

An Iterative Method for Indirectly Solving the Inverse Problem of Electrocardiography

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Solution of the inverse problem of electrocardiography is an ill-posed problem and noise sensitive, leading to non-physiological solutions under noise conditions. We propose the use of an indirect iterative method for solving the inverse problem in terms of multiple moving dipoles. A database of surface potentials generated by single dipoles was generated by solving by Boundary Element Method the forward problem in an eccentric spheres model of the human torso. The inverse problem was solved by iteratively searching the combination of surface potentials in our database most similar to the observed surface potentials in terms of their relative difference measure.

Simulated surface potentials generated by dipoles randomly located inside the myocardial wall were used to test the performance of the algorithm. Single dipoles were accurately located in 94% out of 1000 simulations. White noise with different signal to noise ratios (SNR) was added to simulated surface potentials in order to test noise sensitivity. Added noise with SNR down to 6dB allowed accurate location of single dipoles in 90% simulations. Double dipoles were accurately located in 78%, evidencing the effect of crosstalk errors. Noise, however, did not have a major effect on the performance of the algorithm, allowing accurate location of dipoles in 72% simulations in which 6dB noise was added. Computing times were dependent on the database resolution, number of nodes in the outer surface and number of dipoles searched. In either case, the presented iterative algorithm always reduced computing times for an exhaustive search (i.e. 0.35 vs. 369 s for locating a single dipole with a database size of 1632 dipole locations). An iterative algorithm to solve the inverse problem of electrocardiography based on comparison of stored surface potentials to recorded potentials has been implemented. The present method has shown to be accurate, time efficient and robust against noise.