A Radial Basis Function Neural Network for the Detection of Abnormal Intra-QRS Potentials

Chun-Cheng Lin and Weichih Hu*

Taiping, Taiwan, Taiwan

Abnormal intra-QRS potentials (AIQP) in the signal-averaged electrocardiogram are an important noninvasive index for the diagnosis of the risk of ventricular arrhythmias. However the detection of the low-amplitude, broad-band and transient AIQP is not an easy work because of the extremely low signal-to-noise ratio. This study tries to develop a nonlinear neural network using radial basis functions (RBF) to approximate the smoothed normal QRS complex and then to estimate the AIQP using the approximation error, and further to quantify the estimation error of the AIQP. The neuron number of the RBF neural network was set as equal to the dimension of the input QRS complex in the input layer to have enough neurons to approximate the smoothed normal QRS wave. Different spread parameters of the Gaussian kernel function in the hidden layer were adopted to evaluate the approximation accuracy of the RBF neural network. The study was consisted a group of normal subjects and a group of AIQP. The normal group included 42 normal Taiwanese. The AIQP group data was constructed from adding a white noise with a root-mean-square value of 5 micro V into the adjusted QRS complexes of the normal subjects for simulating the presence of the broad-band and random AIQP, and then had the same root-mean-square values of the QRS complexes in the normal group after adjustment. The results illustrated that the mean root-mean-square values of the estimated AIQP in the AIQP group were 2.5 micro V, 3.5 micro V, 2.9 micro V and 2.3 micro V larger than those in the normal group using the spread parameters of 5, 10, 15 and 20, respectively. Hence the maximum accuracy of the proposed RBF neural network for the estimation of AIQP can reach 70% (3.5 micro V compared to the ideal value of 5 micro V) using the broad-band and random white noise to simulate the AIQP.