AI-driven discovery of plasmonic metasurfaces

Co-supervisors:
Jorge Bravo-Abad (www.uam.es/jorge.bravo) and
Ferry Prins (https://sites.google.com/view/ferryprins/)

Carefully designed plasmonic metasurfaces can provide unprecedented control over light-matter interactions. The advances in this field have been driven in large part thanks to our ability to predict the optical response of complex geometries using the ever-improving numerical and analytical simulators. However, to make optimal use of the full potential of metasurfaces, there is a strong need for the development of specialized 'intelligent' design strategies that can handle such hyper-parametrized systems. In this context, it is crucial to look at the emergence of artificial intelligence (AI), and in particular deep learning inverse design approaches based on artificial neural networks (NN).

The overall aim of this project is to create a new framework that can enable accelerated discovery of metasurfaces with novel photonic responses. To do that, we will combine state-of-the-art deep-learning techniques with improved implementations of numerical and semianalytical methods to simulate the photonic response of metasurfaces. To improve the generalization ability of our AI system we will also combine both numerically and experimentally generated training sets. During this project the student will learn a broad set of skills and techniques, including deep-learning, theoretical methods in nanophotonics and working in close interaction with experiments. We are looking for a student that enjoys coding and wants to apply that knowledge to current scientific challenges.

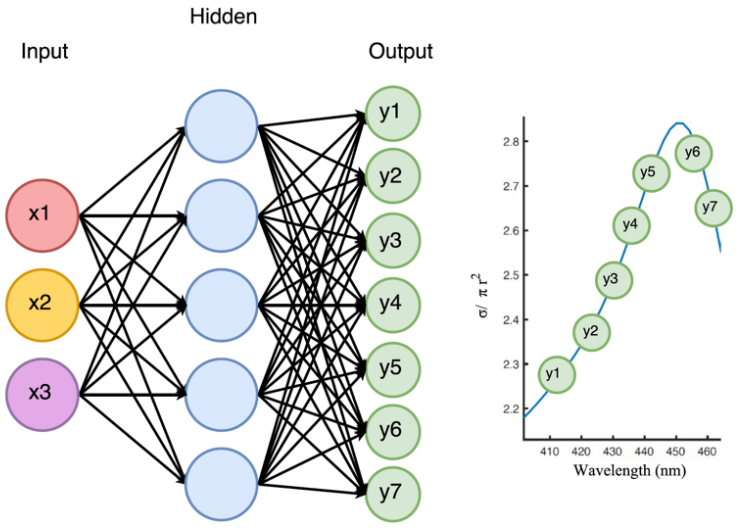

Figure: Schematic visualization of a canonical example of how deep learning can predict the photonic spectrum of a metasurface: The inputs of the NN architecture are geometrical parameters defining the metasurface, whereas the outputs correspond to several sampling points (at different wavelengths) of the metasurface spectrum.