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Optimized Designs of Nano-Photonic Functional Elements based on Quasi-normal Mode Analysis

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We introduce an optimization strategy for nano-photonic functional elements that is based on a combination of perturbation theory and quasi-normal mode analysis [1]. Within this strategy, we first compute the quasi-normal modes [2-7] of an initial structure as they provide us with an efficient way of determining the figure-of-merit associated with a given functionality (many but possibly not all functionalities are representable via QNM). Secondly, through a perturbative analysis we are able to determine the gradient of the merit functional with regards to slight (geometric) deformations of the structure. In combination, these elements allow us to formulate an efficient iterative procedure for the development of optimized designs. We illustrate this strategy by optimizing a nano-antenna: Starting from a simple cylindrical dimer structure with a moderate Q-factor of 80, our strategy delivers an easy-to-fabricate nano-antenna with a Q-factor whose value is nearly tripled.

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