High-speed time series prediction and classification on an all-optical neural network

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Fig. 2. Experimental results of (a) NARMA-10 prediction task, showing the photonic reservoir predicted output relayed onto the NARMA-10 time series of length 1000. The network was trained on 75% of the series, and tested on the remainder. and Binary earthquake classification problem: (b) sample reservoir input and output for 3 time series, (c) classification confusion matrices for training and testing.

time series, which results in an input sequence of time series as shown in Figure. (b). This input time-series is then fed into the photonic reservoir and the nonlinearly transformed output is recorded. A ridge classifier algorithm is then used to fit the reservoir output and the target classes to obtain the readout weights. Similarly, we then generate an input time series of the testing dataset of size 139x100, pad them with zeroes, and record the reservoir output. We then generate the reservoir predicted classes by applying the readout weights obtained during training onto the optical output. Figure (b) shows the reservoir input and the reservoir output time series sequence for a sample of 3. Figure (c) shows the confusion matrices of the classification problem during training and testing stages. Both the matrices are diagonal, as desired. The classification accuracies during training and testing were 78.9% and 69.1% respectively, which are only slightly below the best reported accuracy of 75.92% [6]. The network parameters were not optimized so a better performance may be achieved.

4. Conclusion

We report experimental results on a NARMA-10 time series prediction task, and a binary classification problem on earthquake sensor data using an integrated nonlinear photonic device as the reservoir node. This serves as a path towards employing nonlinear photonic neurons for high-speed, low-latency neural processing.

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