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INVESTIGATION ANALYSIS OF THE SIMULATION OF SOA USING MZI OPTIC SWITCH

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ABSTRACT
The optical communication system has many advantages at long distance communication. Semiconductor optical amplifier based Mach Zehnder Interferometer plays an important role in fast optical communication. In this work the proposed SOA based MZI switch is used for all optical logic and arithmetic operations. In the architecture, the continuous wave laser source and control signal pass through the Mach Zehnder Interferometer. Control signal at the wave length is split at the coupler and more power passes through one arm. The input data signal is fed to the coupler, which splits the signal equally. The resultant signals then propagate simultaneously through the two arms of the interferometer. This architecture can be used to perform all optical processing of signals like half adder, full adder, de multiplexer etc. MZI switch is a very powerful technique to realize all these ultrafast switching. The physical mechanism behind the working of MZI switch is cross-phase modulation (XPM). Here the gain saturation induced by beam reduces the carrier density inside one SOA, which in turn increases the refractive index only in the arm through which the light passes. As a result, an additional phase shift can be introduced on the CW beam because of the XPM, and the CW wave is directed towards the bar port during each one bit. Now it is clear that in the absence of control signal, the incoming signal (CW signal) exits through the cross port (lower channel) of MZI. In this case no light is present in the bar port. But in the presence of the control signal, the incoming signal exits through the bar port of the MZI.

KEYWORDS: SOA, MZI, CW, OTA, Full Adder, XPM,

INTRODUCTION
An MZI switch is a very powerful technique to realize ultra- fast switching. In this switch, SOA is inserted in each arm of an MZI. The pulsed signal at the wavelength is split at the first coupler such that more power passes through one arm. At the same time, the CW signal at the wavelength is split equally by this coupler and propagates simultaneously in the two arms. In the absence of the beam, the CW beam exits from the cross port (lower port in the figure). However, when both means are present simultaneously, one of the bits is directed towards the bar port (upper port in the figure) because of the refractive-index change induced by the beam. The physical mechanism behind the behavior is cross phase modulation (XPM). Gain saturation induced by beam reduces the carrier density inside one SOA, which in turn increases the refractive index only in the arm through which the light passes. As a result, an additional phase shift can be introduced on the CW beam because of the XPM, and the CW wave is directed towards the bar port during each one bit. [1–3]

Optical filters are placed in front of the output ports for blocking the original signal. The MZ scheme is preferable over cross gain saturation as it does not reverse the bit pattern and results in a higher on-off contrast simply because nothing exits from the bar port during 0 bit. Now it is clear that in the absence of control signal, the incoming signal (CW signal) exits through the cross port (lower channel) of MZI. In this case no light is present in the bar port as shown in the figure below.
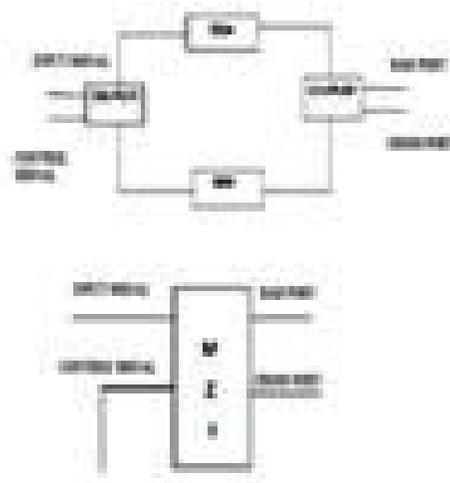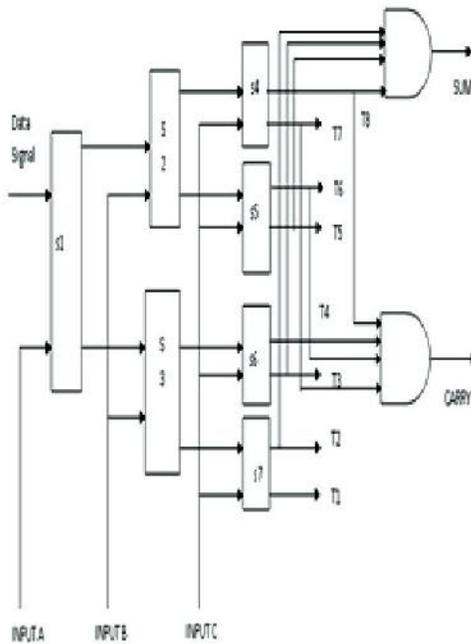

Figure1. MZISwitch.

Figure 2. Full Adder block diagram.

But in the presence of the control signal, the incoming signal exits through the bar port of the MZI as shown in the figure. In this case no light is present in the cross port. In the absence of the incoming signal, the bar port and cross port receive no light as the filter blocks the control signal. [4–5]

WORKING PRINCIPLE OF FULL ADDER

To implement OTA for triple-in-binary logic, taken another four MZI-based optical switche s 4, s5, s6 and s7 as shown in Figure3. In this architecture the continuous wave laser source falls on switchs1. For full adder three control signals are needed. Control signal A is given to the switchs1, control signal B is given to the switch s2 and s3 and control signal C is given to the switch s4, s5, s6, and s7. When the control signal is presented then the light emerges at the upper channel and falls on the next channel and when the control signal is absent the light emerges from the lower channel followed by the next switch. There are eight different input combinations for implementing triple input binary logic. Depending on the state of input variables (A,B,C) [these are also the light signals] the output is obtained from output terminal T-1 to output terminal T-8. Sum and carry are obtained by combining the corresponding terminals. The physical mechanism behind the behavior is cross- phase modulation (XPM). Gain saturation induced by the beam 1 reduce scarier density inside one SOA, which in turn increases the refractive index only in the arm through which the beam 1 passes as are sult, an additional phase shift can be introduced on the CW beam because of XPM, and the CW wave is directed towards the bar port during each one bit. Optical filters are placed in front of the output ports for blocking the original signal. The MZI scheme is preferable over cross-gain saturation as it does not reverse the bit pattern and results in a higher on off contrast simply because nothing exits from the bar port during 0 bits are shown in the Figure1.

The semiconductor optical amplifier (SOA) is of small size and electrically pumped. It can be potentially less expensive than the EDFA and can be integrated with semiconductor lasers, modulators etc. However, the performance is still not comparable with the EDFA. The SOA has higher noise, lower gain, moderate polarization dependence and high non-linearity with fast transient time. This originates from the short nano second or less upper state life time, so that the gain reacts rapidly to changes of pump or signal power and the changes of gain also cause phase changes which can distort the signals. They are shown in the Figure2.

SOFTWARE USED

Optsim is an advanced optical communication system simulation package designed for professional engineering and cutting-edge research of WDM, DWDM, TDM, optical LAN, parallel optical bus and other emerging optical systems in telecom, datacom, and other applications. It can be used to design optical communication systems and simulate them to determine their performance considering in various component parameters. Optsim is designed to combine the greatest accuracy and modeling power with ease of use on both Windows and UNIX platforms. Optsim represents an optical communication system as an interconnected set of blocks, with each block representing a component or subsystem in the communication system. As physical signals are passed between components in a real world communication system.
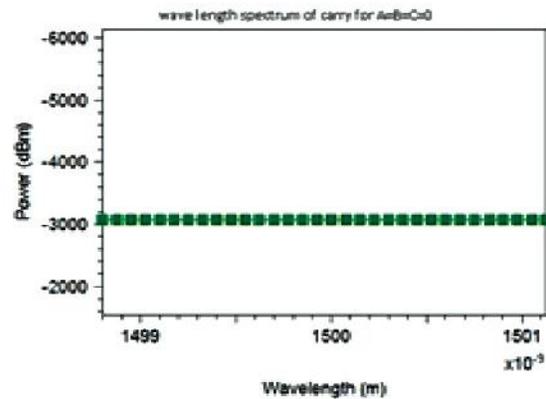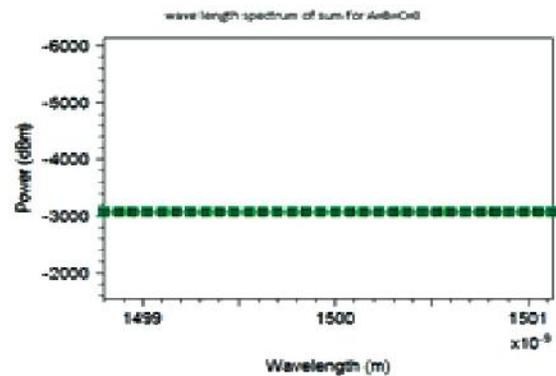

Figure3. Wavelength spectrum for sum (A=B=C=0).

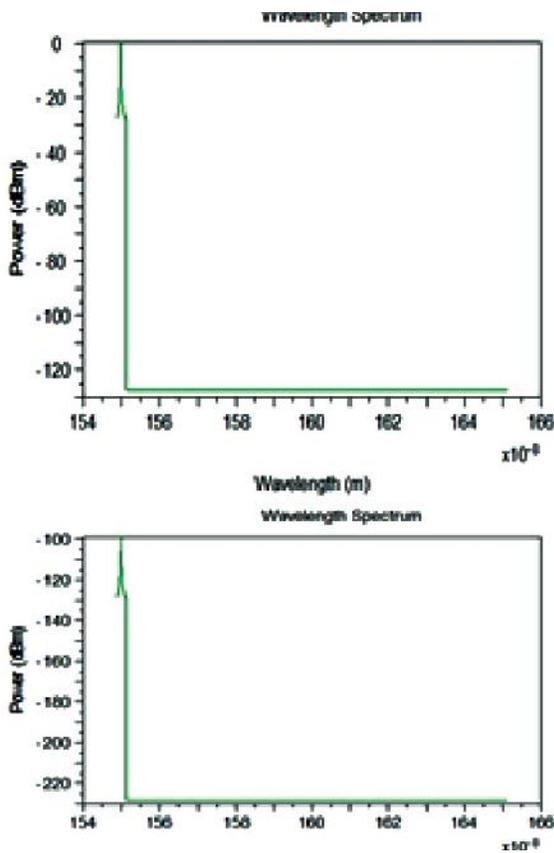Figure4. Wave length spectrum and carry (A=B=C=0).

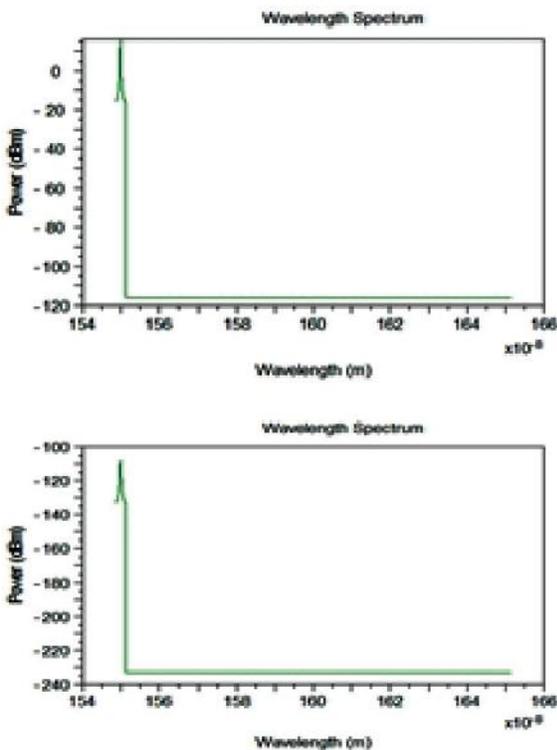**Figure 5.** Wave lengthspectrum S for sum and carry(A=B=0,C=1).

Figure6. WavelengthspectrumsForSumAndCarry(
A=C=0,B=1).

RESULTS

For 000 Logic state at the full adder input the sum and the carry output are logical zeros (Figure 4). Thus the wavelength spectrum for sum and carry show negative spectra. For 001 logical condition Sum is high and carry is low, spectrum will be positive for sum and negative for carry (Figure 5). For 010 logical condition sum is having a positive spectrum and for carry the spectrum is negative (Figure 6). Similarly all sum and carry outputs up to 111 logical conditions can be obtained.

CONCLUSION

An all optical full adder and de multiplexer using SOA based MZI switch is designed and output spectrums for the control signal values A=B=C=0, A=B=0,C=1, A=0,B=1,C=0 are obtained. This type of optical combinational circuits can be used for obtaining various high speed optical networks. By combining beam splitters, beam combiners, and cascading SOA-MZI switches, we can implement and realize any complex logical function expressed in sum of products form. This scheme can be easily and successfully extended for any higher number of input digits by proper incorporation of MZI based optical switches, vertical and horizontal extension of the tree and by suitable branch selection.

REFERENCES

1. Hill M T et al. (2005). Coupled Mach-Zehnder interferometer memory element, Optics Letters, vol 30(13), 1710–1712.

2. Mehra R, and Tripathi J K (2010). All optical switching in a semiconductor optical amplifier based Mach Zehnder interferometer, International Journal of Computer Application, vol 1(9), 102–106.

3. Li Z (2006). Ultrafast all optical signal processing using semi- conductor optical amplifier, Journal of Light waves, vol 24(1), 230–236.

4. Poustie A (2007). Semiconductor optical amplifier lights up all optical signal processing, Journal of Lightwave Technology, vol 25(1), 103–108.

5. Huang D (2008). Potential optoelectronic devices for all opti- cal signal processing, SPIE Proceedings, vol 7134.