RBF Neural Network and the problem of approximating multivariable functions

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Abstract: This thesis investigates the application of Radial Basis Function (RBF) neural networks to the problem of multivariate function approximation. While traditional approximation methods often suffer from the "curse of dimensionality," RBF networks offer a powerful alternative due to their simple architecture, strong local generalization capabilities, and universal approximation properties. This study systematically examines the theoretical foundations of RBF networks, focusing on the critical roles of network structure, center selection, and kernel width in determining approximation accuracy. A comparative analysis is conducted between standard RBF networks and alternative approaches, including multi-layer perceptrons and traditional interpolation methods, across various high-dimensional test functions. The results demonstrate that RBF networks achieve superior approximation performance with faster convergence and reduced computational complexity, particularly when employing optimized center selection algorithms such as k-means clustering. Furthermore, the research explores the impact of different radial basis functions on model stability and precision. The findings confirm that RBF neural networks are a highly effective and robust tool for approximating complex multivariate functions, offering significant advantages in both accuracy and efficiency for practical engineering and scientific applications.

Keywords: RBF Neural Network, Function Approximation, Multivariate, Radial Basis Function