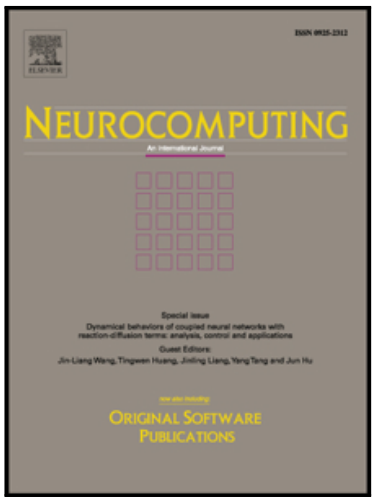

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Gram-Schmidt process based incremental extreme learning machine

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Abstract

To compact the architecture of extreme learning machine (ELM), two incremental learning algorithms are proposed in this paper. The previous incremental learning algorithms for ELM recruit hidden nodes randomly, which is equivalent to implementing a random selection from a candidate set of infinite size. Hence, it is impossible to recruit *good* hidden nodes, and thus it usually requires more hidden nodes than traditional neural networks to achieve matched performance. To improve the quality of the hidden nodes recruited, an incremental learning algorithm for ELM is presented based on Gram-Schmidt process (GSI-ELM), which recruits the *best* hidden node from a random subset of fixed size via defining an evaluating criterion at each learning step. However, the "nesting effect" exists in the GSI-ELM, that is to say, the hidden nodes once recruited by GSI-ELM can not be later discarded. To treat this "nesting problem", the improved GSI-ELM (IGSI-ELM) is generated with an elimination mechanism. At each learning step IGSI-ELM eliminates the *worst* hidden node from the already-recruited group if it is not the newly-recruited one. Finally, to verify the efficacy and feasibility of the proposed algorithms, i.e. GSI-ELM and IGSI-ELM, in this paper, experiments on regression and classification benchmark data sets are investigated.

Key words: extreme learning machine; incremental learning; QR decomposition; Gram-Schmidt process

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