A STATE SPACE APPROACH FOR ANISOTROPIC THERMOELASTICITY WITH TIME RELAXATION

Jiann-Quo Tarn* and Hsi-Hung Chang

Department of Civil Engineering
National Cheng Kung University
Tainan 70101, Taiwan, ROC
*corresponding author, Email: jqtarn@mail.ncku.edu.tw

Abstract

On the basis of the state space formalism for anisotropic elasticity and piezothermoelasticity (Tarn, 2002a, b, c) in which the thermomechanical coupling is neglected, we develop a state space approach for generalized thermoelasticity of anisotropic bodies accounting for the temperature-deformation interaction and time relaxation. The classical theory of thermoelasticity (Nowacki, 1975) is included as a special case. By judicious grouping the field variables using matrix notations, the three-dimensional equations of thermoelasticity with generalized Fourier's law of heat conduction are formulated into a state equation and an output equation in terms of the state vector, in which all the field variables and material constants are represented by only 3 vectors and 4 matrices. To obtain the solution for a specific problem it suffices to solve the state equation subjected to prescribed boundary and initial conditions; there is no need to deal with the field equations and thermoelastic variables individually. When thermomechanical coupling is not strong, an asymptotic solution for the problem can be determined by means of perturbation with multiple scales. As illustrative examples, plane harmonic waves propagating in an unbounded anisotropic medium and thermoelastic surface waves traveling along the free boundary of an anisotropic half-space are treated within the context.

References

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