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Abstract

Impedance cardiography is a low-cost noninvasive technique, based on monitoring of the thoracic impedance, for estimation of stroke volume (SV). Impedance cardiogram (ICG) is the negative of the first derivative of the impedance signal. A technique for beat-to-beat SV estimation using impedance cardiography and artificial neural network (ANN) is proposed. A three-layer feed-forward ANN with error back-propagation algorithm is optimized by examining the effects of number of neurons in the hidden layer, activation function, training algorithm, and set of input parameters. The input parameters are obtained by automatic detection of the ICG characteristic points, and the target values are obtained by beat-to-beat SV measurements from time-aligned Doppler echocardiogram. The technique is evaluated using an ICG-echocardiography database with recordings from subjects with normal health in the under-rest and post-exercise conditions and from subjects with cardiovascular disorders in the under-rest condition. The proposed technique performed much better than the earlier established equation-based estimations, and it resulted in correlation coefficient of 0.93 for recordings from subjects with cardiovascular disorders. It may be helpful in improving the acceptability of impedance cardiography in clinical practice.

Keywords: Artificial neural networks; Doppler echocardiography; Impedance cardiography; Stroke volume