Reconstruction of Multivariate Signals using a Q-Gaussian Radial Basis Function Network

Luiz Eduardo Virgilio Silva*, Juliano Jinzenji Duque, Renato Tinós and Luiz Otavio Murta Jr

Computing Signals and Images in Medicine (CSIM), University of São Paulo, Ribeirão Preto, São Paulo, Brazil

Radial basis function Networks (RBFNs) have been successfully employed in different Machine Learning problems. The use of different radial basis functions in RBFN has been reported in the literature. Here, we discuss the use of the q-Gaussian function as a radial basis function employed in RBFNs. An interesting property of the q-Gaussian function is that it can continuously and smoothly reproduce different radial basis functions, like the Gaussian, the Inverse Multiquadratic, and the Cauchy functions, by changing a real parameter

q. In addition, we discuss the mixed use of different shapes of radial basis functions in only one RBFN. For this purpose, a Genetic Algorithm is employed to select the number of hidden neurons, width of each RBF, and q parameter of the q-Gaussian associated with each radial unit.

Network training is the search for optimal values of the radius and the q-parameter of each radial basis Gaussian. The minimum and maximum numbers of basis function in the mid layer are defined a priori. The k-means clustering algorithm was employed to calculate each set of center positions of the q-Gaussians. In training stage with a multivariate signal with n variable, the network inputs are the n samples of each channel at once, except for the channel which part of the data is missing, which was used as desired output.

Results from testing dataset were precise for good and moderate quality signals. However, if channel which part is missing is very noisy, the reconstruction, in general, was not so good. This fact could be explained by the artificial network training that is strongly dependent on the desired output channel, getting to learn with certain efficiency even when some of the inputs are noisy.