IOCP 2024 Conference
The 1st International Online Conference on Photonics
14–16 October 2024 | Online
MDPI

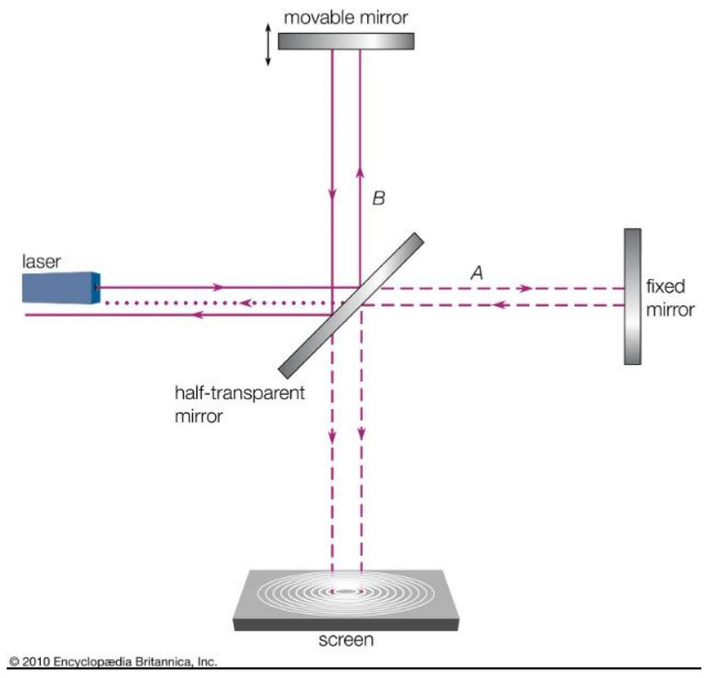
Fast method for the measurement of dispersion of integrated waveguides by utilizing Michelson interferometry effects

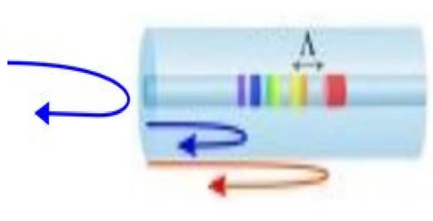
Isaac Yorke[1,2]*, Lars Emil Gutt[2], Peter David Girouard[3] and Michael Galili[2]
[1]Department of Engineering and Architecture, University of Parma, Parco Area delle Scienze 181/A I-43124 Parma, Italy
[2]Department of Electrical and Photonics Engineering, Technical University of Denmark, Ørsteds Plads Bygning 3402800 Kongens Lyngby, Denmark
[3]imec-NL, High Tech Campus 31, 5656 AE Eindhoven, Netherlands

INTRODUCTION & AIM

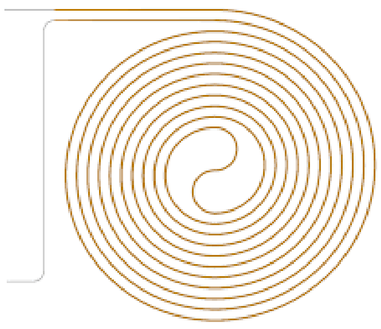
- We demonstrate a method for measuring dispersion of a device under test (**DUT**), which utilizes light reflections at the edge and within an integrated waveguide to create a Michelson interferometer (**MI**). The fringes of the Michelson interferometer depend on the group delay experienced in it.

Main principle of the MI





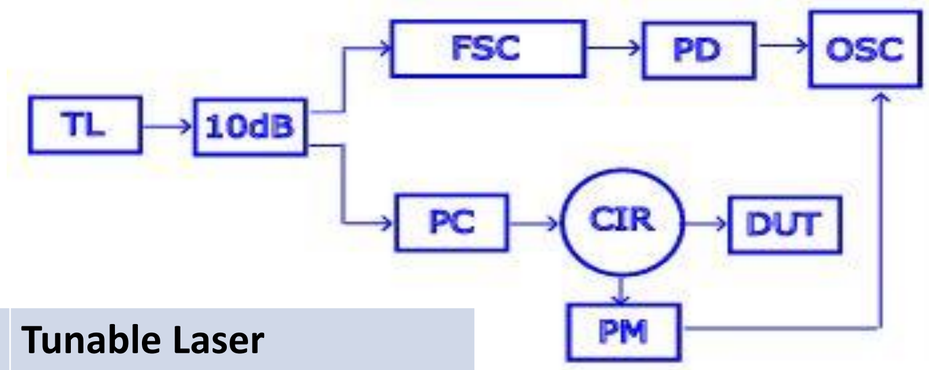
Principle being observed in chirped Bragg gratings



DUT which contains the chirped Bragg gratings

METHOD

Experimental setup to measure spectrum from DUT

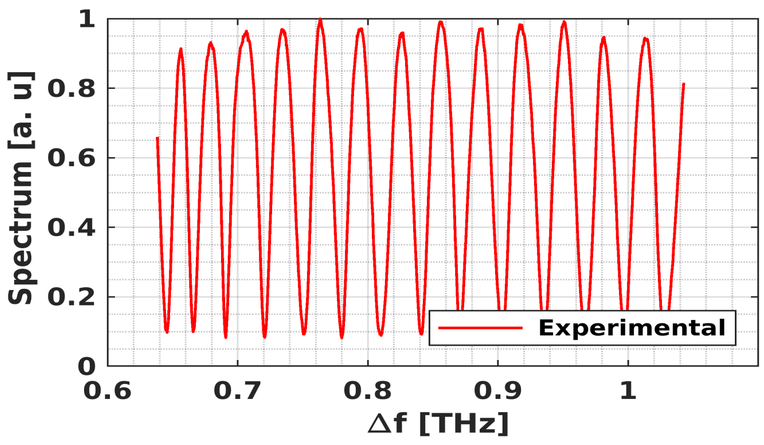


TL	**Tunable Laser**
10dB	**10dB Coupler**
FSC	**Free Space Cavity**
PC	**Polarization controller**
PD	**Photo detector**
CIR	**Circulator**
PM	**Power meter**
DUT	**Device under test**
OSC	**Oscilloscope**

For an optical cavity with a free spectral range of Δf, the group delay (τ) is inversely proportional to Δf [1]. By finding the local period in the reflected spectrum, τ can be found as a function of frequency and from this, the dispersion as the slope of τ.

RESULTS & DISCUSSION

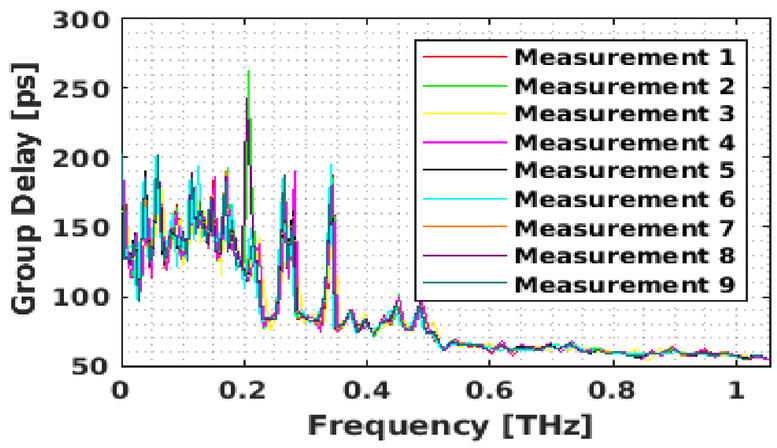
Filtered experimental reflected spectrum



Spacing between peaks (Δf) is varying with frequency.

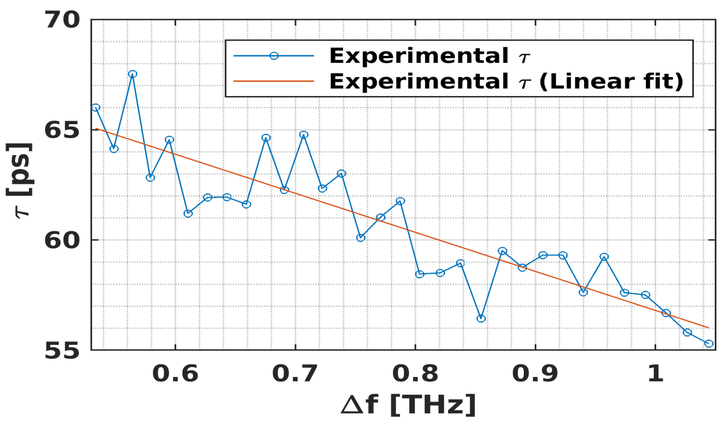
$$\tau = \frac{1}{\Delta f}$$

Group delay measurement



τ as a function of frequency is a linear function with additional oscillations [2]

Curve fit at linear region of τ



DUT is a linearly chirped Bragg grating designed to generate a dispersion of -45.9ps². Dispersion found to be -45.5±11.2ps²

CONCLUSION

Analyzing interferometric fringes from DUT light reflections offers a fast method for measuring Photonic Integrated Circuit dispersion, which aligns well with design values. This approach could serve as an alternative to established methods [3].

FUTURE WORK / REFERENCES

Future works will focus on validation with traditional methods

1. O. Schwelb, J. Light. Technol. 22, 1380 (2004). Journal of Lightwave Technology.
2. O. Belai, E. Podivilov, and D. Shapiro, Opt. communications 266, 512 (2006)
3. B. Costa, IEEE Trans. on Microw. Theory Tech. 30, 1497 (1982)

*Corresponding email: isaac.yorke@unipr.it