Inverse Design in Photonics Using Finite Different Time Domain and Gradient-based Methods

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Inverse design in photonics is a technique that leverages computational algorithms to create photonic components by specifying desired optical performance and subsequently determining the physical structure that achieves it. This process utilizes the adjoint method to compute the gradient of the objective function with respect to design parameters. In this tutorial, we demonstrate the efficient design of a photonic component, beginning with the solution of Maxwell's equations using the finite-difference time-domain (FDTD) method. Computational algorithms are employed to iteratively modify the design and evaluate its optical behavior against defined objectives. The optimization process continues until it converges to a design that meets the specified performance metrics. Additionally, the necessity of incorporating fabrication constraints into the inverse design optimization is discussed.

Keywords: Inverse design, Photonics, FDTD, Gradient-based method, Adjoint method