Waveform Estimation from Nonlinear Systems Using Machine Learning for Rapid Simulation and Design

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2023 IEEE | DOI: 10.1109/RAPID54473.2023.10264747

***Abstract*—Simulating nonlinear systems featuring a dynamic DSP module is cumbersome, e.g., fiber transport with digital coherent receivers. Machine Learning is used to quickly and accurately estimate waveforms transported through multi-span fiber links over multiple launch powers and OSNRs. Replacing simulation techniques with ML is considered.**

Keywords— Machine Learning, Waveform Estimation, Rapid Simulation, Design

I. Introduction

AI-enhanced co-design and evaluation for Micro-electronics/photonics is an increasingly important capability due to the ubiquitous use of DSP and AI within complex

three-span fiber transmission trained using experimentally measured back-to-back (B2B) waveforms with varying OSNRs (18-23 dB) and launch powers (0-8 dBm), with no specific physical modeling. The CNN can quickly (within 180 µs on NVIDIA GeForce GTX Titan X) estimate an accurate waveform (BER within 1dB of experimental) over all other OSNRs and launch powers in the dataset. Cascaded operation to simulate custom systems of varying size and containing dynamic DSP is also considered.

II. Experimental Dataset and Machine Learning

Fig. 1 summarizes the experimental and machine learning work. Experimental data was collected with an 88