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Recovery of a space-dependent vector source in anisotropic thermoelastic systems

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Abstract

We investigate the theoretical and numerical determination of a space-dependent vector source (load) in an anisotropic thermoelastic system of type-III form the knowledge of an additional final time measurement. The uniqueness of a solution to this inverse source problem is proved for various assumptions made on the convolution kernel. A convergent and stable iterative algorithm is proposed for the recovery of the unknown vector source in the linear case and, at the same time, a stopping criterion is also given. Three numerical experiments are considered to validate the properties of the proposed iterative procedure and the regularizing/stabilizing character of the corresponding stopping criterion. The numerical experiments carried out showed that it exists a certain limitation of the method with respect to the recovery of non-symmetric sources.

Keywords: anisotropic thermoelasticity, inverse problems, iterative regularization, discrepancy principle, finite element method
2010 MSC: 35Q61, 35K61, 35R09, 65M20, 82D55

1. Introduction

In numerous practical applications related to nuclear power plants, engines and electronic devices, structures of aircraft and propulsion systems, gas and steam turbines, or in chemical reactors, the effect of thermo-mechanical loads acting on the solid body of interest must be studied and analyzed. In such situations, thermal stresses may arise in a heated body because of a non-uniform temperature distribution, external constraints, or a combination of these conditions. Also, the cooling and heating of a solid may be associated with a change of volume and, consequently, the temperature distribution in the body is influenced by the diagonal components of the strain tensor [1]. Green and Naghdi [2] described the heat flow in solid bodies by employing a general entropy balance. According to these authors, the characterization of material response for such thermal phenomena is referred to as type-I, type-II and type-III thermoelasticity. After linearization, the type-I thermoelasticity actually coincides with the classical heat conduction theory (Fourier's law). This theory has the shortcoming that a thermal disturbance at one point of the body is instantly felt

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