

Title: Recurrent Neural Network Architecture to Predict Supercontinuum Generation in Chalcogenide-Silica Hybrid Photonic Crystal Fiber

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Abstract: In this paper, we have introduced a novel deep learning approach as an efficient alternative to conventional numerical simulations for predicting supercontinuum generation in a chalcogenide-silica hybrid Photonic Crystal Fiber. Traditional simulations performed in COMSOL Multiphysics and subsequent supercontinuum spectrum analysis in MATLAB are computationally intensive and time-consuming. Our proposed Recurrent Neural Network (RNN) model, trained from scratch, demonstrates impressive accuracy in forecasting supercontinuum spectral bandwidth, achieving a mean square error of 0.00078784. This accuracy enables us to effectively map the optical characteristics of our model. Our results position the RNN model as a fast and accurate alternative to conventional numerical calculations for predicting supercontinuum spectral bandwidth. By significantly reducing computational time, our model enables rapid predictions of supercontinuum spectra, benefiting early cancer cell detection, frequency metrology, optical coherence tomography, spectroscopy, and hazardous material sensing. This is, to the authors' knowledge, the first exploration of supercontinuum generation using an RNN model in PCF.

Key words: Deep learning , Supercontinuum generation , Recurrent neural networks , Accuracy , Computational modeling , Photonic crystal fibers

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