedures continues to be a topic of considerable interest.

To this end, Virtual (Scattering) Experiments (VE) have been proposed in literature. They amount to recast the original scattering experiments into new virtual ones, by means of a proper design equation able to enforce some given features to the auxiliary unknowns of the nonlinear inverse scattering problem. In particular, among some chances, a possibility is to build the VEs by means of the far field equation, in such a way to enforce circular symmetry of the induced contrast sources [1, 2]. Such paradigm has been already conveniently exploited to introduce many different effective inversion methods [1, 2].

On the other hand, in the last decade, Deep Learning (DL) has been extensively used for a wide variety of fundamental applications, reporting impressive results [3, 4]. DL approaches for Inverse Scattering (IS), able to improve the accuracy and computational efficiency, have been also emerging over years [4]. Nevertheless, most of the proposed DL-based approaches for IS are purely data-driven.

In this paper, authors introduce a new inversion method able to take advantage of both DL and VE. Indeed, the proposed DL-approach takes into account the physics underlying the problem by means of VE, thus achieving more accurate and reliable outcomes with respect to benchmark examples.

REFERENCES