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SENSITIVITY TO MEASURED DATA IN CORROSION DETECTION PROBLEM

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ABSTRACT

In this work we consider the following problem: provided an elliptic partial differential problem, to evaluate the data relative to a part of the boundary of the domain on the basis of the data assigned on the remaining part of the boundary. In technical literature this is known as Cauchy problem and it can be considered a data completion problem for an assigned partial differential operator [1].

This kind of problem arises in many industrial, engineering or biomedical applications. For example in the detection of inclusions or flaws inside bodies [2], in many applications of the electrical impedance tomography [3] and in the detection of the state of corrosion of inaccessible parts of objects [4, 5]. In all these problems the complete reconstruction of the boundary information is a step required to compute the required solution.

The object of the present work is the detection of the corrosion damage parameter [4] along the inaccessible part of the boundary of a body under investigation. The data of the problem, besides all the information relative to the domain such as the geometry and the conductivity of the body, are the prescribed current fluxes and voltage measurements on the accessible part of the boundary. This constitutes a nonlinear inverse problem whose solution, being an ill-posed problem, can be tried on the basis of different strategies, for a detailed account see the recent work [5]. In particular we present a numerical study with the aim to highlight the sensitivity of the computed solution with respect to all factors affecting the available information relative to the accessible boundary such as their quantity and quality and the unavoidable errors corrupting the compatibility of the measured data. The study tries also to quantify this sensitivity with respect to the adopted strategy, in particular we compare strategies based on Tikhonov regularization [6, 7] with those based on the minimization of energy-like functionals [8].

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