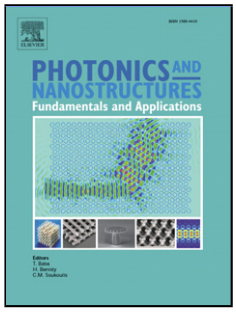

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Photonic crystal waveguide intersection design based on Maxwell's fish-eye lens

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Highlights

- Maxwell's fish-eye lens can be used as a multiband waveguide crossing medium.
- Waveguide bends are needed in previous designs of intersection to adjust the crossing angle of waveguides.
- Maxwell's fish-eye lens is relatively insensitive to the angle of intersection so there is no need to design waveguide bends.
- Waveguide intersection based on Maxwell's fish-eye lens is implemented with graded photonic crystal and it is optimized to cover the entire C-band of optical communication.

Abstract

The number of waveguides crossing an intersection increases with the development of complex photonic integrated circuits. Numerical simulations are presented to demonstrate that Maxwell's fish-eye (MFE) lens can be used as a multiband crossing medium. In previous designs of waveguide intersection, bends are needed before and after the intersection to adjust the crossing angle resulting in a larger footprint. The presented design incorporates the waveguide bends into the intersection which saves footprint. In this paper, *4×4* and *6×6* intersections based on ideal and graded photonic crystal (GPC) MFE lenses are investigated, where *4* and *6* waveguides intersect, respectively. The intersection based on ideal MFE lens partially covers the O, E, S, C, L, and U bands of optical communication, while the intersection based on GPC-MFE lens is optimized to cover the entire C-band. For *4×4* and *6×6* intersections based on GPC-MFE lens, crosstalk levels are below *-24dB* and *-18dB*, and the average insertion losses are *0.60dB* and *0.85dB* in the C-band with lenses' radii of *7×a* and *10×a*, respectively, where *a* is the lattice constant of the photonic crystal.

Keywords: Waveguide intersection; Maxwell's fish-eye lens; Gradient index lens; Graded photonic crystal; Metamaterials