

Instalight

-Real-time Simulation of PIC

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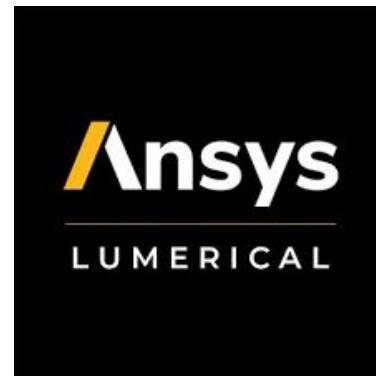
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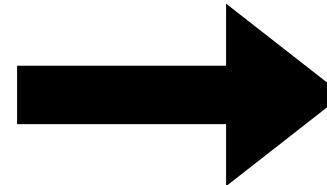
Outline

- Motivation
- Fundamental building blocks
- Live demo
- Outlook
- Reference & Appendix

Why Instalight?



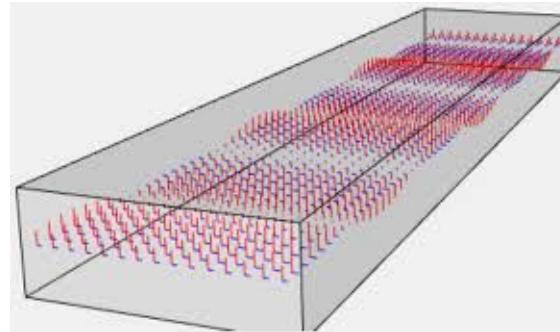
Ansys Lumerical



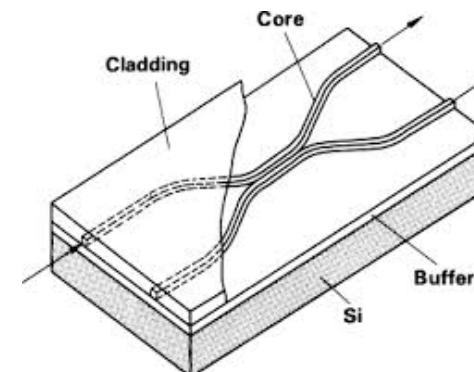
Instalight

- Time-consuming
- “Black box”
- Rigid
- Real-time parameter tuning
- Easy to assemble
- Flexible

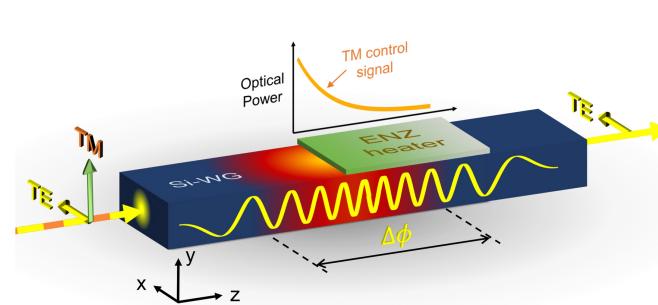
Fundamental Building Blocks



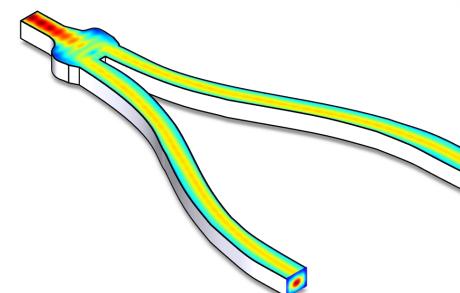
Waveguide



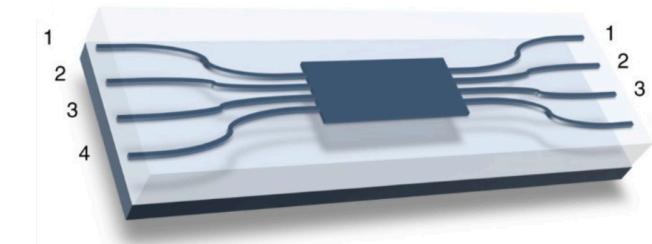
Directional Coupler



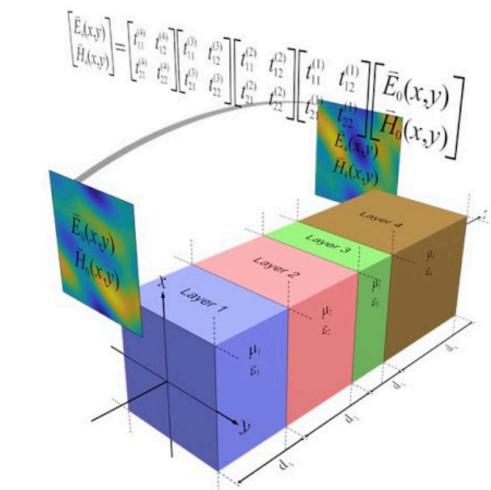
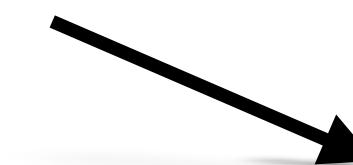
Phase Shifter



Y-Branch



Multimode Interferometer (MMI)



Transfer Matrices

Live Demo



Outlooks

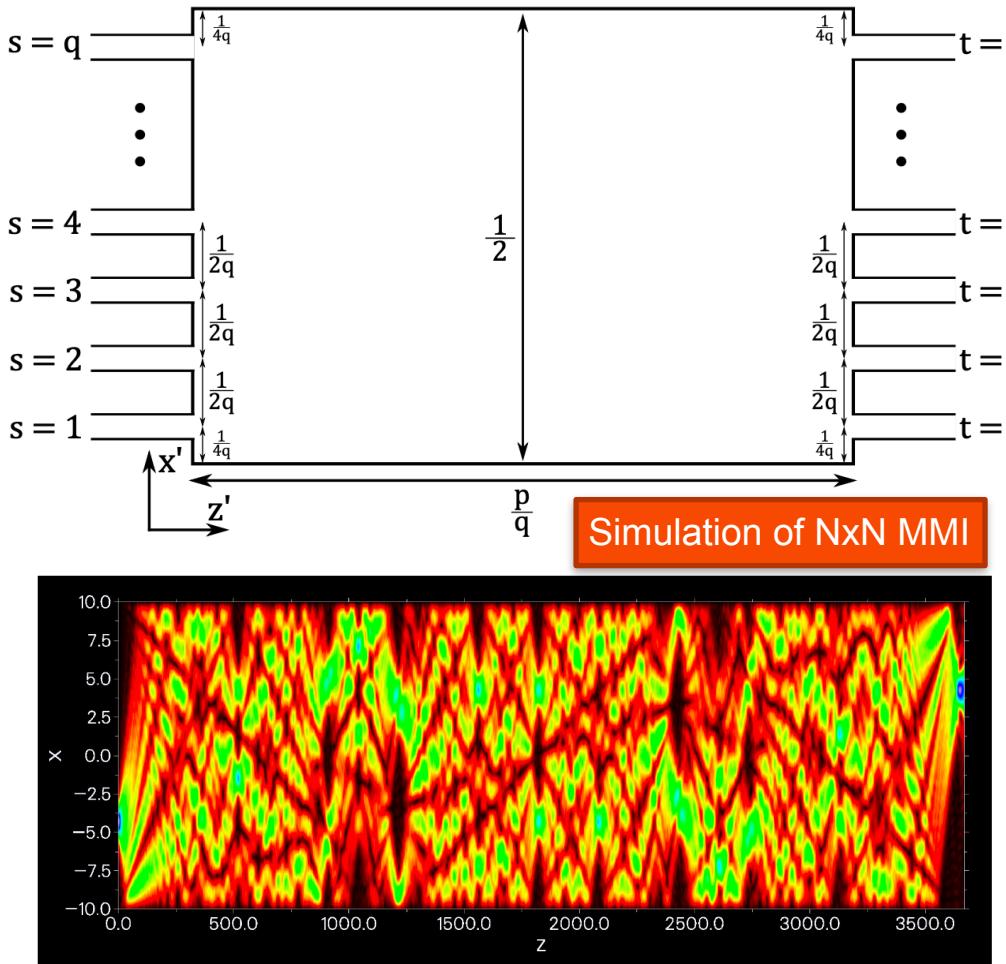
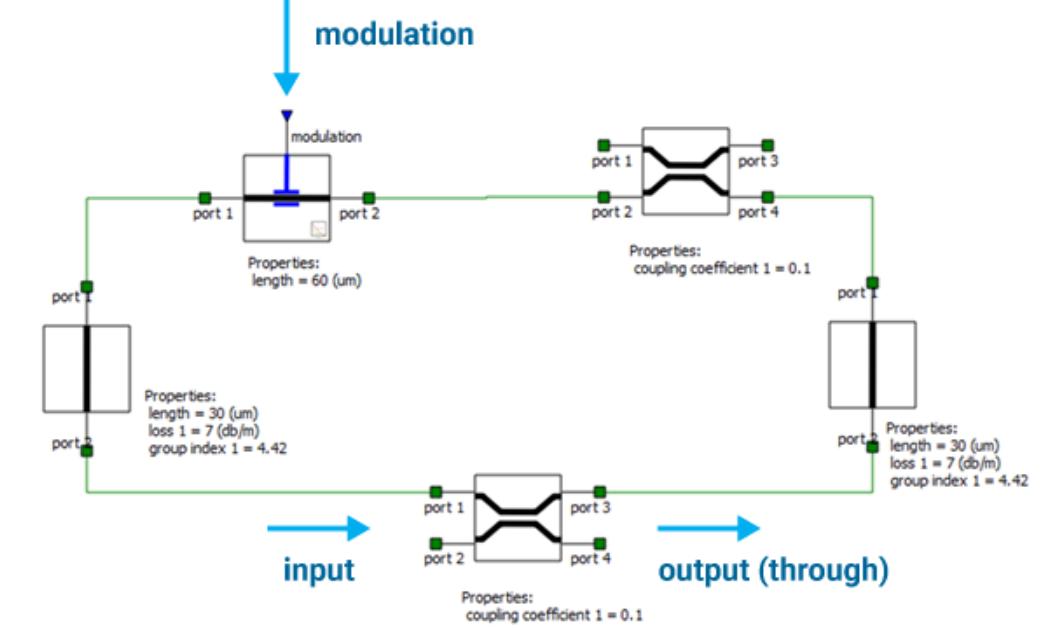


Fig. 3. A single image.



Graphical User Interface (GUI)



Reference

- Optoplex.Com, www.optoplex.com/Optical_Hybrid.htm. Accessed 12 July 2023.
- Mathuranathan. "QPSK Modulation & Demodulation (MATLAB and Python)." GaussianWaves, 7 Nov. 2020, www.gaussianwaves.com/2010/10/qpsk-modulation-and-demodulation-2/.
- "How to Demodulate Digital Phase Modulation: Radio Frequency Demodulation: Electronics Textbook." All About Circuits, www.allaboutcircuits.com/textbook/radio-frequency-analysis-design/radio-frequency-demodulation/how-to-demodulate-digital-phase-modulation/. Accessed 12 July 2023.
- Hang Guan et al., "Compact and low loss 90° optical hybrid on a silicon-on-insulator platform," Opt. Express 25, 28957-28968 (2017)
- Kieran Cooney and Frank H. Peters, "Analysis of multimode interferometers," Opt. Express 24, 22481-22515 (2016)

Appendix

Let $\mathbf{S}(t)$ and \mathbf{R} denote the two inputs to the optical hybrid and $\mathbf{S}(t) + \mathbf{R} \exp[j(\frac{\pi}{2}n)]$, with $n = 0, 1, 2$ and 3 , represent the four outputs from it. Using the PSK modulation and phase-diversity homodyne receiver as an illustration, one can write the following expression for the signal power to be received by the four detectors:

$$P_n(t) \propto P_s + P_r + 2\sqrt{P_s P_r} \cos[\theta_s(t) + \theta_c(t) - \frac{\pi}{2}n], \quad n = 0, \dots, 3;$$

where P_s and P_r are the signal and reference power, respectively, $\theta_s(t)$ the signal phase modulation, and $\theta_c(t)$ the carrier phase relative to the LO phase. With proper subtractions, the two photocurrents fed to the TIA's can be expressed as

$$I_{BD1} \propto \sqrt{P_s P_r} \cos[\theta_s(t) + \theta_c(t)];$$

$$I_{BD2} \propto \sqrt{P_s P_r} \sin[\theta_s(t) + \theta_c(t)];$$