Performance Evaluation of Techniques for Enhancing Memory Capacity of Reservoir Computing

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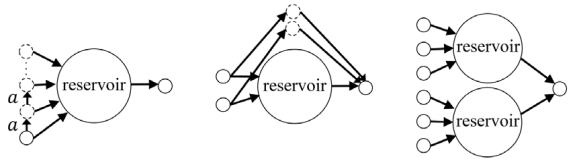
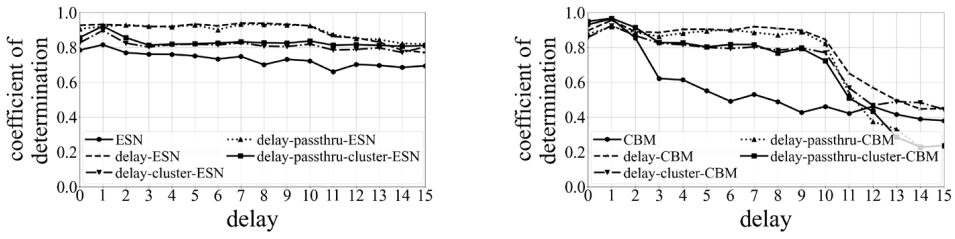
Reservoir Computing (RC) is a bio-inspired machine learning framework and various models have been proposed. RC is a well-suited model for time series data processing, but there is a trade-off between memory capacity and nonlinearity [1]. In this study, we propose methods to improve the memory capacity of reservoir models by modifying their network configuration except for the inside of the reservoirs, as shown in Figure 1. The Delay method propagates past inputs between input nodes for an arbitrary number of steps. The Pass-through method feeds input values directly to the output layer. The Clustering method divides the input and reservoir nodes into multiple parts and integrates them at the output layer. We applied these techniques to the Echo State Network (ESN), a typical RC model, and the chaotic Boltzmann machine (CBM)-RC, which can be efficiently implemented in integrated circuits, and evaluated their performance on the NARMA task. The trade-off between memory capacity and nonlinearity was also evaluated by measuring information processing capacity (IPC).



(a) Delay (b)Pass through (c) Clustering

Figure 1: Proposed methods



(a) ESN (b) CBM-RC

Figure 2: Evaluation results for NARMA tasks

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References

[1] M. Inubushi and K. Yoshimura, “Reservoir computing beyond memory-nonlinearity trade-off,” *Scientific Reports*, Vol.7, No.10199, 2017.