Mach-Zehnder Interferometer Design Proposal

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Abstract

This report describes the design of Mach-Zehnder Interferometer, including its design background, components used, and physical parameters.

1 Introduction

(LaTeX version)

The Mach-Zehnder Interferometer (MZI) design is widely used in Photonics circuit. It can be used as photonics switches in data center. In this MZI design, $y_s plitter sareusedatinputandoutputofthewaveguidetosplitthelightatinputandcombinethelightatoutput.A50umwaveguideof$

2 Theory

For a Y_splitter and combiner, the input intensity I_i Electric field E_i can be discribed as following:

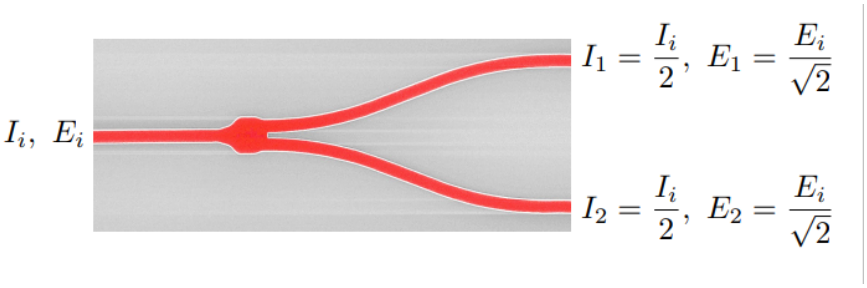

Figure 1: Y_splitter

In MZI the intensity is:

$I_o = I_i$ x 1 / 2 x (1 + cos(β[?]L)

from the equation above, we know the length difference between 2 arms affect the output intensity of MZI design, also

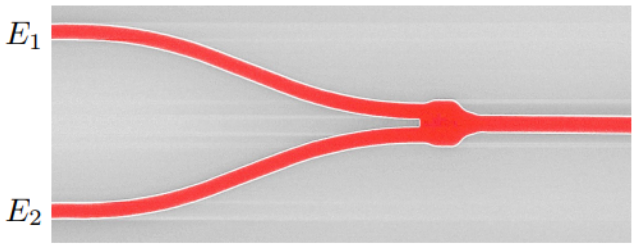

Figure 2: Y Combiner

$$\beta_{1,2} = \frac{2\pi\left(n + \frac{dn}{dt}\Delta T_{1,2}\right)}{\lambda}$$

from the equation above, we know that the intensity also depends on the tempurature on the waveguide.

3 Modelling and Simulation

3.1

3.2 A. Waveguide:

In this design, we are using waveguide with 220nm in height, and 350nm in width. In layout, the width of waveguide and length offset between two arms can be updated as needed for different testing purpose.

the simulated waveguide mode profiles are the following:

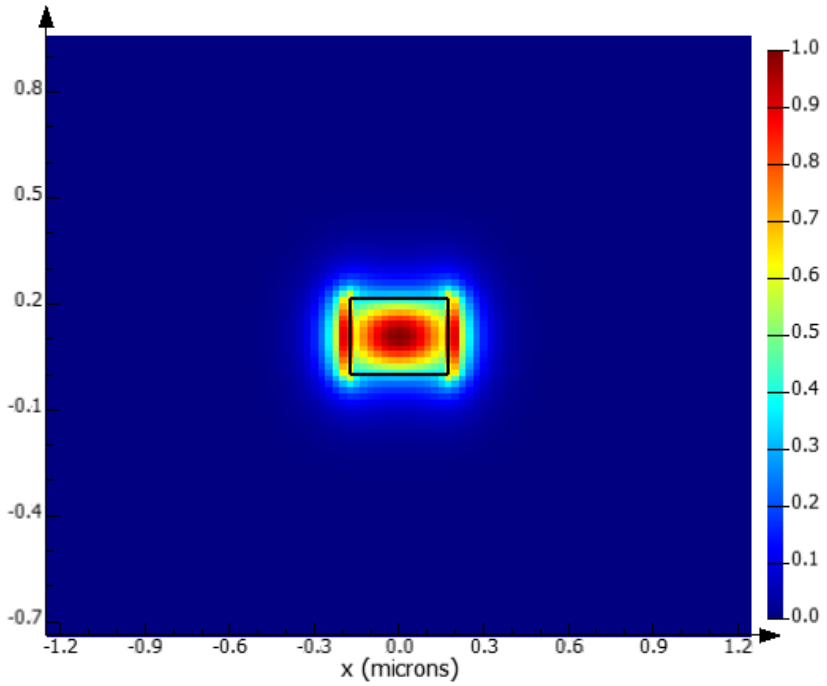

Figure 3: Electric field intensity of TE mode in waveguide

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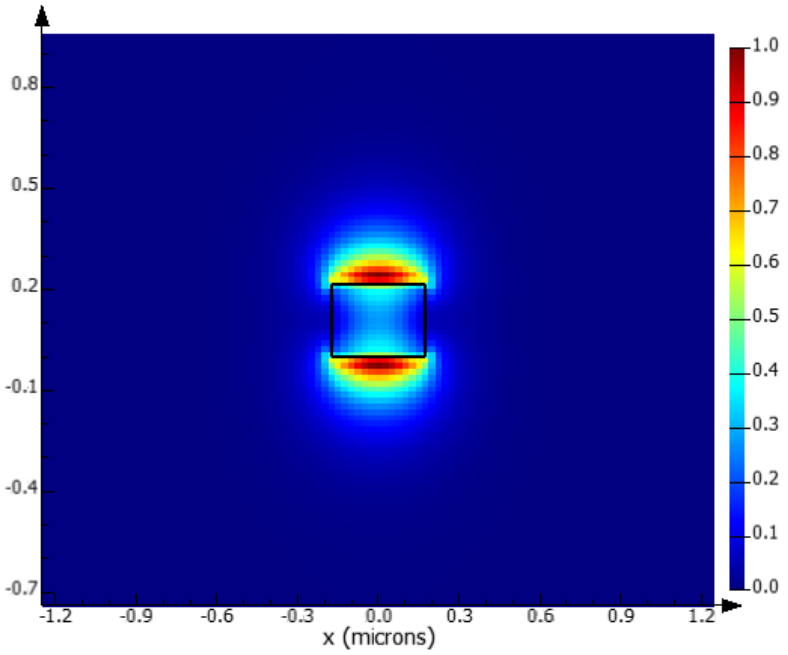

Figure 4: Electric Field intensity of TM mode

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5.1 B. Mach-Zehnder Interferometer

INTERCONNECT software is used to model MZI performance.

A 50um lengh is introduced between two arms of 350nm waveguide. and grating coupler is used at input of the model. In this test case, the interference at MZI output is only affect by the length mismatch.

here is a TE gain plot of MZI:

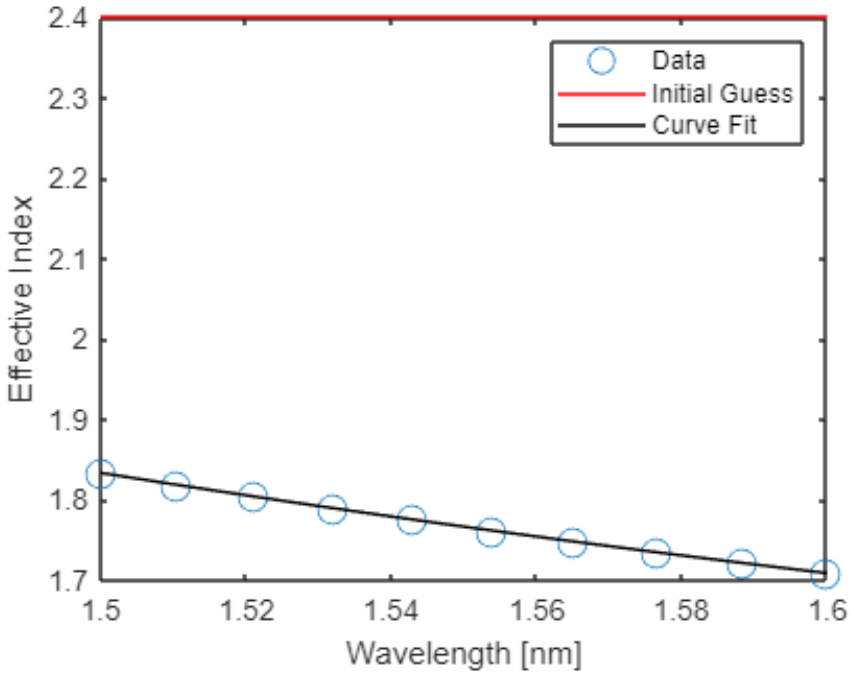

Figure 5: effective index in TE mode

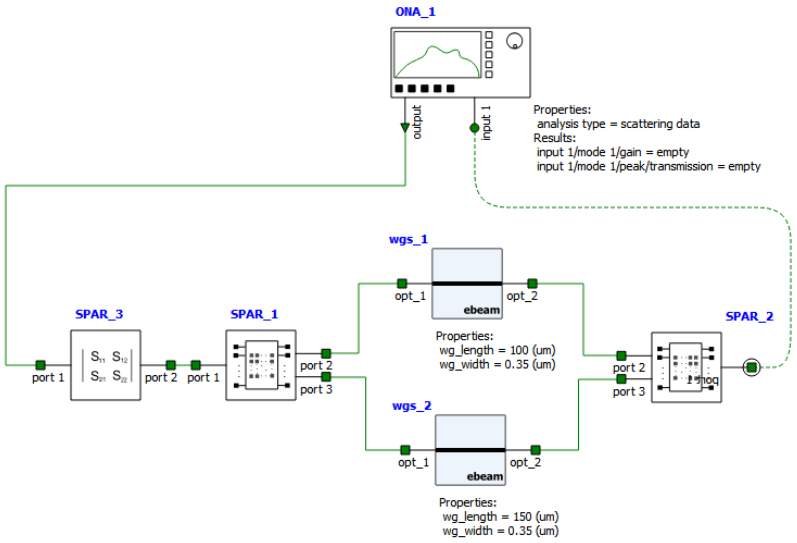

Figure 6: INTERCONNECT MZI model

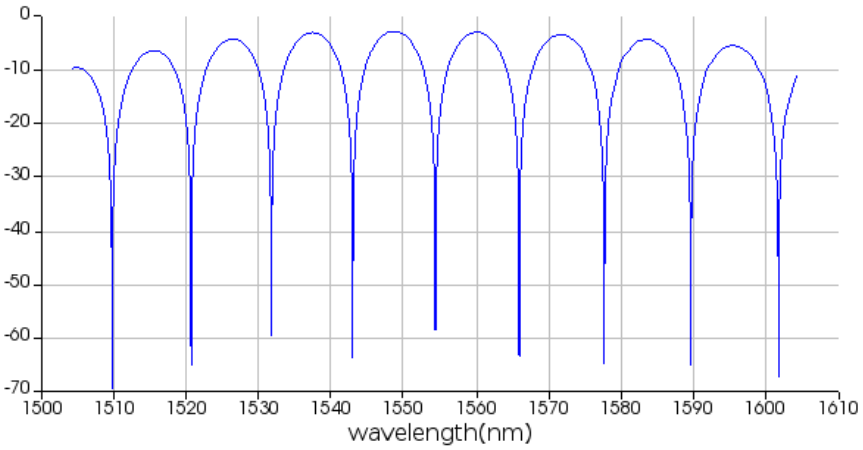

Figure 7: TE gain of MZI

6 Conclusion

This reports describes the theory and design parameters of MZI design in SOI technology, with strip waveguide design. To further test the performance of MZI, ipkiss will be used as layout design tool, and programming parameters will be introduced to the code for different variances of MZI design, including waveguide arm length offset, waveguide width, fully or partially etched waveguide.