

On investigation of a dynamical thermoelastic model with two phase-lags

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The present paper is devoted to investigation of Chandrasekharaiah-Tzou dynamical nonclassical model for thermoelastic bodies. This model was constructed to eliminate shortcoming of the classical thermoelasticity, such as infinite velocity of thermoelastic disturbances. In the paper [1] Tzou proposed a dual-phase-lag heat conduction model and further Chandrasekharaiah [2] constructed nonclassical model for thermoelastic bodies, where the classical Fourier's law of heat conduction was replaced with its generalization proposed by Tzou. In this model the equation describing the temperature field involves the third order derivative with respect to the time variable of the temperature and divergence of the third order derivative with respect to the time variable of the displacement.

Applying variational approach and suitable a priori estimates the existence and uniqueness of solution of general three-dimensional initial-boundary value problem with mixed boundary conditions corresponding to the Chandrasekharaiah-Tzou dynamical model in suitable Sobolev spaces is proved. In order to simplify algorithms of numerical solution of three-dimensional problem for thermoelastic shell a sequence of two-dimensional initial-boundary value problems is constructed applying approximation method, which is a generalization and extension of the dimensional reduction method proposed by I. Vekua [3] in the classical theory of elasticity for plates with variable thickness. I. Vekua's method and similar spectral methods were applied to various problems of the theory of elasticity and mathematical physics (see [4] and references given therein). The two-dimensional problems constructed for the Chandrasekharaiah-Tzou nonclassical model are investigated in suitable weighted Sobolev spaces. Moreover, it is proved that in corresponding spaces the sequence of vector-functions of three space variables, constructed by means of the solutions of the reduced problems, converges to the exact solution of the original three-dimensional problem and under additional regularity conditions the rate of convergence is estimated.

This is a joint work with Mariam Avalishvili.

Acknowledgment. The work of Gia Avalishvili has been supported by the Presidential Grant for Young Scientists 12/62.

References

- [1] *D. Y. Tzou*: A unified approach for heat conduction from macro to micro-scales. *J. Heat Transfer* *117* (1995), 8–16.
- [2] *D. S. Chandrasekharaiah*: Hyperbolic thermoelasticity: a review of recent literature. *Appl. Mech. Review* *51* (1998), 705–729.
- [3] *I. N. Vekua*: *Shell theory: General methods of construction*. Pitman Advanced Publishing Program, Boston, 1985.
- [4] *G. Avalishvili, M. Avalishvili, D. Gordeziani, B. Miara*: Hierarchical modeling of thermoelastic plates with variable thickness. *Anal. Appl.* *8* (2010), 125–159.