JOURNAL OF INTEGRAL EQUATIONS
AND APPLICATIONS
Volume 18, Number 1, Spring 2006

NONLINEAR INTEGRAL EQUATIONS FOR SOLVING INVERSE BOUNDARY VALUE PROBLEMS FOR INCLUSIONS AND CRACKS

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Dedicated to Kendall Atkinson

ABSTRACT. For the problem to determine the shape of a perfectly conducting inclusion within a conducting homogeneous host medium from overdetermined Cauchy data on the accessible exterior boundary, that is, for an inverse Dirichlet boundary value problem, recently Kress and Rundell suggested a new inverse algorithm based on nonlinear integral equations arising from the reciprocity gap principle. The present paper extends this approach to the case of a perfectly insulating inclusion and the case of a perfectly conducting crack. The mathematical foundations of these extensions are provided and numerical examples illustrate the feasibility of the method.

1. Introduction. Inverse boundary value problems for the Laplace equation model electrostatic imaging methods in nondestructive testing and evaluation. Roughly speaking, in these applications an unknown inclusion within a conducting medium is assessed by imposing a voltage pattern at a number of electrodes attached to the boundary of the conducting object and measuring the resulting currents (or vice versa). For these inverse problems the reciprocity gap approach based on Green's integral theorem has been successfully applied, among others, by Andrieux and Ben Abda [**6**] for the identification of planar cracks and by Bryan et al. [**9**] for the reconstruction of cracks with unknown transmission conditions. For the problem to determine the shape of a perfectly conducting inclusion within a two-dimensional homogeneous host medium from overdetermined Cauchy data on the accessible exterior boundary, recently Kress and Rundell [**20**] suggested an inverse algorithm based on nonlinear integral equations arising from the reciprocity gap principle. The purpose of this paper is to extend this approach to the case of a perfectly insulating inclusion and the case of a perfectly conducting crack.

Received by the editors on May 23, 2005, and in revised form on July 26, 2005.