JOURNAL OF INTEGRAL EQUATIONS
AND APPLICATIONS
Volume 21, Number 3, Fall 2009

THE METHOD OF FUNDAMENTAL SOLUTIONS FOR DETECTION OF CAVITIES IN EIT

D. BORMAN, D. B. INGHAM, B. T. JOHANSSON AND D. LESNIC

Communicated by Simon Chandler-Wilde, Ivan Graham and J. Trevelyan

JIEA: A special Issue for the UKBIM6 Meeting

ABSTRACT. In this paper, the method of fundamental solutions (MFS) is used to solve numerically an inverse problem which consists of finding an unknown cavity within a region of interest based on given boundary Cauchy data. A range of examples are used to demonstrate that this technique is very effective at locating cavities in both two- and three-dimensional geometries for exact input data. The MFS is then developed to include a regularisation parameter that enables cavities to be located accurately and stably even for noisy input data.

1. Introduction. Electrical Impedance Tomography (EIT) is a technique in which an image of the permittivity, or conductivity, of the interior of an object such as the human body is inferred from surface measurements of electrical quantities. Practically, this can be achieved by attaching conducting electrodes to the boundary of a person or object and applying small alternating currents to some or all of the electrodes. The resulting voltages are measured and the process repeated for numerous different configurations of applied current. The electrical potential produced across the object containing the cavity depends on the particular location and the electrical properties of the cavity and, as such, it should be possible to use boundary measurements of the voltage to detect and locate such cavities [Hanke and Bruhl 2003, Holder 2005]. This allows an approximate image of the spatial distribution of the electrical conductivity within the object to be constructed [Borcea 2002].

Keywords and phrases. Electrical impedance tomography, inverse problems, method of fundamental solutions.
Received by the editors on November 9, 2007, and in revised form on June 13, 2008.
DOI:10.1216/JIE-2009-21-3-381