ISAAC Conference, 23-27 April, 2007, Tbilisi, Georgia
Dedicated to the Centenary of I.Vekua

NEW MATHEMATICAL MODELS FOR THIN-WALLED SOLID STRUCTURES AND PROJECTIVE METHODS FOR THEIR SOLUTION

R.Ewing*, R.Lazarov*, V.Makarov** , T.Vashakmadze ***

*Texas A&M University.

lazarov@imath.tamu.edu, richard-ewing@tamu.edu ,

**Inst.Mathematic Uk.NAS,

makarov@imath.kiev.edu,

***.Javakhishvili Tbilisi St.University,

tamazvashakmadze@yahoo.com

The main objective of this report is construction and justification of the new mathematical models for anisotropic nonhomogeneous visco-poro-elastic, piezo-electric and electrically conductive binary mixture and their application in case of thin-walled structures with variable thickness in thermodynamic and stationary nonlinear problems of definition of stress-strain states for thin-walled structures [1]. This investigation could have interesting applications in the areas of pseudo-xsantoma, medical tomography and land mine detection and possible could have an impact in the fields of geophysics, energy exploration, composite manufacturing, earthquake engineering, biomechanics, and many other areas. For the relevant applications it would be necessary to develop and justify new projective numerical-analytical methods. These new methods will be compared with existing methods for problems of that kind and used for recomputating of Basic Elements of Aircrafts. Above proposed models in abstract settings may be presented by the operator equation

$$a\frac{d^2}{dt^2}A_1u + b\frac{d}{dt}A_2u = A_3u + A_4(t,u) + f, \quad t\in[0;T].$$

Here A_1, A_2, A_3—are linear strongly positive operators, A_4— nonlinear operator of Monge-Ampere type acting in some Banach space; *a, b*—matrices with constant coefficients, $T \le +\infty$, u — unknown vector. For different choices of parameters one can obtain equations of various types. We are concern with abstract linear parabolic, hyperbolic with damping and nonlinear variant of such equations. Numerical methods for these problems will be developed and studied (they will be closed to and based on works [1-5]).

Recently constructed methods by Makarov (see f.e.[4,5]), provide an exponentially convergence or convergence without accuracy saturation. These methods lead to sequence of stationary problems which will be solved by FEM and FVEM developed for example in [2,3].

References

1. T. Vashakmadze, *The Theory of Anisotropic Elastic Plates*, Kluwer Acad. Publ. & Springer Verlag, Dortrecht/Boston/London, 1999, 256p.
2. V.A. Dobrev, R.D. Lazarov, P.S. Vassilevski, and L.T. Zikatanov, Two-level preconditioning of discontinuous Galerkin approximations of second order elliptic equations, Numer. Linear Alg. Appl., **13 (9)** (2006), 753—770
3. R.E. Ewing, O. Iliev, and R.D. Lazarov, A modified finite volume approximation of second-order elliptic equations with discontinuous coefficients, SIAM Sci. Comput., **23 (4)** (2001), 1334—1350.
4. Gavrilyuk, I. P.; Makarov, V. L. Exponentially convergent algorithms for the operator exponential with applications to inhomogeneous problems in Banach spaces. *SIAM J. Numer. Anal.* 43 (2005), no. 5, 2144—2171
5. Gavrilyuk, I. P.; Makarov, V. L. Algorithms without accuracy saturation for evolution equations in Hilbert and Banach spaces. *Math. Comp.* 74 (2005), no. 250, 555—583