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A RBF Neural Network Modeling Method based on Sensitivity Analysis and Pareto Law

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Abstract

Radial basis function neural network (RBFNN) has been widely used in nonlinear function approximation. In this paper, two limits of RBFNN have been handled which are network complexity and large-scale calculation respectively. Firstly, network complexity, which results from problems of numerous width parameters optimization, is solved by a method of space decomposition based on sensitivity analysis. If a dimension is more sensitive to approximation error, the design space along this dimension is decomposed into several subspaces and the width parameter in each subspace is regarded as an independent variable and optimized respectively. In this way, the number of width parameters to be optimized can be reduced while the flexibility of parameter settings is maintained, so that the approximation accuracy and modeling efficiency can be balanced. Secondly, large-scale calculations, which come from leave-one-out method for cross validation error estimation, are improved by adopting the Pareto law in economic science. According to the Pareto law, referred as " majority is decided by the minority" , we propose to choose only those sample points, which play dominant roles on the global errors, as cross validation points. Then large-scale calculations can be greatly reduced as the cross validation need not be conducted at those samples which have minor effects on the global errors. Combining the space decomposition and leave-one-out methods, the improved RBFNN modeling method based on sensitivity analysis and Pareto principle can effectively reduce the calculation costs and improves the accurate. Finally, several mathematical examples are tested to verify the efficacy of this method.