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PICTURE

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Peter Wiecha's main research interests are the interaction of light with subwavelength small structures, and applications of artificial intelligence in nano-optics and photonics. He studied physics at the Technical University of Munich in Germany where he wrote his Diploma thesis at the Walter Schottky Institute. In 2016 he obtained his PhD from the Université Paul Sabatier of Toulouse for a work on non-linear optical processes in nanostructures. After a postdoc at CEMES-CNRS Toulouse on the interaction of magnetic quantum emitters with non-magnetic nanostructures, he held a German DFG research fellowship between 2018 and the beginning of 2020, working with Prof. Otto Muskens at the University of Southampton on deep learning for nano-photonics. Since 2020 he is a permanent CNRS researcher (CRCN) at LAAS in Toulouse.

DEEP LEARNING MEETS NANO-OPTICS

Abstract

Deep artificial neural networks (ANNs) have shown tremendous potential in solving problems that are very difficult to approach with conventional algorithms. Therefore, researchers from manifold areas including medicine, biology and physics increasingly use methods of AI to approach problems that were formerly hard or even impossible to solve [1]. ANNs can be very efficient in the analysis of large (scientific) datasets from simulations, microscopy, tomography or spectroscopy among others [2-5]. ANNs can learn to phenomenologically solve physical models with unprecendented speed and have proven to be able to predict approximate solutions to notoriously hard inverse problems [3-4]. In several proof-of-principle studies ANNs have been recently used for the on-demand conception of photonic devices and meta-materials [2].

I will introduce the core concepts of ANNs and how they can be employed to tackle problems in (nano-)optics, allowing to drastically accelerate numerical simulations or to solve inverse problems. I will describe how an ANN can be taught a generalized intuition of nano-scale light-matter interaction [4]. I will also show how ANNs can help in the evaluation of experimental data in nano-optics. An example is the combination of photonic nanostructures with ANNs for optical information storage, allowing to overcome a major constraint for the achievable data-density due to the optical diffraction limit [5].

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