Memory Optimization for Delay-Based Optoelectronic Reservoir Computing

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Abstract

We modified the traditional reservoir computing (RC) system with an electro-optic modulator as the single working physical node. Additionally, we implemented an optical fiber cable to introduce delayed feedback back into the RC system [1]. The purpose of our research is to leverage simulations to determine the optimal time delay depending on the number of nodes. We are interested in determining if we can increase the performance of our scheme by altering the length of the time delay in the system.

Motivation

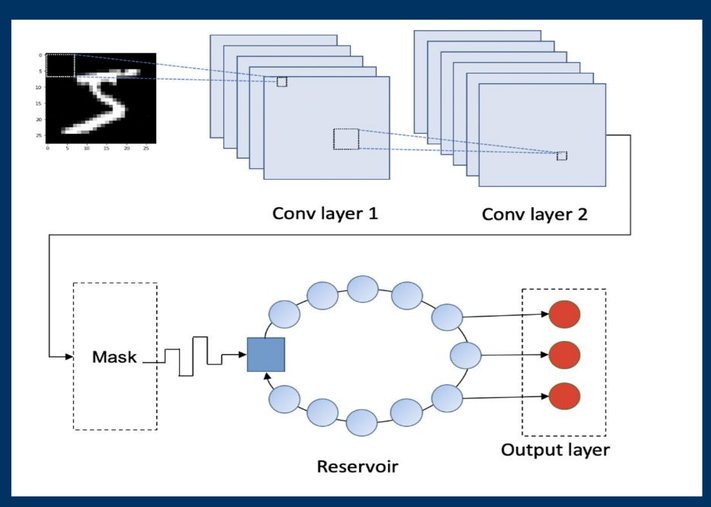
- Creating a compact neural network
- Further increasing the performance of optoelectronic RC systems while performing image classification tasks

Methods

- Computational simulations altering the time delay were performed using MNIST dataset and the CIFAR-10 dataset
- simulations were used to test the theoretical performance of our RC system

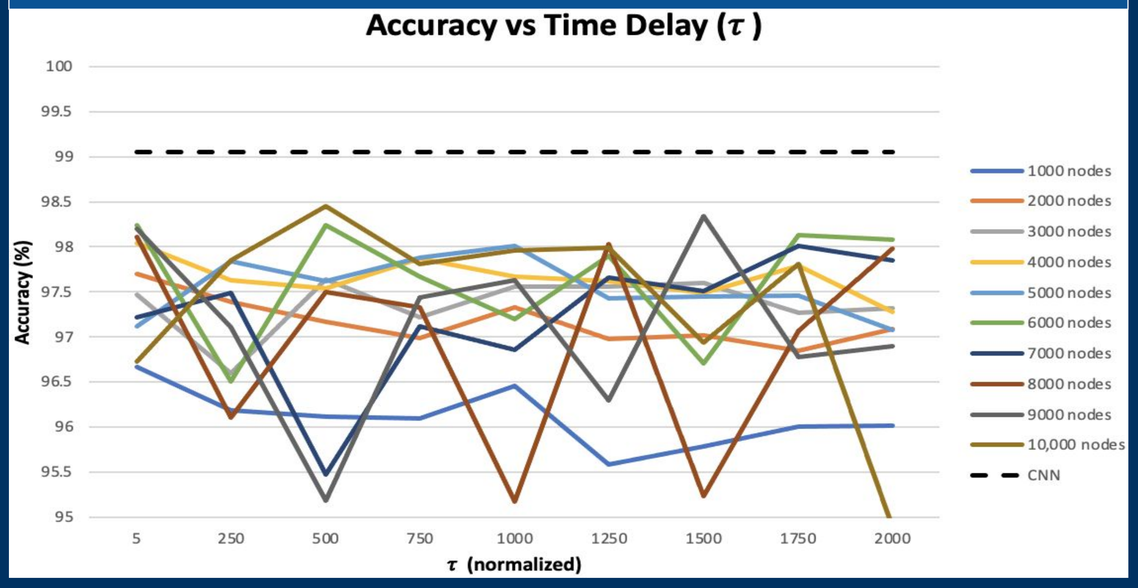
System Overview

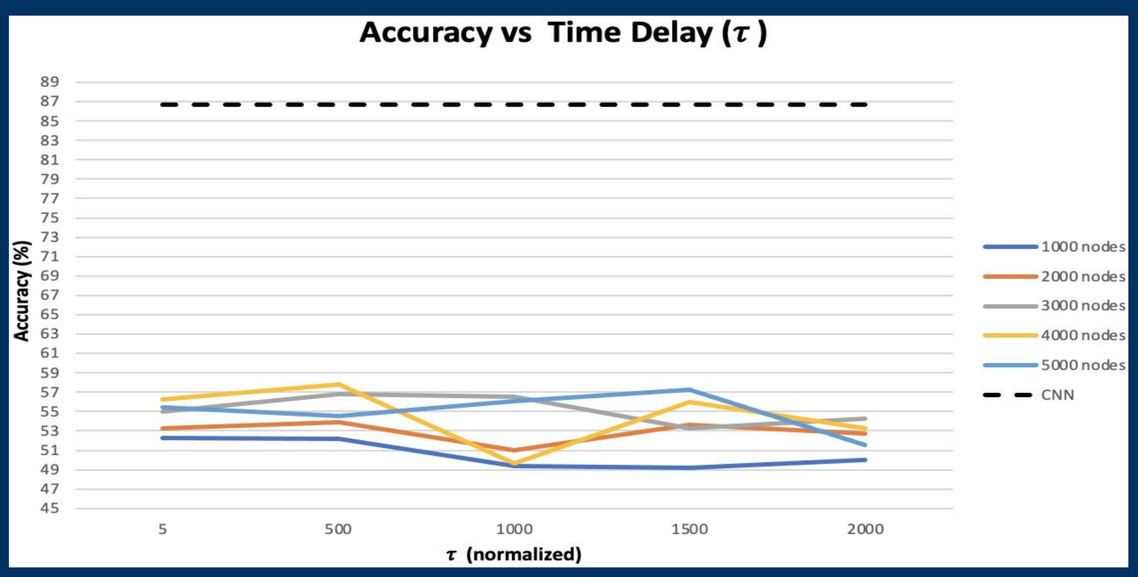
- Preprocessing of data occurs via untrained convolution layers
- Our delay-based RC system uses an Optoelectronic Oscillator as a single physical node
- A DAC is transforms signal before entering the oscillator
- An ADC is used to transform the electrical signal before re-entering the FPGA



This high level image of how data in imputed, classified, and output from our system.
Source: Adapted from [3]

Results and Discussion





We performed a parameter sweep of the time delay across varying number of nodes. We found that varying the time delay did not show a significant, nor a stable increase in performance of our system.

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Citations

[1] H. Jaeger, “Harnessing Nonlinearity: Predicting Chaotic Systems and Saving Energy in Wireless Communication,” Science, vol. 304, no. 5667, pp. 78–80, Apr. 2004, doi: 10.1126/science.1091277

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Supporting Information
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