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Design of photonics half subtractor logics for photonics signal processing

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ABSTRACT

This paper deals with photonics half subtraction design for photonics signal processing by using SOA-MZI configuration. The simulation is used to design the half subtraction operation at 1 Gb/s. The photonics half subtractor logic is implemented by using phase modulation of signals in SOA-MZI. Simulative realization of optical half subtraction is obtained by using three SOA-MZI structure which lead revolution in signal processing for high speed operation. The photonics half subtractor is obtained with good quality of signal. The clear eye diagram and spectrums are observed for each output of subtractor and borrows.

1. Introduction

The signal processing is a key technology for computation and information processing in computer and communication networks. Future ultra high speed optical networks need various kinds of photonics signal processing elements at optical nodes including wavelength conversion, optical add-drop multiplexing (OADM) and optical regeneration, etc. [1]. Optical signal processors are transparent in both the time and wavelength domain and will used the future wavelength-division multiplexed (WDM) networks with ultra-broad bandwidth over 100 nm and the data rate will range from 1 to 160 Gb/s or higher.

Future optical signal processors will be essential for ultra high speed networks. These processors has multi-channel optical processing capabilities and high transparency at ultra-high-speed of all-optical processors over opto-electronic (O-E) types.

Optical transistor and router are also developed with the switching speed of about 15 ns. These optical transistors and routers can be controlled by multi-parameters i.e. power, detuning and polarization [2]. Nie et al. [3] demonstrated the shift characteristics of four-wave mixing (FWM) beam spots which are controlled by the strong laser fields via the large cross-Kerr nonlinearity. Spatial optical switching is achieved by such spatial displacements of the FWM beams as well as the probe beam.

Li et al. [4] experimentally demonstrated the spatial splitting of the four wave mixings and probe laser beam which can be used for the space demultiplexer and router.

All photonic adder and subtractor have used for large variety of signal processing applications. All optical gates are used in all optical data comparison, optical encryption/decryption, optical parity checking and generation of pseudorandom bit patterns.

All optical signal processing elements based on a nonlinear element followed by a optical filter has received considerable attention during the past years due to their extensive applications which can be grouped into two categories: nonlinear fiber-based type [1,5,6] and semiconductor optical amplifier (SOA) based type [7–10]. As compared to optical fiber, the SOA based all optical signal processing elements has demonstrated great potential in terms of low power consumption, small size and ease of integration [1].

Sharaiha et al. [8] reported the realization of a novel all-optical logic AND–NOR gate based on cross-gain modulation (XGM). The used scheme requires only one SOA to perform the logic gate with three input signals. Mcgeehan et al. [11] reported optical subtraction for ultrafast signal processing by using SOA and PPLN.

Garai [12] reported all-photonics arithmetic and logic unit is the integral part of optical computing and data processing. He proposes a method to develop an all-optical arithmetic and logic unit by means of which so many binary logic operations such as AND, OR, NAND, NOR, EXOR, data comparator and some arithmetic

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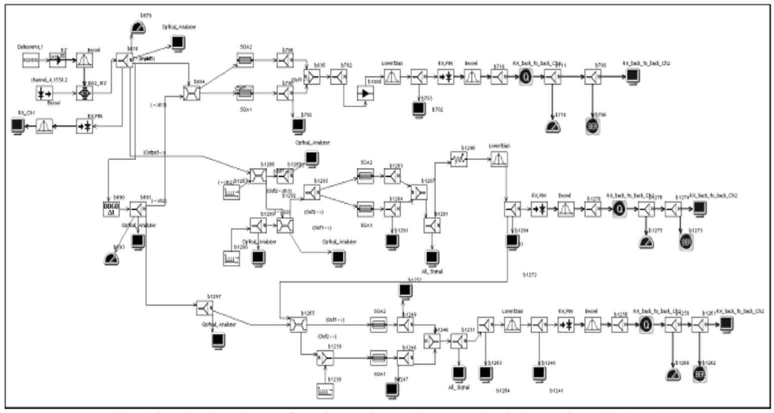
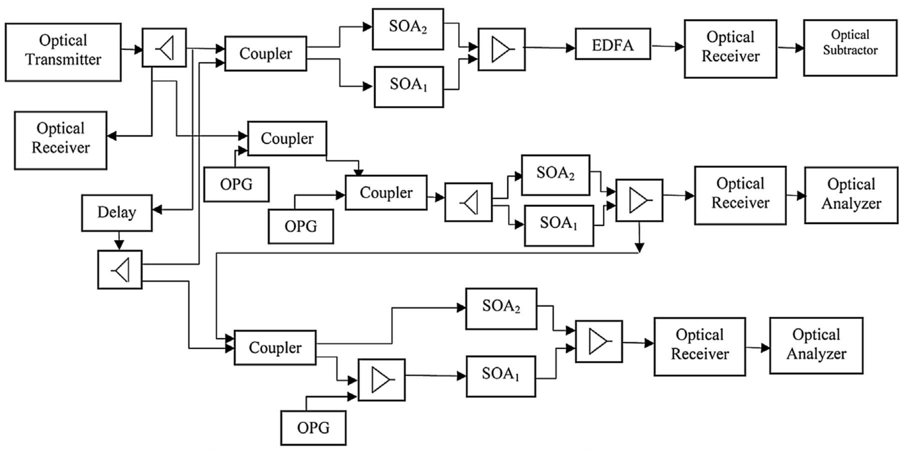


(a): Simulation Setup for photonics subtractor logic by using SOA-MZI



(b): Block diagram for photonics subtractor logic by using SOA-MZI

Fig. 1. (a) Simulation setup for photonics subtractor logic by using SOA-MZI. (b) Block diagram for photonics subtractor logic by using SOA-MZI.

operations i.e. optical half-addition, optical half-subtraction, optical full-addition, optical full-subtraction and multiplication can be obtained. These can be found by properly selecting the frequencies of the control signals and by using the frequency encoded input data at 2.5 Gb/s. Formation of optical full adder has been used large number of SOA.

Kaur and Kaler [13] exploiting nonlinear effects in a semiconductor optical amplifier for demonstrate the logic functions of integrated addition–subtraction and demultiplexing. The results of detailed implementation are missing by using SOA-MZI in Refs. [11–14].

Singh et al. [15] reported the realization of half adder and subtractor using SOA and MZI structures. Gayen et al. [16] reported all-optical half-adder and half-subtractor using terahertz optical asymmetric demultiplexer. A. Kumar et al. [17] implemented the full-adder and full-subtractor based on electro-optic effect in Mach–Zehnder interferometers. Dimitriadou and Zoiros reported on the feasibility of 320 Gb/s all-optical AND gate using quantum-dot semiconductor optical amplifier-based Mach–Zehnder interferometer.

Till date, the all SOA-MZI structure is not used for realization of all optical half subtractor by using phase variations in the arms

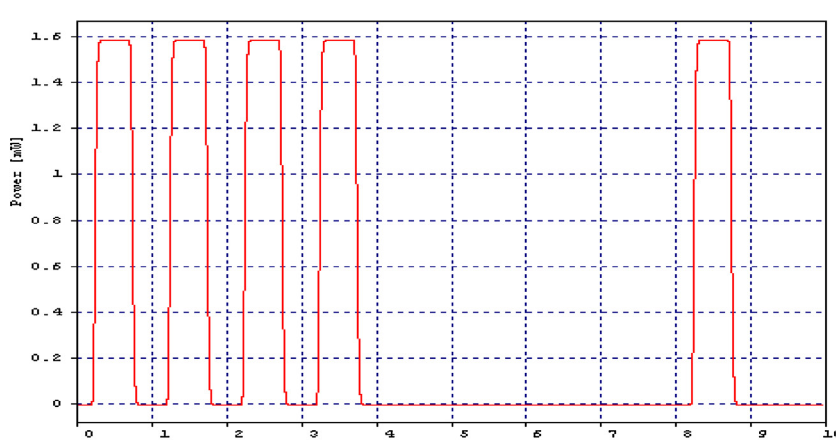


Fig. 2. Optical intensity waveform for input signal A.