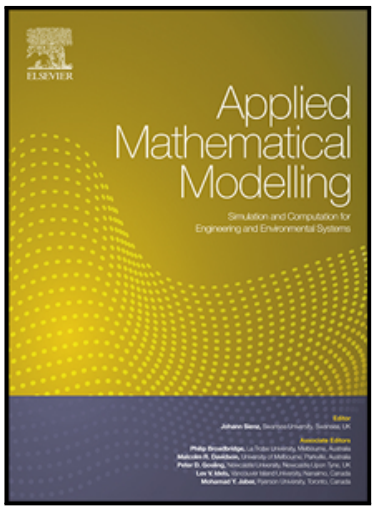

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Energy methods for non-destructive testing in a two dimensional damaged structure

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Abstract

The article investigates the response to ultrasonic exploration using Helmholtz equations. It concerns non-destructive testing in homogeneous and heterogeneous materials. We suggest an energy invariant for detecting a defect. This quantity is more stable than pointwise values for analyzing the echo of an ultrasonic wave. The model avoids reflection of waves on a part of the boundary in order to simulate infinite structures in one direction. The defect is a circular hole or a slit. Numerical tests are presented in order to illustrate the method.

Keywords: non-destructive testing, energy methods, functional analysis

1. Introduction

Non-destructive testing and evaluation have known a considerable development during the last decade, for both safety reasons (nuclear and transport industries) and economical aspects. For instance, the early detection of defects can enable one to repair safely, quickly and cheaply. The new trend in smart structure technology is to equip mechanical systems with health monitoring devices in order to follow in real time the development of defects. An important challenge is to minimize the number of sensors required for an acceptable efficiency of the method. Clearly, this goal requires introducing methods which have the property to explore wide ranges of the structure using only measures performed on a part of the boundary of the structure. As far as ultrasonic methods are used, it is necessary to upgrade the signal processing software which is connected to the actuators and the sensors (piezoelectric devices). Many remarkable contributions from Imperial College have been suggested for instance, in the articles by M.J.S. Lowe [1], G.D. Connolly, M.J.S. Lowe and J.A.G. Temple [2], and the thesis by P.N. Marty [3]. A.J. Mulholland and A. Walker have

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