Tamaz S. Vashakmadze

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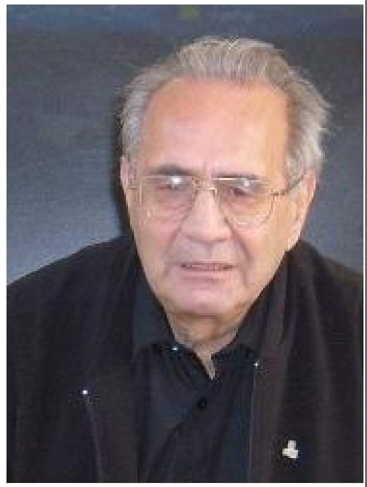

RESEARCH FIELDS

Numerical Mathematics, Mechanics, Computer Sciences, Mathematical Modeling, Differential Equations, Calculus, Informatics.

EDUCATION

1959-62: postgraduate student of Razmadze Inst. of Math. (Academy of Sci. of Georgia),O N-066324
1954-59: graduate student of Tbilisi State University in Mechanics & Mathematics

ACADEMIC DEGREE, TITLE

2005: Academician of Georgian Engineering Academy-N **002018**

1995: Professor-N 103000

Dr. Hab. (Full Professor) in Mechanics of Solids. Preliminary: Lomonosov Moscow St. University Dept. of Mechanics of Solids (**1984**). Officially: Razmadze Inst (**1987**)-ФМ N 004012

Thesis: Solution of Basic Problems of Elasticity Theory for Cylindrical Regions (Opponents: Acad. S. Ambartsumian, Acad. I.Vorovich, Acad. S. Mikhlin (Sankt-Peterburg State University), Prof. V. Kondratiev, Prof.V. Zgenti);

1972: **Senior Researcher** in Numerical Mathematics Computer Sciences-MCH N 067000

1964: Ph. D. (Candidate of Sci.) in Computational Mathematics, Razmadze Inst. МФМ N-003738

Thesis: Numerical Solution of Some Boundary Value Problems for Ordinary Differential Equation (Supervisor: Acad. Sh. Mikeladze, Opponents: Prof. D. Khveselava, Prof. I. Qartsivadze).

WORK EXPERIENCE

2010-present: Emeritus Professor, Invited Professor of Faculty of Exact and Natural Sciences, TSU;
1963-2006-2010: Associate Professor, Professor (part time until 1992), Full Professor, TSU;
1968-2009-present: Senior Researcher, Head of Dept., Leader of Division of Vekua IAM, TSU;
1962-68: Junior Researcher, Razmadze Mathematical Institute.

LONG TERM INTERNATIONAL MISSIONS

2008-2010: Senior-researcher in Uniroma 1, Roma-Milano, Kiev Shevchenko University,1 month;
2001, 2003, 2007: Senior-researcher of College-Park (Maryland) and North Dakota, 5-7 weeks;
1999: Professor-researcher in Delawere Univ. USA by COBASE grant, 6 months,Austin University Texas,10 days.
1984-1988: Lecturer of Summer Schools in Dept of Math., Biophysical Research Centre AS of FSU, 4x4 weeks;
1980: Senior-researcher, Moscow Physical Technical Inst., 3 months, doctorant (Consultant: Acad. O. Belotserkovski);
1972: Senior-researcher of Weimar Inst. Architecture and Baumvesen, 4 weeks.

AWARDS AND GRANTS

2017,23.10: Spase map 0.7X0.7X0.12 of the Mediterranean Sea Region did by Admiral Piri Reis,
2017,14.05: Honor Mantle of Harran University of Shanli-Ulfa,Turkey
2016: Certificate of Association of Mathematicians Turkey (for foreign mathematicians) “International Lifetime Achievement for Mathematics Award” with silver plate
2015: Co-Chairman Sci./Prog. Commission TICCSAM-2015 Shota Rustaveli NSF
2013-2015-Grant Shota Rustaveli NSF-AR/320/5-109/(Main worker)
2013: Presidential order of Excellence N-174,Certificate N-149
1997, 2009: Medals of Iv. Javakhishvili;
2006-2008-Grant of GNSF/ST 06/3.035,Georg.Ministry ES(Main worker)
2005-2006 –Grant of ST Committee of Georgia, N1.01.74(Leader)
2003: Honor order, N182;
1999: Premium of COBASE (6 months, Professor-Explorer in University of Delaware);
1997-1998: Grant of ST Committee of Georgia(Leader)
1993-Short-Term, **1995-96-**Long-Term-KZB200 (Leader of Group) Premiums of ISF (G.Soros Foundation);
1993: Premium of Ilia Vekua Georgian National Academy of Sciences;
1976-1979: Govenment grant 0.80.14.09.20 of STCommittee of FSU(Leader of group))
1959: The First Premium of Diploma Works Tbilisi State University.

CONSULTANCY, POST GRADUATE STUDENTS

Consultant of Dr.Hab. (Full professors): Givi Kiziria, Avthandil Tvalchrelidze, Jemal Rogava;
Supervizors of PhD (Candidate of Sciences): Alex Dolidze, Givi Pavlenishvili, Jemal Rogava, Guram Gvinchidze, Iacob Upor, Gia Dzodzuashvili, Archil Papukashvili, Roman Dzneladze, Aliki Muradova, Eka

Gordeziani, Vakhtang Khukhunaishvili**(see** Autoreferences and “Act on Collaboration of Research works “ between Zavriev Inst**.**SCM and Vekua IAM,14.05.1986).

Supervisor of doctorates: Gela Manelidze (published 9 works), Dimitri Arabidze-4 works, Revaz Chikashua-4 works ,

Leader of more than 70 diploma and master works.

PUBLICATIONS

Articles, thesis and reviews: about 190;
Monographs and manuals: 7; (for details see the list of publications)

NOMINATIONS

Prof. T. S. Vashakmadze was presented: on R.**Wolf Foundation (2011),J.Latsis(2012,C.F.Gauss (2016)** premiums, Academician member of NAS of Georgia (2016) without advances

OTHER PROFESSIONAL EMPLOYMENT

Member of Editorial Boards: Vekua Institute of Applied Mathematics (4 journal), International Journal JAFA (Memphis);
Main editor: "Proceedings of Javakhishvili Tbilisi State University, Applied Mathematics and Computer Sciences“ (1999-2004);
Correspondent: Math. Reviews, Zentralblatt, RJMat (1967-1980);
Vice-president: GUTAM and Society of Sci. History;
Membership: Presidium of GMU, ISIMM(1979), ISBEM(1990), ISPOROSci (2002);
Member of organizing commitees: 20 All Union of FSU and International conferences.

TEACHING AND TRAININGS

1963-present: Lecturer in Tbilisi State University,
Basic and Advanced courses and corresponding syllabuses:

- Mathematical analyses and analytical geometry,
- The DE of Mathematical Physics,
- Numerical Methods,
- The mathematical theory of elastic plates and shells,
- The theory and applications of orthogonal functions,
- Projective Methods,
- The technology of solutions of systems of linear alqebraic equations with rare matrices,
- Introduction in one and two-dimensional spline-function theory,
- The mathematical modeling of some problems of solid mechanics,
- Programming,
- Spline-functions Theory and some Applications.

1962-present: For education of researchers and students gives **Seminars** on the following topics:

(I) Projective and Numerical Methods (from 1962),
(ii) Direct Methods of Mathematical Physics (from1968),
(iii) The mathematical theory of elastic plates and shells (from 1971),
(iv) High order finite difference schemes and finite elements method (1972-1974, with Prof. Solomon Mikhlin).

PARATICIPATION IN INTERNATIONAL CONFERENCES AND SEMINARS

More than 180 reports, invited and plenary lecturers in Armenia, Austria, Azerbaijan, Belarus, Czech Rep., China, Estonia, France, Germany (FRG and DDR), Greece, Italy, Japan, Kazakhstan, Kirgizstan, Moldova, Netherlands, Poland, Portugal, Russia, Serbia, Slovakia, Turkey, Ukraina, USA, Uzbekistan.
In 2016-17 yy. plenary reports and invited speakers: 3- in Elazig and Ankara Universities,ICST in Ankara(2016),5- on V conference of Math.Dept.VIII –ICGUM Tbilisi State ,Harran,P.Reis Universities.(2017)

*LETTERS **AND REFERENCES***

R1. **R.Bellman, R.Calaba**, Quasilinearization and nonlinear boundary value problems, American Elsevier Publ. Co., New York, 1965.
R2. **P. Henrici**, Mathematical Reviews vol.31-2-17749, On the numerical solution of baundary-value problems by T. S. Vashakmadze.
R3. **W.Bekker**, Zentralblatt fur Mathematic und Mechanik, 0936.74003,The Theory of Anisotropic Elastic Plates by T.Vashakmadze.
R4. **Book review**: The Theory of Anisotropic Elastic Plates by T.Vashakmadze, J.Georgian Geophysical Society, Issue A. Physics of Solid Earth, vol.9A, Tbilisi, 2005, pp.121-123.
R5. **P. Ciarlet**, Mathematical Elasticity, vol.II: Theory of Plates, NH, 1997.
R6. **S. Antman**, Nonlinear Problems of Elasicity, second edition, Springer, 2004.
R7. **V. Chavchanidze et al.**,The sign of progress of Georgian Mathematical Society, Newspaper “Tbilisis Universiteti,” 08 April, 2004 (in Georgian), 1 complite page A2.
R8. **C. O. Horgan**, The Theory of Anisotropic Elastic Plates by T.Vashakmadze, SIAM Review, 42, 2000, p.750.
R9. **T. Ebanoidze**, From Mathematics to Edgar Allan Poe, Newspaper “Svobodnaia Gruzia,” 14 July, 2007 (in Russian), half page A4 (with the picture of T.Vashakmadze).
More than 10th letter in newspapers

List of publications of T. S. Vashakmadze

A: Monographs and Text Books

1. The Approximate Methods of Solution of Problems of Math. Physics. Works Collection. Tbilisi University Press, 1975 (with L. Magnaradze)
2. Package of Applied Programs of Design of Spatial Structures. Tbilisi University Press, 1982, Vol.1:165p., Vol.2:161p.

3. Some Problems of Mathematical Theory of Anisotropic Elastic Plates. Tbilisi University Press, 1986, 176 p. (in Russian).
4. The Theory of Anisotropic Elastic Plates. Kluwer Academic Publishers , Dortrecht/ Boston/London, 1999, xv+240p.
5. Theory and Application of Spline Functions, Course of Lectures, Moodle program of Textbook with electronic version for Students and Researchers, Javakhishvili Tbilisi State University , 75p, 1996.
6. The mathematical theory of elastic thin-walled structures, Moodle program of Textbook with electronic version for Students and Researchers, Javakhishvili Tbilisi State University, 2007, 60p (in English, Geogian, Russian).
7. Numerical Analysis, I, Tbilisi University Press, 2009, 188p (in Georgian).
8. The Theory of Anisotropic Elastic Plates. Springer; 2nd Edition, December 2010, 256 pages.
9. Tamaz Vashakmadze-75 ,Tbilisi Univ.Press,1975(Editor G.Kkipiani)

B: Edited Books (4)

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1.Proceedings of Vekua's Institutes of Applied Mathematics, Vol. 44 Tbilisi University Press, 1992(Editor: T. Vashakmadze).
2.A. Razmadze, Course of Integral calculus,part II,The Definite Integrals, Tbilisi University Press ,2004 (Editor I. Qartsivadze, Referee T. Vashakmadze)
3.Memoirs and Letters, Dedicated to Andrew Razmadze, (Editor-Complier T. Vashakmadze), Tbilisi University Press, 1993).

BRIEF DESCRIPTION OF SCIENTIFIC ACHIEVEMENTS Observe of some results

Professor T. Vashakmadze's achievements can be summarized in five directions:
Direction I (D.). Creation of mathematical theory of elastic thin-walled structures (TWS) by decision problems(see [4]):
Pr.1. Construction of finite models of TWS without simplifying hypothesis (SH) of theories of group A (among them classical and well-known refined theories),
Pr.2 Investigation of convergence, estimation of error transition, effective solvability of 2-dimemsional models of group B (containing regular processes)
D.II. Creation of optimal methods of investigation and computation of some classes of initial and boundary value problems (BVP) of ordinary differential equations(ODEs)
D.III. On the uniform systems of governing equations of Continuum Mechanics and some generalizations
D.IV. Informatics, Problems of Linear Algebra, Scientific Computing with Programming Languages
D.V. To Theory of Distributions, **Laws of the Unity and Conflict of Opposites and Negation of the Negation**

Direction I. With respect to Pr.1, 2 main results look as:
1.1. The method of construction of refined theories and new analogous models (without SH with arbitrary control parameters and having continuum capacity) were elaborated. The exact analytical expressions were found for corresponding remainder vector. Using those expressions and by applying new technology for error transition the unimprovable estimates were obtained, which represents the fact of negative invention. The principal aspects of those estimates are the same with Chladny's experiments for vibrating plates. Many principal authors in this field (including *Euler*,

Bernulli, Germen, Navier, Kirchhoff, Love, Filon, Poincare, von Kármán, Timoshenko, Reissner, Henky, Mindlin, Goldenveiser, Landau, Donnel, Vorovich, Vekua, Koiter, Naghdy, Ambartsumian, Vashicu, Lucasievich, Antman, Ball, Ciarlet, Destuynder,…)assumed that their theories gave an approximation (in physical, geometrical, asymptotical or other meanings) to initial 3D BVP for TWS of theory of elasticity, but Prof. Vashakmadze proved that for each one from finite theories the transition error is bounded from below. We can cite here Edgar Allan Poe's words:"And yet, for centuries, no man, in verse, has ever done, or ever seemed to think of doing, an original thing. The fact is that originality (unless in minds of very unusual force) is by no means a matter, as some suppose, of impulse or intuition .…A positive merit of the highest class demands in its attainment less of invention than negation" (The Philosophy of Composition,1846).

1.2. Based on works [, the method of constructing the anisotropic inhomogeneous 2D nonlinear models of *von Kármán-Mindlin-Reissner (KMR)* type for binary mixture of porous, piezo-magneto–electric and electrically conductive and viscous elastic TWS with variable thickness is given. In particular ,the *Truesdell* Problem (formulated in 1978) with respect to "Physical Soundness" of *von Kármán* system was solved. Against the *Ciarlet* elaborations [1,Ch.5] the corresponding variables are the quantities with physical meaning such as the averaged components of the displacement vector, bending and twisting moments, shearing forces, rotation of normals, surface efforts. From *KMR* (by choosing the parameter with some additional physical assumptions) the *von Kármán* system as one of possible models is obtained. The given method differs from the classical ones by the fact, that according to classical method one of the equations of *von Kármán* system represents the *Saint-Venant-Beltrami* compatibility condition *(* remarked by *Podio-Guidugli too).* For isotropic and generalized transversal elastic plates in linear case *KMR* have the unified representation as the systems of *Cauchy-Riemann* DEs in terms of planar expansion and rotation. For dynamical case (along the values describing the vertical directions and *Rayleigh-Lamb* surface wave processes) the quantity $\Delta\partial_{tt}\Phi$ (Φ denotes Airy stress function) appears too.

1.3. Given are generalized *Hellinger-Reissner* variational principle and method of constructing *MR-Filon* type refined theories for nonhomogeneous plates with variable thickness without assumptions of geometrical or physical characters, some well-known paradoxes of classical refined theories are explained, a member, characterizing new edge effects and different for well-known classical layer one is discovered. This correction is situated in bounds of *KMR models.*

2.1.Considered are *Vekua* and piecewise type processes when on surfaces of plates the linear form of stress tensor and displacement vector are given.

For justification of *Kantorovich-Vekua* type projective methods: i) the problem of basis property of Jacobi polynomials is studied, ii) for remainder members of *Fourier-Legendre* series synchronous exact estimates with respect to a thickness h and N-number of approximation are given.

For BVP of *Vekua* type systems DEs: i) for any $N \leq \infty$ there are truly *Korn's* type inequalities,ii) for the transition error in Sobolev's space of functions exact estimates with respect to h and N are obtained and the convergence of corresponding processes is proved, iii)there are constructing factorized schemes(*Rutishauser* or *Gauss* types) by means of which an approximate solution for any $N< \infty$ can be found,

2.2. New regular processes of approximate solution of 3Dim linear initial BVP is developed .The model is constructed on the basis of refined representations which have been already set in 1.1 and finite linear broken element method is created. The system, corresponding to this model, is reduced to the inversion to the operator of comparatively simple structure m-times, where m denotes the number of pseudo-layers and defines the exactness of approximation of the initial problem by two-dimensional one. The full split factorized scheme of the solution assumes complete parallelizability of the algorithm. The estimate of transition error and the convergence of corresponding processes follow immediately by using methods of functional analysis, in particular, methods of energetic inequalities and *Lax-Milgram's* technology.

Direction II , II.1.BVP for ODEs

Recently an interesting book of encyclopedic character has been published:"The Princeton Companion to MATHEMATICS" (Editor *Timothy Gowers*). Here (page 603) we can find among major results the numerically stable, rapidly convergent *Gauss* (with optimal netpoint roots of Legendre polynomials) and *Clenshaw-Curtis* (with interpolation points cos(jπ/n), 0≤j≤n) quadratures. The last one (unlike *Gauss* rule) can be executed in O(nlogn) arithmetic (Horner unit) operations by the *Fast Fourier Transform* (*FFT*). Further for the field " Numerical methods of solution of DEs" the great problem is optimization (minimization in certain sense) of arithmetic operations for calculation of the approximate solution(AOS).We remind that for *Cauchy* problem AOS order is O(1/h),where h is mesh width. Below in this connection we consider BVP of ODEs. Let us divide BVP into two classes. We include in the first class the problems satisfying the *Banach-Picard-Schauder* conditions and in the second class- BVP when they satisfy Maximum Principle.

For the first class investigated were (with linear boundary conditions) the problems of solvability, construction of numerical schemes, the error estimation of approximate solutions, convergence of corresponding processes and an estimation of the number of AOS. In this direction the following statement is typical:

Stmt.1.*The order of arithmetic operations for calculation of approximate solution and its derivative of BVP for nonlinear second order DE of normal form (or with small parameter)with Sturm-Liouville boundary conditions is O(nlnn) Horner unit. The convergence of the approximate solution and its derivative has (*p-1*) order with respect to mesh width h=1/n if y(x) has (p+1) order continuously differentiable derivative .If the order is less than p, the remainder member of corresponding scheme has best constant in Sard's sense.*

We remark that in this case the basic apparatus are special spline-functions (named as $(P),(Q)$ formulas and are the high order finite elements too) and Cesáro-Stiltjes type method of finite sums, both elaborated by *Vashakmadze*. These results refined and generalized corresponding results by *Shroder,Collatz,Berezin&Jidkov Quarteroni&Buthcher&Stetter*, having first order of convergence and AOS is O(n^2logn). First order of convergence with respect to n, where n is the number of subintervals, has the Multiple Shooting method (*Keller,Osborne,Bulirsch*) but the order of AOS is no less than O(n^2).

For the second class the corresponding results which are cited in classical textbooks of *.Collats, .Henrici,Keller,Richtmaier.Engel-Miugler&Router,Berezin&Jidkov,Marchuk.Kantorovich&Krilov, Strang&GFix,de Boor* and recent manuals(e.g.monographs of *Quarteroni&Buthcher& Stetter,Bulirsch&Stoer*) may be formulated in the following form:

by finite-difference or FEM methods, the approximate solutions converge to exact solution with no more than fourth order with respect to mesh width, AOS are O(1/ h). Further the high order accuracy three point schemes were obtained by *Tikhonov& Samarski,Volkov*. The constructions of these models contain unstable processes and the orders of AOSs are no less than two because an employment of multipoint formulas of numerical differentiation is necessary for them.

For this second case the same results of **Stmt.1** aretrue.:

Stmt.2.*Let us consider the BVP for linear second order DE (when the principal part has selfadjoint form too or contains small parameter)with Sturm-Liouville boundary conditions. Then by* $(P),(Q)$ *expressions constructed are new multi-point stable schemes needing O(1/ h) of AOS, the convergence of the approximate solution has (*p-1*) order with respect to h. When p=3 this scheme is identical to classical ones. For 3< p<6 these schemes are different from the Streng&Fix and Mikhlin unstable FEM.*

II.2.*Cauchy* (the Initial) problems for ODEs

In the monograph [8] investigated are the problems of numerical solution of Cauchy problem for ODE basing on applications of *Gauss* and *Clenshaw-Curtis type* quadratures and *Hermite* interpolation process. **In this way are proved that the *Adam*'s type multistep finite-difference schemes converge as O(h^{2n}) for any finite integer n and absolutely stable are if the matrices of nodes are normal types in *Fejer's* sense.**

As we see in the last case it is necessary to calculate roots of classical Orthogonal polynomials (having of course great theoretical and practical sense).The following statement is true :

Stmt.3.*New schemes and corresponding programs are created by which are possible to calculate the classical Orthogonal Polynomials (Legendre,Laguerre,Hermite,Chebyshev,all other Ultraspherical ones) when the order of degrees are no less than 100.000000(one million thousand) and an accuracy about 1000 decimal points*.

D.III. 1. The uniform systems of governing equations of Continuum Mechanics

Within of *Newtonian and Truesdell-Noll* axiomatics, *Vashakmadze* created a uniform dynamic system of pseudo-differential equations which is 3D with respect to spatial coordinates, contains as a particular case *Navier-Stokes, Euler* equations, systems of PDEs of Solid Mechanics(*if on continuum media electro-magnetic fields act) Maxwell's* dynamical systems, the mass and principle of energy conservations, *Saint-Venant-Beltrami* (continuity equations) conditions. Such unique representation of this system allows us to prove that the nonlinear phenomena observed in problems of solid mechanics can also be detected in *Navier-Stokes* type equations, and vice versa. We describe this part in more details. The basic system of PDE has the following form:

$$\circ\,\frac{D_\Gamma^2 u}{Dt^2} = f - (1-\Gamma)\nabla p + \nabla\left[(1+\nabla u)^2\right] \quad , \qquad (1)$$

where $\circ$ is a density, p is pressure, $v=(v_1,v_2,v_3)^T$ is vector of velocities, f are known volume forces, D/Dt is total or convective derivative, ^{2} is stress tensor, $u=(u_1,u_2,u_3)^T$ denotes displacement vector,

$$\partial u/\partial t = v, \nabla = (\partial_1,\partial_2,\partial_3)^T = grad,\ \frac{D_\Gamma^2 u}{Dt^2} = \begin{cases}\partial^2 u/\partial t^2, \Gamma = 1\\ Dv/Dt, \Gamma = 0\end{cases}.$$

Newton's type law for viscous flow and *Hooke*'s generalized law for solid structures may be written i the form:

$$^2 = \left[(1-\Gamma)\frac{\partial}{\partial t} + \Gamma\right] A_\Gamma \cdot £ \ , (0 \le \Gamma \le 1) \qquad (2)$$

For conditions of conservation of mass or equations of continuity *Saint-Venant – Beltrami* conditions we have:

$$\left[(1-\Gamma)\partial t + \Gamma\right] B_\Gamma\left[£\right] = 0 \ , \qquad (3)$$

where

$$B_0\left[\circ, £\right] = \partial_t \circ + \nabla(\circ v)\,.\ B_1[£] = (B_{11}, B_{12}, B_{13}, B_{14}, B_{15}, B_{16})^T \qquad (4)$$

In the classical case $B_{11}(u) = 2(u_{3,12})^2 - 2u_{3,11}u_{3,22}$ corresponds to well-known Monge-Amper form.We underline that **above elaborations are in conformity with Newton's second axiom and different from it in concrete substance.** In case if on some continuum media also the electro-magnetic fields act with PDEs (1)-(3) *Vashakmadz*e used *Maxwell's* dynamical system too.

2. The three-dimensional models created by *Vashakmadze, contain* as a particular case and refined models of *Coleman-Noll (*in the direction of elasticity theory), *Griffith, Kobayashi, Atluri* (in case of cracks and inclusions), *Biot* (in case of poroelastic media), *Green, Naghdi, Steel* (in case of binary mixtures). For example, in the linear theory by Biot corresponding differential operators with respect to

spatial variables have double degeneration, since symbolic determinants contain as a cofactor a symbolic minor corresponding to *graddiv* operator . In the nonlinear theory of *Biot* the anisotropic property of the media depends on the ratio of strain and deformation tensors and not on the character of the media. It must be pointed out, that in the models presented by *Vashakmadze* these controversies are overcome. He introduced for each point of the mixture average quantities of tensors of stresses and strains and displacement vectors. He refined *Biot-Hooke's* law. Relevant systems of DEs have the same form as nonlinear spatial theory of elasticity with positive symbolic determinant. This form of equilibrium equations proves that the *Pascal-Darcy* law for poroelastic media (introduced by *Biot)* demands more precise definition

D.III.2 Some generalizations

1.In the second part of monograph [*Vashakmadz*e 1999,Ch.III] the stable projective methods are also presented using the linear form of classical orthogonal polynomials as coordinate systems and their numerical realizations for a design of 2D BVPs (in bounded and unbounded domains) for the first part. These efficient and optimal (in some sense) methods increase the possibilities of classical finite-difference, exponential-fitted, variational-discrete and continuous analogue of alternating-direction methods. Here[pages 124-127}there are created the Alternative to Perturbation *Poincare-Lyapunov's* theory convergent method for linear operator equation (L+εM)=f (with parameter ε) , which gives approximate solution by inversion of L n-times and applications operator εM to known function.

2. For observation and analysis of results of *Vashakmadze* corresponding to Directions I,III we can recommend the following form of *KMR* type systems:

$$\left(D\Delta^2 + 2h^\circ\partial_{tt} - 2DE^{-1}\left(1+\text{³}\right)^\circ\partial_{tt}\Delta\right)w = \left(1-\frac{h^2\left(1+2\text{¥}\right)\left(2-\text{³}\right)}{3\left(1-\text{³}\right)}\Delta\right)\left(g_3^{\ +} - g_3^{\ -}\right),$$

(5)

$$2h\left(1-\frac{2h^2\left(1+2\text{¥}\right)}{3\left(1-\text{³}\right)}\Delta\right)\left[w,\ddot{}\ \right] + h\left(g_{\sim,\sim}^{\ +} - g_{\sim,\sim}^{\ -}\right) - \int_{-h}^{+h}\left(tf_{\sim,\sim} - \left(1-\frac{1}{1-\text{³}}\Delta\left(h^2-t^2\right)\right)f_3\right)dt,$$

$$\left(\Delta^2 - \frac{1-\neg^2}{E}{}^\circ\Delta\partial_{tt}\right)\ddot{}\ = -\frac{E}{2}\left[w,w\right] + \frac{\neg}{2}\left(\Delta - \frac{2^\circ}{E}\partial_{tt}\right)\left(g_3^+ + g_3^-\right) + \frac{1+\neg}{2h}f_{\sim,\sim}. \qquad (6)$$

The second equation of *von Kármán* system even in dynamical case has the form: $\Delta^{2\ddot{}} = -o.5E\left[w,w\right]$ while a dynamical part of the first equation has the same form as (5). Such structure of *von Kármán* classical system gives the possibility to use methods of **Harmonic A nalysis**. As the new dynamical members are $\Delta\partial_{tt}\ddot{}$ and $\partial_{tt}\left(g_3^+ - g_3^-\right)$ too, t**he *KMR* type (5)-(6) systems describe new nonlinear wave processes and it's evident that for them it isn't possible to apply The Fourier Analysis technique**

At last we remind the words of *Antman* [Nonlinear Problems of Elasticity,Springer,2005,p.699] that:"See *Vashakmadze* (1999) for an alternative treatment. *This work was the first that gave the von Kármán equations with a rational positions within the general theory of nonlinear elasticity*. All previous derivations of these equations, beginning with *von Kármán* (1910),employed a variety of ad hoc assumptions about the negligibility of certain terms". This estimation is true but the sufficiently incomplete one.

D.IV.

There is considered the problem of contruction of the new scheme for a product of polynomials of one variable.Thus we construct an expansion (5) for arbitrary parameter s .The squares of two integers with

n significant digits produced as linear combinations of $2s+1$ numbers with k significant digits. Same expression for $s=1$ is considered in [2, exercise 1.2.6] and for the work [3] this result is essential.

The results considered above present new scheme for product of polynomials, from which particularly follows that the numbers of multiplications $T(n)=O(n^{\log_{s+1}(2s+1)})$ for theproduct of two integers with n significant digits (compare with[4],Theorem C,p.324).

The above article-related materials were deposited at the Georgian Patent Office on 17.09.2015, Certificate N6353.

We investigated the problem of decision to construct the coefficients and eigenvalues of Secular Equation (SE). In this aim we develop the reliable technology for calculating coefficients of SE in the range of 1200 scientific digits based on our methodology defining classical orthogonal polynomials of degree of order 10^6 with 1200 decimal digits and assumption that the exact multiplication operations of two matrices with integer elements in the range 10^{16}approximately for 600 digits is possible.

Our investigations and Programming products essentially generalized the correspond parts (ch-s 6,7,8) of [A.Quarteroni, F.Saleri:Scientific Computing with MATLAB and Octave, Texts of Computational Science and Engineering 2, Springer, 2016] and are ready for publication.

D.V. Investigating the problem of creation theory of distributions and demonstrating that to the origin of creation of this theory stood A.Razmadze, which to the first introduced the class of finite-jumping functions both the native solutions (extremals) of some variotional problems and foundation for creation of generalized functions.With the Theory of Distributions (TrDis) hardly compare the other achievements of mathematics, for the first time originating of which be ascribed to S.Sobolev and L.Schwartz.

The evolution on some sense is connected with works of Ernst Florens Friedrich Chladni and Kurt Friedrich Gödel and represents the example of realizing the laws of the unity and conflict of opposites and of the negation of the negation. The key element for the effective development Project in the fields of Science-Education and Technology-Production is the Mathematics. The importance of Mathematics from the historical aspects will be explained in our presentation on the base of the works of Morris Kline and Albert Einstein. Then we consider in detail the problem how the theory of Clifford Truesdell, Walter Noll and other similar theories will be compared with our corresponding elaborations. The excellency of our methodology will be proved as a new convenient mathematical models, which is not only in theory with regard to natural generalization of widely penetrating initial- boundary value problems but also in practice with regard to development and functioning of modern technologies (analysis and full design) for thin walled structures used in aircrafts, ships, long pipes and almost every structures characterized with boundary layer effects.