

## Optimization of nano-phonic devices based on transformation optics method

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### 1. Abstract

In this paper, we propose a modelling and optimization method for designing Photonic Crystal (PhC) devices that consist of dielectric rods with varying layout and size. In the proposed design method, PhC devices are modelled with the Transformation Optics (TO) approach. Both the explicit and implicit modelling based on TO method for PhC devices are proposed. For the explicit modelling method, the TO technique is used to transform the original device model with different size of dielectric rods into an equivalent model that consists of rods with a uniform and fixed size. The permittivity and permeability of the PhC devices and its surrounding dielectric material are described by discontinuously piecewise expressions, according to the geometry of the devices. For the implicit modelling method, the necessary of explicit geometry model of the PhC device is further eliminated so that the layout of dielectric rods can be adjusted conveniently. In order to maintain the numerical discretization accuracy for the implicit modelling method, an improved TO with continuous expressions of permittivity is proposed using the cubic Hermite interpolation. The proposed implicit TO modelling method can be used in the initial stage of the optimization of PhC devices with complex topology structure. Then optimization of the PhC devices can be performed with more accuracy by using the explicit TO modelling method. Furthermore, TO technique can be used to transform devices structures with smaller dimensions into reasonably larger ones so that the multi-scale problem and the efficiency of electromagnetic field calculation are partially solved.

### References

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