Abstract

All-optical networks, although highly promising, have a long way to go before they will replace existing optical networks such as SONET. The development of the all-optical networks relies on the components market to supply reliable and integrated components to facilitate filtering and management in the optical domain. Planar lightwave circuits (PLCs) and photonic integrated circuits (PICs) provide the answer, with the potential of integrating various functions on a single substrate.

The design of lightwave circuits starts with the design and testing of a waveguide. Once this manufactured waveguide exhibits the right characteristics and is proved to be reproducible, it can be used in the design of components. In industry, this design is done by utilizing the beam propagation method (BPM).

In order to design useful circuits, the simulation results of simple structures should be compared with experimental results to check their sensitivity to certain parameters. Once the relationship between manufactured and simulated components is understood, the design of components can commence with confidence.

In this thesis, BPM simulation results are compared with a reported manufactured waveguide, and then used to design various components used for filtering purposes in dense wavelength division multiplexed (DWDM) systems. Designs for the couplers that serve as building blocks for the filters are discussed, and a novel technique of design downscaling is presented for bi-directional couplers. The filters under investigation are all moving average filters, namely Mach-Zehnder lattice filters, and the highly integrated arrayed waveguide gratings (AWGs). Applications for both these filters are presented.