PhD in Interdisciplinary Studies:

Physics, Computer Science and Social Sciences

Inverse design in Nanophotonics: From Theory to Implementation

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Abstract

In recent decades, the growth of nanotechnology has enabled the manipulation of materials at the atomic and molecular levels, leading to important applications in fields such as telecommunications and medical diagnostics. Nanophotonics, which explores the interaction of light with nanostructures, has resulted in advanced optical devices like metasurfaces and metalenses.

My research focuses on the application of inverse design in nanophotonics, a revolutionary method that starts with desired optical properties to determine the optimal nanostructures. Unlike conventional trial-and-error approaches, inverse design leverages artificial intelligence and advanced optimization techniques to develop more efficient and complex nanophotonic devices.

This thesis explores both the theoretical and practical aspects of inverse design, with a focus on implementing metasurfaces for applications such as radiative cooling and CO_2 detection. By combining physics and AI, I have developed methods that accelerate design cycles and enable innovative solutions that are unattainable with traditional methods.