Github fork link if needed:
https://github.com/ygao2002/openEBL-2025-02/tree/main/submissions the file named EBeam_ELEC413_GAOYANG

Design and Evaluation of Mach-Zehnder Interferometer Devices for High-Performance Photonic Circuits

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Abstract

Introduction

The objective of this project is to design, simulate, and test a photonic integrated circuit (PIC) that connects a commercial swept tunable laser to a Mach-Zehnder Interferometer (MZI). The design aims to achieve a 25 GHz Free Spectral Range (FSR) operating around the 1310 nm wavelength, with minimal waveguide losses. This report outlines the design intentions, calculations, simulations, and expected outcomes.

Theoretical Calculations

Effective Index (n_eff)

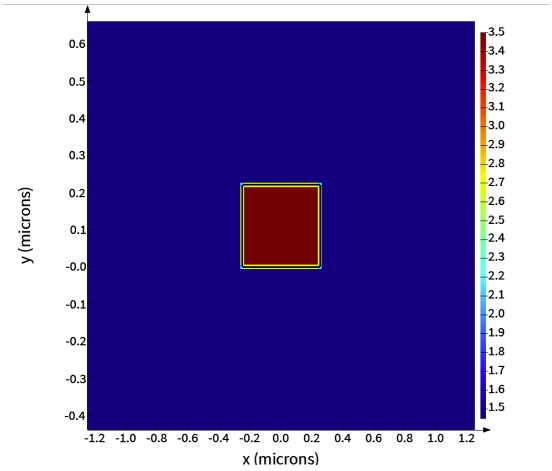
Group Index (n_g)

Free Spectral Range (FSR)

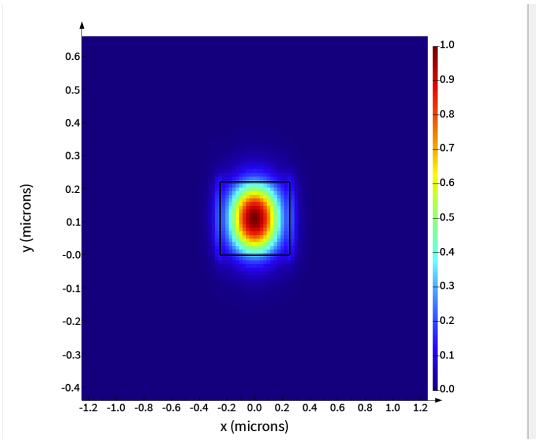
Simulation Approach

Simulations were conducted using Lumerical INTERCONNECT to validate theoretical predictions and refine the design.

- Lumerical MODE



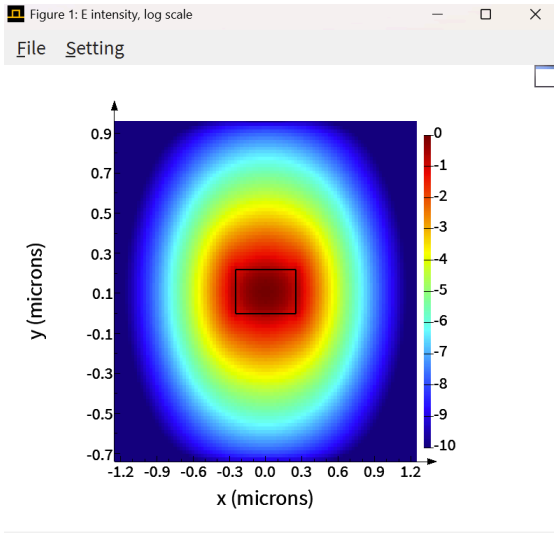
Mesh structure

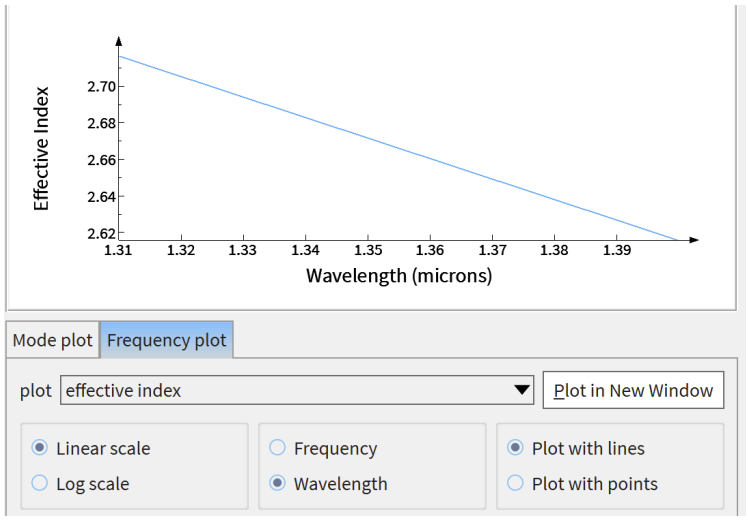


Model fields

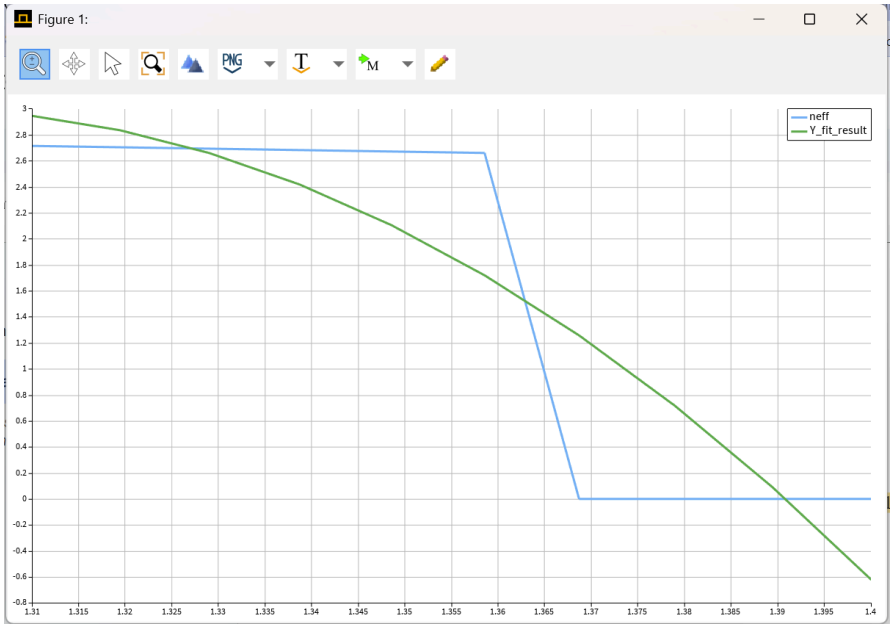
mode #	effective index	wavelength (μm)	loss (dB/cm)	group index	
1	2.713801+1.526226e-09i	1.31	0.00063583	4.174585+3.454967e-09i	99
2	2.168615+1.474021e-09i	1.31	0.00061408	4.681086+5.003704e-09i	4
3	1.823615+1.506743e-09i	1.31	0.00062771	4.713374+7.837469e-09i	86

Calculation result at 1310nm



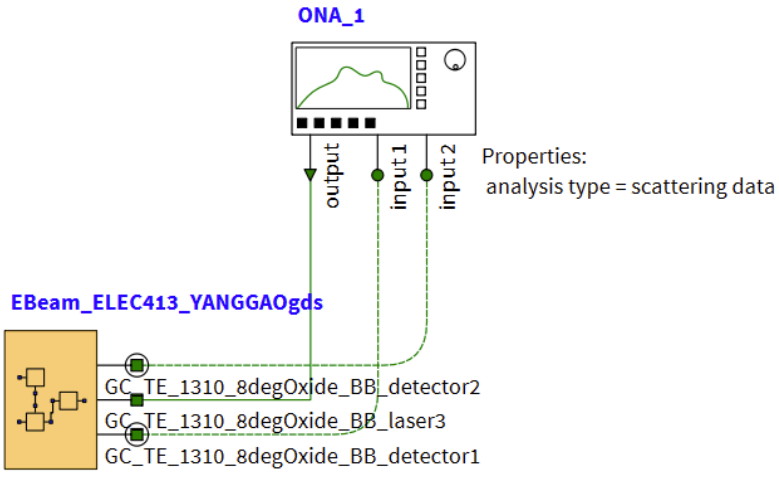


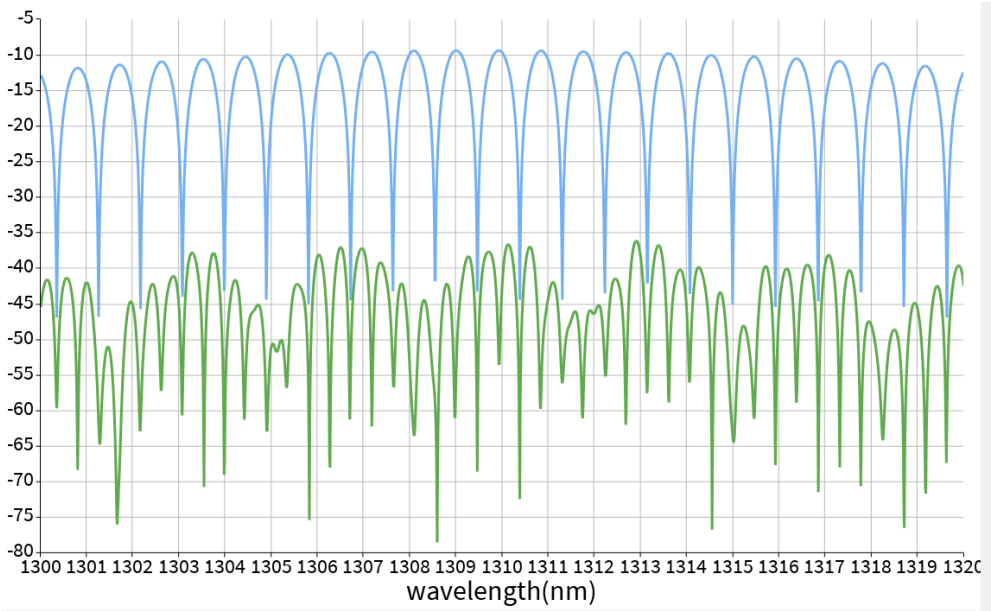
sweep from 1310 to 1400nm




```
result:
2.9448
-8.46418
-346.151
```

- Lumerical INTERCONNECT





Results and Discussion

Conclusion

References

Appendix