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A SELF-ADAPTIVE QUANTUM RADIAL BASIS FUNCTION NETWORK FOR CLASSIFICATION APPLICATIONS

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Abstract. *In this paper, a self-adaptive quantum radial basis function network (QRBF-N) is proposed for classification applications. The QRBFN model is with three layers, while the hidden layer contains quantum function neurons (QFNs), equipped with multilevel activation functions. Each QFN is composed of the sum of sigmoid functions shifted by some specific quantum intervals. A self-adaptive learning algorithm consisting of the self-clustering algorithm (SCA) and the backpropagation algorithm is proposed. The proposed SCA method is a fast, one-pass approach for a dynamic estimation of the number of clusters in the given input data space. The backpropagation algorithm is used to tune the adjustable parameters. Simulation results on the three well-known benchmarking classification applications show that the proposed model outperforms to other relative approaches, in term of higher classification accuracies.*
Keywords: Classification, Quantum function, Radial basis function, Self-clustering method

1. **Introduction.** Classification is one of the most often performed decision-making tasks for human's daily life. In general, a classification issue will be raised when an object needs to be assigned to a predefined group or class, based on the number of observed attributes related to that object. Therefore, many applications in business, science, industry and medicine can be treated as classification problems [1-4].

Traditional statistical classification procedures, such as discrimination analysis, were built up based on the Bayesian decision theory [5]. In these procedures, an underlying probability model must be assumed in order to calculate the a posteriori probability upon which a classification decision can be made. One major limitation of statistical models is that they worked well only when the underlying assumptions were fully satisfied. The effectiveness of these methods highly depends to a large extent on the various assumptions and/or conditions under which the models were developed. Users of these approaches must have well-enough background knowledge of both the data properties and model capabilities before the models can be successfully applied.

Being the trainable pattern classifiers, artificial neural networks (NNs) have been a natural choice due to their strong capability to approximate arbitrary functions and generalization [6]. Nevertheless, there are some disadvantages for using NNs. One of the major disadvantages of NNs is their inability to correctly divide data belonging to regions of feature space where there is overlapping between the existing classes. Aiming to tackle the limitations of conventional NNs, quantum neural networks (QNNs) were developed [7-9].

Conventional NNs and QNNs satisfy the requirements outlined in [10] for universal function approximators. More specifically, QNNs can identify overlaps between classes,