Master Thesis:

Design and Optimization of 3D Freeform Waveguides with Machine Learning

Karlsruhe Institute of Technology

Photonic wire bonding (PWB) is a technology of making 3D freeform polymer optical waveguides by direct laser writing [1]. It enables efficient chip-scale coupling, and multi-chip integration [2]. Modeling, design, and optimization efforts aimed at minimizing propagation losses of 3D freeform waveguides with arbitrary trajectories are of great importance. The commercial fully vectoiral simulation softwares give precise results yet are time consuming. By training neural network with accurate simulation results, we have the potential to predict the loss of a 3D waveguide with arbitrary trajectory in real time, thus enables fast optimization of waveguide trajectory design during fabrication.

Your tasks:

- Simulating the transmission of PWBs with various trajectories.
- Exploring different architectures of neural network for accurate prediction of the waveguide propagation loss.
- Optimizing the design of PWB trajectory.

[1] N. Lindenmann, et al., “Photonic wire bonding: a novel concept for chip-scale interconnects,” Optics Express, 20(16), 17667-17677, 2012

[2] M. R. Billah, et al., "Hybrid integration of silicon photonics circuits and InP lasers by photonic wire bonding," Optica, 5(7), 876-883, 2018

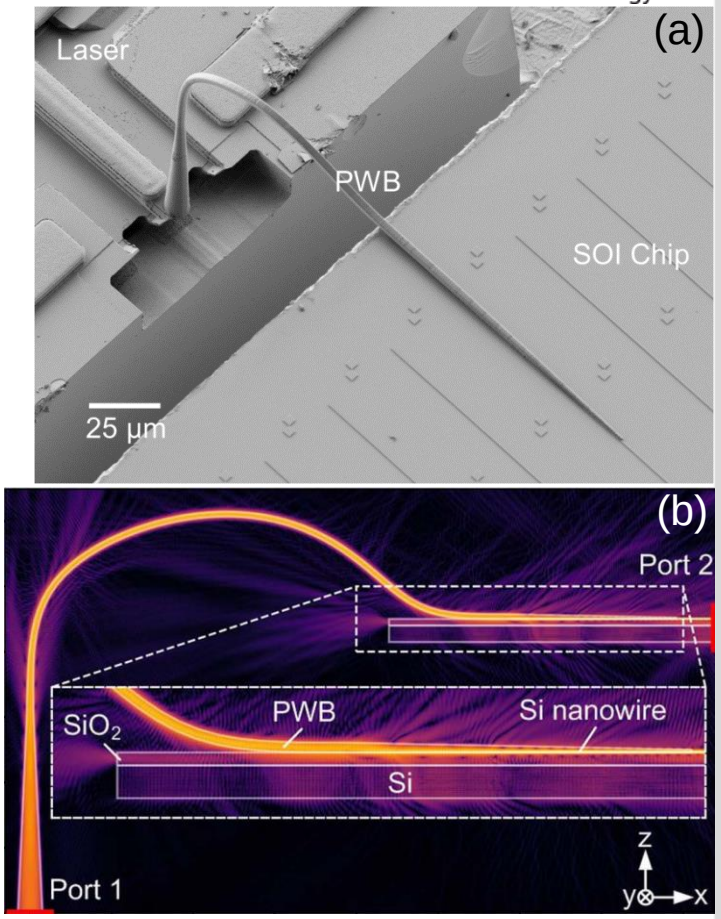

Figure 1: An example showing the distinct advantage of PWB in connecting different photonic integration platforms. (a) a PWB enables efficient coupling between an InP-based horizontal cavity surface-emitting laser (HCSEL) and a silicon on isolator (SOI) chip. (b) normalized intensity of the PWB simulated using a vectorial finite-integration technique (CST Microwave Studio).

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