Abstract

Moustafa Hussein Aly

Reconstructing the Heart Depolarization Pattern from Body Surface Potentials Using Artificial Neural Network

The inverse problem of electrocardiogram (ECG) is an ill-posed problem. Several methods for this problem have been suggested long ago as the regularization technique, with its different types. Artificial neural network technique (ANN) is one of the most important techniques used to solve this problem as it allows a real time solution with minimal processing time. In this paper we present a three-dimensional model of torso-embedded whole heart electrical activity, with spontaneous initiation of activation in the sinoatrial node, showing the electrical activity conduction system throughout the heart. The ANN is trained by data obtained from the forward model by relating the transmembrane potential (TMP) of 58 points distributed all over the heart's surface with body surface potential (BSP) of 81 (9x9) points on the torso's surface. The network is trained by 100 cases each represent a time interval of one millisecond during the depolarization process of 100 milliseconds. This study successfully proves that ANN is able to retrieve the depolarization pattern of the heart at different time intervals. The depolarization patterns of the heart are compared for both the forward and the inverse results at different times. Same steps are repeated for a heart with myocardial infarction. ANN is able to detect the abnormal depolarization pattern and successfully localize the position and size of infarcted region.