

An analysis of the single moving dipole source for electrocardiography inverse problem

Dang T.T., Pham T.M.

Department of Software Engineering, Faculty of Information Technology, Hanoi National University of Education, Hanoi, Viet Nam; Department of Computer Technic and Network, Faculty of Information Technology, Hanoi National University of Education, Hanoi, Viet Nam

Abstract: The electrocardiogram inverse problem is a non-linear and ill-posed problem for which it is very difficult to find an exact solution. In this paper, we presented an efficient and robust method to solve this problem. The heart activity is modeled by a single moving dipole and the human body is considered as finite volume conductor constructed based on an anatomic atlas. For solution method, finite element method is applied to the forward problem. The volume conductor is meshed into arbitrary triangular elements. The efficiency of the methods stems from the employment of genetic algorithm for minimization of difference between the measured potentials and the calculated potentials generated from a predicted dipole source. Finally, the algorithm is successfully tested with simulation model and used to estimate dipole source for real data obtained from 31 electrodes on body surface. As a result, the equivalent dipole always moves clockwise and its direction changes counterclockwise. ©2008 IEEE.

Author Keywords: Electrocardiography (ECG); Finite element method; Genetic algorithm; Inverse problem
Index Keywords: Bioelectric phenomena; Communication; Diesel engines; Genetic algorithms; Inverse problems; Technology; Communication technologies; Electrocardiography (ECG); Exact solutions; Finite volumes; Finite-element methods; Forward problems; Genetic algorithm; Human bodies; Ill-posed problems; International conferences; Inverse problem; Non-linear; On-body; Real data; Simulation modelling; Solution methods; Triangular elements; Volume conductors; Finite element method

Year: 2008

Source title: RIVF 2008 - 2008 IEEE International Conference on Research, Innovation and Vision for the Future in Computing and Communication Technologies

Art. No.: 4586334

Page : 64-70

Link: [Scopus Link](#)

Correspondence Address: Dang, T. T.; Department of Software Engineering, Faculty of Information Technology, Hanoi National University of Education, Hanoi, Viet Nam; email: trungdt@hnue.edu.vn

Conference name: RIVF 2008 - 2008 IEEE International Conference on Research, Innovation and Vision for the Future in Computing and Communication Technologies

Conference date: 13 July 2008 through 17 July 2008

Conference location: Ho Chi Minh City

Conference code: 73565

ISBN: 9.78E+12

DOI: 10.1109/RIVF.2008.4586334

Language of Original Document: English

Abbreviated Source Title: RIVF 2008 - 2008 IEEE International Conference on Research, Innovation and Vision for the Future in Computing and Communication Technologies

Document Type: Conference Paper

Source: Scopus

Authors with affiliations:

- Dang, T.T., Department of Software Engineering, Faculty of Information Technology, Hanoi National University of Education, Hanoi, Viet Nam
- Pham, T.M., Department of Computer Technic and Network, Faculty of Information Technology, Hanoi National University of Education, Hanoi, Viet Nam

References:

- Macleod, R.S., Brooks, D.H., Recent progress in inverse problem in Electrocardiology (1998) IEEE Engineering in Medicine and Biology, 17 (1), pp. 73-83. , January-February
- Jaakko, M., Robert, P., (1995) Bioelectromagnetism, , Oxfoxd University Press
- Gulrajani, R.M., Roberge, F.A., Savard, P., The inverse problem in electrocardiography: Solutions in terms of equivalent sources (1988) CRC Crit Rev Biomedical Engineering, 16 (3), pp. 171-214
- Gulrajani, R.M., The Forward and inverse problem of Electrocardiography (1998) IEEE Engineering in Medicine and Biology, 17 (5), pp. 84-101. , September-October
- Musha, T., Okamoto, Y., EEG dipole tracing (1998) Engineering in Medicine and Biology, 4, pp. 1683-1688
- Musha, T., Okamoto, Y., Forward and inverse problem of EEG dipole localization (1999) Biomedical Engineering, 27, pp. 189-239
- Johnson, C.R., (1994) Numerical methods for bioelectric field problems, , CRC Press
- Johnson, C.R., MacLeod, R.S., Matheson, M.A., Computational medicine: Bioelectric field problem (1993) Proc. of IEEE International Symposium on Bio-Informatics and Biomedical Engineering, 26 (10), pp. 59-67. , October
- Johnson, C.R., MacLeod, R.S., Adaptive local regularization methods for the inverse ECG Problem (1998) Progress in Biophysics and Biochemistry, 69, pp. 405-428
- Silvester, P.P., Ferrari, R.L., (1996) Finite Elements for Electrical Engineers, , New York, Cambridge University Press
- Hoffman, J.D., (2001) Numerical methods for engineering and scientists, , Marcel Dekker Inc
- Chari, M.V.K., Silvester, P.P., (1980) Finite elements in electrical and magnetic field problem, , John Wiley & Sons
- Michalewicz, Z., (1994) Genetic algorithms + data structures = evolution programs, , Springer-Verlag
- Goldberg, D.E., (1989) Genetic algorithm in search, optimization, and machine learning, , Reading, MA:Addison-Wesley
- Chang, Y., Coddington, P., Hutchens, K., (1999) The NPAC/OLDA visible human viewer, , <http://www.dhpc.adelaide.edu.au>, Computer Science Department, Adelaide University, Adelaide, Australia, Available: projects/vishuman2
- Shewchuk, J.R., Triangle: Engineering a 2D Quality Mesh Generator and Delaunay Triangulator (1996) Lecture Notes in Computer Science, 1148, pp. 203-222. , Springer-Verlag, Berlin
- Stefano, D., Marchionni, M., Mattoccia, S., Neri, G., A fast area-based stereo matching algorithm (2004) Image and Vision Computing, 22, pp. 983-1005
- Sun, C., A fast stereo matching method (1997) Digial Image Computing: Techniques and Application, pp. 95-100. , December
- Rush, S., Abildskov, J.A., McFee, R., Resistivity of body tissue at low frequencies (1963) Circ. Res, 22 (1), pp. 40-50