Myocardial Ischemia Detection Algorithm (MIDA): An Automated Echocardiography Sequence Analysis for the Diagnosis of Heart Muscle Damage

Vijayalakshmi Ahanathapillai and John Soraghan*

Centre for Excellence in Signal & Image Processing, University of Strathclyde, Glasgow, United Kingdom

Myocardial Ischemia or damaged heart muscle does not contract as much as the healthy muscle, resulting in abnormal heart wall movement. Myocardial Ischemia Detection Algorithm (MIDA) is developed to analyze the echocardiography sequences automatically in order to detect the presence of such heart muscle damage within the heart chamber. Firstly, the proposed algorithm involves applying a wavelet transform based speckle noise reduction followed by contrast enhancement using Delaunay triangulation technique to enhance the heart wall boundary. Following this, a Fuzzy multi resolution edge detection method is used to obtain both the inner and outer heart wall boundaries from each Echo scan frame and are subsequently combined to form a composite image. This image contains useful information regarding the movement of the heart wall from the contracted phase to the relaxed phase. Parameters which describe the heart function such as Ejection Fraction, LV Volume, and Cavity area are also determined from heart wall boundaries. Finally, statistical pattern recognition techniques such as Principal Component Analysis (PCA) and Independent Component Analysis (ICA) are applied to extract features which are then classified using a combined k-nearest neighbour (Combined kNN) classifier to identify the abnormal heart wall movement. This Combined kNN classifiers combines different kNN classifier outputs in a way to increase the sensitivity and better classification, when compared with SVM, Naive Bayes and linear classifiers. The total number of patient data used for testing was 62, out of which 27 hearts had normal wall movement and 35 hearts possessing varying levels of abnormal wall movement in different wall segments. A correct recognition of 83.87% was observed with a sensitivity of 82.85% and specificity of 85.18%. The results to date indicate clearly that the proposed feature extraction and classification technique can be used as an effective tool for automatically diagnosing Myocardial Ischemia.