

Title: Unified predictive modeling of supercontinuum spectra: Using multi-material data with Closed-Form Continuous Time Neural Networks

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Abstract: This paper explores the application of the Closed-Form Continuous-Time Neural Networks (CfC) model in predicting supercontinuum spectra in a unified dataset of various core materials in a planar waveguide. Through numerical simulations and dataset generation, the study constructs a robust model capable of accurately predicting spectral behavior under different conditions and material variation. Initially, the unified dataset comprises spectral data for three materials: Silicon Nitride (SiN), Lithium Niobate (LiNbO), and Silicon Carbide (SiC). The CfC model demonstrates remarkable accuracy in capturing spectral nuances and exhibits a minimal Mean Squared Error (MSE) loss value of . Subsequently, the dataset is expanded to include Tantalum Pentoxide (TaO), introducing a fourth material for evaluation. The inclusion of TaO data further validates the model's scalability and generalization capabilities with Mean Squared Error (MSE) loss value of . The advantage of the CfC model in precisely predicting supercontinuum spectra while retaining computational efficiency is demonstrated by comparisons with conventional methods. The CfC model is a viable tool for enhancing predictive modeling in photonics research because of its scalability and generalization characteristics. This will pave the way for future developments in deep learning techniques for optical device optimization.

Keywords: Closed-Form Continuous-Time Neural Networks (CfC) Supercontinuum Spectra Planar Waveguides Photonics Silicon Nitride (SiN)

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