Hierarchical Models of Conduction of Heat in Continua Contained in Prismatic Shell-like Domains

George Jaiani

Abstract

If the quantities, causing deformation and temperature change, vary sufficiently slow from zero to their finite values and remain in such a state, then we have a steady process, i.e., static process as $t \to \infty$. Therefore, displacements and temperature become independent of time and are functions only of the state. Thus, in the equation of conduction of Heat disappear derivatives with respect to time, in particular deformation tensor velocity $\dot{\varepsilon}_{ij}(x,t) \equiv 0$. So, the governing system of thermoelasticity will be split and after solving the independent BVPs for temperature change θ and substituting the found temperature change into governing system of thermoelasticity we arrive at independent BVP of elasticity with the additional (caused by temperature) member. In the theory of temperature stresses, which studies influence of heating the body surfaces and of heat sources on the stress state of body it is assumed that the influence of $\dot{\varepsilon}_{kk}$ involved in the equation of heat conduction on body deformation is negligible.

Thus, for the above-mentioned and for analogous cases it is important to have hierarchical models separately for the heat conduction in standard and prismatic shell-like and rod-like domains occupied by a continuum. In the present paper our purpose is to construct hierarchical models for heat conduction in prismatic shell-like domains Ω. To this and we use I.Vekua's dimension redaction method. We have a definite experience of application of this method, we have constructed hierarchical models: for micropolar elastic cusped prismatic shells, elastic prismatic shells with microtemperatures, piezoelectric viscoelastic Kelvin-Voight prismatic shells with voids for prismatic shells with mixed conditions on face surfaces, layered prismatic shells. The above-mentioned hierarchical models we easily reformulate from elastic to thermoelastic if in the constitutive relations, namely, in expression of stress tensor, to the right-hand side we add

$$-\gamma(x)T(x)\delta_{ij}, \quad \gamma = \frac{\alpha E}{1-2\nu}$$

with the linear thermal expansion coefficient $\alpha(x)$.

George Jaiani
I.Vekua Institute of Applied Mathematics of I. Javakhishvili Tbilisi State University e-mail: george.jaiani@gmail.com

Now, within the framework of the last hierarchical models we may consider the states described at the beginning of the present section and handle them with the way indicated there.