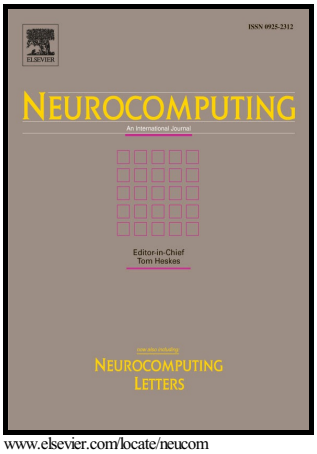

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Map-Reduce framework-based non-iterative granular echo state network for prediction intervals construction

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Abstract

When using interval-weighted granular neural networks (NNs) for prediction intervals (PIs) construction, the iterative prediction mode is always accompanied with error accumulation that is detrimental to the reliability of the PIs. In this study, a granular echo state network (ESN) is developed for PIs construction, in which the network connections are represented by the interval-valued information granules. To cope with the error accumulation caused by the iterative mode, a non-iterative prediction mode is proposed here for the granular ESN. The training process of the granular ESN can be viewed as the optimization of the allocation of information granularity, in which a particle swarm optimization (PSO)-based approach is employed for solving the optimization problem, and the evaluation criteria of the PIs performance, including PIs coverage probability (PICP) and mean PIs width (MPIW), are chosen as the optimized objectives. To improve the computational accuracy and efficiency, a Map-Reduce (MR) framework is designed for the programming implementation of the PSO-based optimization process. Two kinds of time series data, including two benchmark prediction problems and two industrial ones coming from the gas system in steel industry, are employed here to verify the effectiveness of the proposed method. The experimental results indicate that the proposed approach provides a good performance for PIs construction.

Keywords: non-iterative prediction; interval-valued granularity; echo state network; prediction intervals.