Partial differential equations in Nanophotonics solved with Physics-Informed Neural Networks

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Artificial intelligence (AI) makes now possible things that only humans could do. Image recognition and translation from one language to another are among the most exciting applications. Physics is not blind to the recent developments in AI and new techniques are being introduced.

A relatively little known and recently developed facet is the use of AI to solve Partial Differential Equations (PDE) by means of Physics-Informed Neural Networks (PINNs). This type of neural networks allows solving all types of differential equations, whether ordinary or partial, with one or several variables, single equations or systems of equations. These PINNs have been used, for example, to solve the Schrödinger equation, in fluid physics to solve the Navier-Stokes equations or in photonics. In the Institute of Nanoscience and Materials of Aragón (INMA), which a joint Institute between CSIC and the University of Zaragoza, we initiated the study of simple differential equations (first and second order) with PINNs, in the context of a Final Degree Project. Our aim here is to continue this work going further simple differential equations, trying to solve the PDEs appearing in the problems our group is currently involved in the area of Nanophotonics.