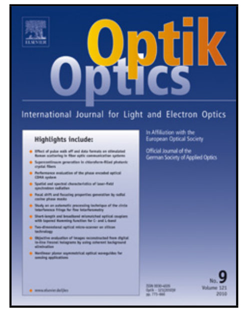

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Implementation of Some High Speed Combinational and Sequential Logic Gates using Micro-Ring Resonator

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Abstract: All optical logical operation is one of the most important aspects of modern research activity in the optical computing. The paper includes the detailed description of switching phenomena in the Micro-ring resonator (MRR). The Micro-ring resonator is very effective component for the implementation of various combinational and sequential logic devices, because of its small and compact size, immunity to electronic interference, low-attenuation, higher bandwidth and cheap computing. The literature includes the different combination of MRR in order to implement the combinational logic circuits (XOR/XNOR, AND, Full ADDER/SUBTRACTOR) and sequential logic circuits (D Flip-Flops). The results are verified by the MATLAB simulation.

Keywords: All optical logic gates, micro-ring resonator, Combinational & Sequential circuits.

I. Introduction

In modern technological scenario, the importance of all optical logic gates has widely increased. A logic gate is a device, which performs the certain and specific Boolean operation on one or more than one input and produces Boolean outputs on the basis of the designed functionality. The logic gate implementation based on the optical computing provides the enormous advantages over electronic computing e.g immunity to electronic interference, more compact system, low-loss transmission, significantly more bandwidth, easier and cheaper computing. However, several techniques has been employed to implement the optical logic gates. Design of XOR, XNOR, NAND and OR gate based on photonic crystal fiber has been described in detail in [1]. The logic gate principle uses the concept of multi-mode interference waveguide. In the same manner the most important logical phenomena such as Binary half adder/Subtractor is implemented using the dark-bright Soliton conversion is explained in [2]. The soliton conversion method shows the great level of accuracy keeping the operation in the optical domain. However lots of effort has been given for the construction of all optical logic gates such as (XOR/XNOR) logic implementation using the dark bright soliton conversion [3], experimental method of construction of all optical logic gate [4]. The concept of optical flip-flop composed of two silicon-on-Insulator coupled to straight waveguides by exploiting the optical bistability behavior due to the nonlinear Kerr effect is explained in [5]. Logic gates based on MMI waveguide for