

Curriculum Vitae

Sergei A. Sazhenkov

ADDRESSES¹

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PERSONAL DATA:

Place and date of birth: Novosibirsk, Russia, 27 June 1972.

Citizenship: Russia.

Marital status: Elena (spouse), Polina (daughter).

Knowledge of languages: English, Portugues.

RESEARCH FIELD:

Mathematical models and methods for nonlinear mechanics of continuous media.

EDUCATION

CANDIDATE OF PHYSICAL & MATHEMATICAL SCIENCES (EQUIV. OF PH. D.)

From: Novosibirsk State University, Russia, 8 December 1998.

Speciality: 01.01.02 – differential equations.

The title of the thesis: “Weak limits of solutions of problems on motion of non-homogeneous fluids”.

Supervisor: Professor Dr. Pavel I. Plotnikov, Corresp. Member of Russian Acad. of Sciences.

M. S. IN MATHEMATICS (cum laude): Novosibirsk State University, Russia, 1995.

The title of the thesis: “Two problems on motion of viscous incompressible fluids”.

B. S. IN MECHANICS AND APPLIED MATHEMATICS (cum laude):

Novosibirsk State University, 1993.

The title of the thesis: “A problem on motion of a non-Newtonian fluid”.

SCHOOL LEAVING CERTIFICATE FROM:

Lavrentyev Special Boarding Physical & Mathematical School at Novosibirsk State University, 1989.

¹Temporarily till 15 June 2007. The permanent address and affiliation are: Lavrentyev Institute of Hydrodynamics, Siberian Branch of Russian Academy of Sciences, Prospekt Lavrentyeva 15, Novosibirsk 630090, RUSSIA.

ACADEMIC & TEACHING POSITIONS OCCUPIED

**LABORATORY FOR MATHEMATICAL MODELING OF PHASE TRANSITIONS,
LAVRENTYEV INSTITUTE OF HYDRODYNAMICS,
SIBERIAN BRANCH OF RUSSIAN ACAD. OF SCIENCES, NOVOSIBIRSK**

Positions occupied:

Senior research scientist: from January 2004 till now.

Research scientist: from May 1999 till January 2004.

Junior research scientist: from October 1995 till May 1999.

**CHAIR OF THEORETICAL MECHANICS,
DEPARTMENT OF MECHANICS & MATHEMATICS,
NOVOSIBIRSK STATE UNIVERSITY (NSU)**

Positions occupied:

Associated professor: from April 2003 till now.

Assistant: from September 1998 till June 2001, and from January 2003 till April 2003.

**CENTER FOR ADVANCED MATHEMATICS AND PHYSICS,
NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY (NUST-CAMP),
RAWALPINDI, PAKISTAN**

Position occupied:

Foreign professor: from August 2005 till June 2007.

**CENTER OF MATHEMATICS, DEPARTMENT OF MATHEMATICS,
UNIVERSITY OF BEIRA INTERIOR, COVILHÃ, PORTUGAL**

Position occupied:

Post doctorate researcher: from December 2001 till November 2002.

**CHAIR OF INFORMATICS, DEPARTMENT OF MATHEMATICS,
ALTAY STATE UNIVERSITY, BARNAUL, RUSSIA**

Position occupied:

Assistant: from July till September 1993.

THE TAUGHT COURSES

Theoretical Mechanics

A two-semester course of seminars, complementary to the course of lectures.

The course taught for the 2nd year students of Department of Mechanics & Mathematics, NSU, Russia, academic years 1998/99 – 2000/01, 2002/03, 03/04.

The course is devoted to the classical topics of theoretical mechanics.

Mathematical Models of Continuum Mechanics

A one-semester course of lectures and seminars.

The course taught for the 4th year students of Department of Mechanics & Mathematics, NSU, Russia, academic years 2000/01, 03/04, 04/05.

The course is devoted to mathematical methods of study of the Stokes and Navier–Stokes equations, the Euler equations of perfect fluids, and the Stefan problem on phase transitions.

Mathematical Modeling

A one-semester course of seminars, complementary to the course of lectures.

The course taught for the 2nd year students of Department of Mechanics & Mathematics, NSU, Russia, academic year 2002/03.

The course is devoted to introduction into the fundamental principles of constructing mathematical models in continuum mechanics.

Generalized Solutions of Equations of Mathematical Physics

A one-semester course of lectures.

The course taught for M.S. students of Department of Mechanics & Mathematics, NSU, Russia, academic years 2003/04, 04/05.

The course is devoted to the questions about existence, uniqueness, and stability of generalized solutions to boundary-value problems for linear and quasilinear elliptic, parabolic, and hyperbolic equations of the first and second order.

Special Functions

A one-semester course of lectures and seminars.

The course taught for Ph.D. students of NUST–CAMP, Rawalpindi, Pakistan, academic years 2005/06, 06/07.

The course is devoted to the main topics in the theory of special functions, like the gamma, beta, Bessel, and hypergeometric functions, Legendre, Hermite, and Laguerre polynomials, etc.

Differential Equations II

A one-semester course of lectures and seminars.

The course taught for Ph.D. students of NUST–CAMP, Rawalpindi, Pakistan, academic years 2005/06.

In the course, the classical topics in the theory of ordinary differential equations and systems and the Fourier and Laplace methods of solutions of boundary-value problems in mathematical physics are considered.

Continuum Mechanics I

A one-semester course of lectures and seminars.

The course taught for Ph.D. students of NUST–CAMP, Rawalpindi, Pakistan, academic years 2006/07.

The first part of the course is devoted to introduction into the fundamental principles of constructing mathematical models in continuum mechanics and the second part is emphasized on the study of the simplest motions of incompressible liquids and elastic bodies.

Partial Differential Equations I

A one-semester course of lectures and seminars.

The course taught for Ph.D. students of NUST–CAMP, Rawalpindi, Pakistan, academic years 2006/07.

In the course, the fundamental topics in theory of second-order linear partial differential equations are considered, such as classification of equations, basic formulations of boundary value problems, separation of variables, Fourier’s method, methods of integral transforms, the method of Green’s function. The final couple lectures of the course are devoted to introduction into the

theory of generalized solutions of scalar conservation laws (i.e., quasilinear first-order hyperbolic equations).

SCIENTIFIC SUPERVISION

Supervised a B.S. Thesis of Mr. Iliia Paranichev. The title of the thesis: “Kinetic formulations of scalar conservation laws in bounded domains” (The successful defence took place at the Chair of Theoretical Mechanics, NSU, Russia, in June 2005).

Supervision of reading courses for Mr. Riaz Akhmad Khan, Ph.D. student of NUST-CAMP, Pakistan (the titles of the courses: Homogenization methods for continuum mechanics, in the fall semester 2006/07, and Multiscale analysis of fluid-solid structures, in the spring semester 2006/07) and for Mr. Naseer Ahmad Asif, Ph.D. student of NUST-CAMP, Pakistan (the title of the course: Mathematical modeling of complex phenomena in continuous media, in the spring semester 2006/07).

THE MAIN SCIENTIFIC RESULTS

- Existence and uniqueness of entropy solutions of the Cauchy problem for an ultraparabolic Graetz–Nusselt equation of nonlinear diffusion in non-isotropic continuous media are proved. A version of kinetic formulation of this problem is constructed. (Jointly with Professor Pavel Plotnikov.)
- Solvability of the Darcy–Stefan problem on freezing and melting of a medium, filtering through a porous ground, is established. A kinetic formulation of this problem is constructed.
- Existence of entropy solutions of the Cauchy problem for a genuinely nonlinear ultraparabolic Graetz–Nusselt equation, with discontinuous convection coefficients and a diffusion matrix of variable rank, is established. Relative compactness of bounded families of entropy solutions of this equation is proved.
- Existence of entropy solutions to the ultraparabolic Verigin problem on filtration of a viscous incompressible fluid, containing an admixture, through a non-isotropic porous ground is established. The porous ground consists of one-dimensional filaments (threads), and its geometry satisfies an additional genuine nonlinearity condition.
- A homogenization procedure for the linearized model of microstructure “compressible thermofluid – heat conducting elastic porous ground” is fulfilled. As the result, a well-posed linear model of thermoviscoelastic body with memory of heat and shape is derived.
- Derivation of Tartar’s kinetic equation is fulfilled in description of dynamics of nonhomogeneous viscous incompressible fluid with rapidly oscillating initial data. Within this framework, solutions of Tartar’s kinetic equation are the so-called H -measures, which contain information about the limiting stationary regime, arising as the oscillation frequency tends to infinity.
- Homogenization of a heterogeneous dynamical model of a fine-dispersed mixture with rapidly oscillating initial viscosity distributions is fulfilled, without imposing any kind of structure, like periodic, random homogeneous, etc, on the medium. As the result, the closed well-posed homogeneous model is constructed, which involves Tartar’s kinetic equation for H -measures, associated with distributions of viscosity.
- Well-posedness of the Cauchy problems for Tartar’s kinetic equation and for the linear

transport equation with a minor term are proved in a case of non-smooth divergence-free velocity fields. The proofs rely on the originally constructed notion of generalized Lagrangian coordinates.

- Global existence of generalized solutions to the problem on motion of an absolutely rigid body in a dilatant non-Newtonian incompressible fluid under the hydrodynamic reactions is proved.

GRANTS/PROJECTS, SCHOLARSHIPS, PRIZES

- RFBR (Russian Foundation for Basic Research) grant no. 03-01-00829, “Mathematical problems in theory of nonlinear waves in fluids”, 2003-2005, principal investigator: Professor Pavel Plotnikov, Corresp. Member of Russian Acad. of Sciences.
- RFBR grant no. 01-01-06016 for support of young scientists and postgraduate researchers, 2001, principal investigator: Dr. Sergei Sazhenkov.
- RFBR grant no. 00-01-00911, “Dynamics of two-phase media”, 2000–2002, principal investigator: Professor Pavel Plotnikov.
- RFBR grant no. 97-01-00501, “Propagation of singularities in solutions of dynamical equations of multi-phase media”, 1997–1999, principal investigator: Professor Pavel Plotnikov.
- Grant of Russian Acad. of Sciences for young scientists “Dynamics of nonhomogeneous media”, 2000–2002, principal investigator: Dr. Victor Starovoitov.
- Grant of Siberian Branch of Russian Acad. of Sciences “Dynamics of two-component media”, 1998–2000, principal investigator: Dr. Victor Starovoitov.
- Contract LH-04-06 “Development of the software for coupled dynamic analysis of vessel/mooring/risers system including vortex induced vibrations” between Lavrentyev Institute of Hydrodynamics (Siberian Branch of Russian Acad. of Sciences) and Hyundai Heavy Industries Co. (Rep. Korea), 2004–2006, chief of scientific group at Lavrentyev Inst. Hydrodyn.: Dr. Alexander Korobkin.
- Grant no. 8247 of Federal Education of Russia under the program “Development of scientific potential of higher education”. The project title: “Modern mathematical analysis for nonlinear models of continuum mechanics”, 2005, principal investigator: Dr. Sergei Sazhenkov.
- Grant of Higher Education Commission of Pakistan under National Research Program for Universities. The project title: “Modern Mathematical Analysis for Phenomena of Anisotropic Diffusion and Acoustic Wave Propagation in Porous Media”, 2006–2007, principal investigator: Dr. Sergei Sazhenkov.
- Scholarship of Russian Acad. of Sciences under the program “Young talented sciences”, 1999–2001.
- “Academician Ilia Vekua Prize” of Siberian Branch of Russian Acad. of Sciences awarded for the series of papers on mathematical physics, 2005. The title of the series: “Method of kinetic equation in problems on nonlinear dynamics of multi-phase media”.

OTHER PROFESSIONAL ACTIVITIES

REFEREEING OF ARTICLES SUBMITTED FOR PUBLISHING AND PH. D. THESES

- Composed referee's report on Candidate's Dissertation (Ph. D. Thesis in Maths) by Mr. N. P. Lazarev of the Yakutsk State University (Yakutsk, Russia) for the Ph. D. Committee at the Novosibirsk State University, Chairman of Committee: Academician Prof. M. M. Lavrentyev (Sr.), 2004.
- Composed referee's report on Candidate's Dissertation (Ph. D. Thesis in Maths) by Mr. A. Yu. Gubin of the Sobolev Institute of Mathematics (Novosibirsk, Russia) for the Ph. D. Committee at the Novosibirsk State University, Chairman of Committee: Academician Prof. M. M. Lavrentyev (Sr.), 2004.
- On behalf of the Lavrentyev Institute of Hydrodynamics, composed referee's report on Candidate's Dissertation (Ph. D. Thesis in Maths) by Mr. M. F. Mugafarov of the Sterlitamak State Pedagogical University (Sterlitamak, Russia) for the Ph. D. Committee in Sterlitamak, 2005.
- Refereeing of scientific articles submitted for publication in mechanical and mathematical journals and serial editions: Bulletin of Novosibirsk State University, Siberian Mathematical Journal, Siberian Electronic Mathematical Reports, Applied Mechanics and Technical Physics, Dynamics of Continuous Media/Collection of Works, since 2000.

PARTICIPATION IN REFEREE BOARDS OF MECHANICS AND MATHEMATICS CONTESTS OF HIGHER AND SECONDARY SCHOOL STUDENTS

- Participation in referee's boards on regional mathematical contests for secondary school students in Siberia, regularly since 1997.
- Participation in referee's boards on All-Russian and regional classical mechanics contests for university students, regularly since 1999.

PARTICIPATION IN CONFERENCES AND INTERNATIONAL SEMINARS (SELECTED)

- The 3rd All-Russian Congress on Industrial and Applied Mathematics. Novosibirsk, Russia, June, 1998. Title of the talk: Representation in Lagrange coordinates for non-smooth solenoidal velocity fields and the well posedness of Cauchy problems for two kinetic equations.
- The 4th All-Russian Congress on Industrial and Applied Mathematics. Novosibirsk, Russia, June, 2000. Title of the talk: On homogenization of small asymptotic mixture of incompressible fluids.
- International Conference *Differential Equations and Related Topics* Dedicated to Centenary Anniversary of I. G. Petrovsky. Moscow State University, Russia, May, 2001. Title of the talk: The Tartar equation in homogenization of a problem on motion of a small asymptotic mixture.

- The 8th All-Russian Congress on Theoretical and Applied Mechanics. Perm, Russia, August, 2001. Title of the talk: Generalized Lagrange coordinates in a case of non-smooth solenoidal velocity fields.
- International seminar *Nonlinear partial differential equations and free boundary problems*. CMAF, Óbidos, Portugal, May 2002. Title of the talk: H -measures and homogenization of a fine-dispersed mixture.
- International seminar *Nonlinear partial differential equations and free boundary problems*. University of Algarve, Faro, Portugal, September 2002. Participation without a talk.
- Instructional conference on mathematical analysis of hydrodynamics. Edinburgh, UK, ICMS, June 2003. Participation without a talk.
- International conference *Nonlinear partial differential equations NPDE-2003*. Alushta, Ukraine, Ukrainian National Acad. Sc. September 2003. Title of the talk: Entropy and kinetic formulations for the convection-diffusion ultra-parabolic equations.
- International conference *Differential Equations and Related Topics* Dedicated to I. G. Petrovsky. Moscow State University, Russia, May, 2004. Title of the talk: The genuinely non-linear non-isotropic degenerate parabolic-hyperbolic equation.
- International seminar on computational mechanics at the Institute of technical mechanics of the University of Karlsruhe, Germany, July, 2004. Title of the talk: Entropy and kinetic formulations for the reaction-diffusion-convection ultra-parabolic equations and related topics.
- 14th Winter School on Problems in Mechanics of Continuous Media. Institute for Mechanics of Continuous Media of the Ural Branch of Russian Academy of Sciences, March 2005. Poster presentation: Method of kinetic equation for the ultraparabolic Graetz–Nusselt equation.
- International Conference on Mathematics, Mechanics and Physics Dedicated to the memory of M. A. Lavrentiev. Lavrentiev Institute of Hydrodynamics, Novosibirsk, Russia, May, 2005. Title of the talk: Kinetic formulation and entropy solutions of the ultraparabolic Graetz–Nusselt equation.
- Weekly seminar series at the National University for Sciences and Technology, College of Electrical and Mechanical Engineering, Centre for Advanced Mathematics and Physics, Rawalpindi, Pakistan. September, 2005. Title of the talk: Kinetic formulation of conservation laws and one filtration problem.
- Weekly seminar series at the National University for Sciences and Technology, College of Electrical and Mechanical Engineering, Centre for Advanced Mathematics and Physics, Rawalpindi, Pakistan. March, 2006. Title of the talk: H -measures and homogenization of fine-dispersion mixtures.

- The 12th International Regional Conference on Mathematical Physics, National Center for Physics, Quaid-i-Azam University, Islamabad, Pakistan. March, 2006. Title of the talk: Entropy solutions to a genuinely nonlinear ultraparabolic Kolmogorov-type equation.
- International Conference on Mathematics, Department of Mathematics, Quaid-i-Azam University, Islamabad, Pakistan. September, 2006. Title of the talk: Theory of H -measures applied to homogenization of fine-dispersed mixtures.
- Winter Conference on Mathematics, Center for Advanced Mathematical Studies, Lahore University of Management Sciences, Lahore, Pakistan, December 2006. Title of the talk: Two-scale convergence for derivation of macroscopic linear thermoviscoelasticity from microstructure.
- 3rd International Conference on 21st Century Mathematics 2007, School of Mathematical Sciences & National Center for Mathematics, Government College University, Lahore, Pakistan, March 2007. Title of the talk: An ultraparabolic model of two-phase filtration with degenerate hydrodynamic dispersion.

LIST OF PUBLICATIONS

Ph.D. Thesis:

- S. A. Sazhenkov. *Weak limits of sequences of solutions to problems on motion of nonhomogeneous fluids* (Ph. D. Thesis, Novosibirsk State University, Novosibirsk, 1998, 116 pages). (In Russian.)

Articles in Journals

1. S. A. Sazhenkov. A problem on motion of rigid bodies in a non-Newtonian incompressible fluid. *Sibirskii Matematicheskii Zhurnal*, 1998, **39**(1). P. 146–160. (In Russian.) (English translation: *Siberian Math. Journal*, Plenum Publishers, 1998, **39**(1). P. 126–140.)
2. S. A. Sazhenkov. On homogenization of multi-dimensional parabolic differential operators in hydrodynamics. *News of Altai State University*, Barnaul, Russia, 2001, **17**(1). P. 43–47. (In Russian. English summary.)
3. S. A. Sazhenkov. The Tartar equation for homogenization of a dynamical model for fine-dispersion mixture. *Sibirskii Matematicheskii Zhurnal*, 2001, **42**(6), P. 1375–1390. (In Russian.) (English translation: *Siberian Math. Journal*, Plenum Publishers, 2001, **42**(6). P. 1142–1155.)
4. S. A. Sazhenkov. Generalized Lagrange coordinates and the uniqueness of the solution of a linear transport equation. *Differentsialnye Uravneniya*, 2002, **38**(1). P. 117–125. (In Russian.) (English translation: *Differential Equations*, MAIK Nauka/Interperiodica, 2002, **38**(1). P. 127–136.)
5. S. A. Sazhenkov. A Cauchy problem for the Tartar equation. *Proceedings of the Royal Society of Edinburgh*, 2002, **132A**. P. 395–418. (In English.)

6. S. A. Sazhenkov. A method of kinetic equation and the Darcy–Stefan problem on phase transitions in a porous ground. *News of Altai State University*, Barnaul, Russia, 2004, **31**(1). P. 17–22. (In Russian.) (English translation: Server of Preprints on Conservation Laws www.math.ntnu.no/conservation/. Preprint no. 2004-006, February 2004, 9 pages.)
7. P. I. Plotnikov and S. A. Sazhenkov. Kinetic formulation for the Graetz–Nusselt ultraparabolic equation. *Journal of Mathematical Analysis and Applications*, 2005, **304**. P. 703–724. (In English.)
8. P. I. Plotnikov and S. A. Sazhenkov. A Cauchy problem for the Graetz–Nusselt ultraparabolic equation. *Doklady Akademii Nauk*, 2005, **401**(4). P. 455–458. (In Russian.) (English translation: *Doklady Mathematics*, 2005, **71**(2). P. 234–237.)
9. S. A. Sazhenkov. The genuinely nonlinear Graetz–Nusselt ultraparabolic equation. *Sibirskii Matematicheskii Zhurnal*, 2006, **47**(2). P. 431–455. (English translation: *Siberian Mathematical Journal*, Springer New York, 2006, **47**(2). P. 355–375.)
10. A. M. Meirmanov and S. A. Sazhenkov. Generalized solutions to linearized equations of thermoelastic solid viscous thermofluid. *Electronic Journal of Differential Equations*, 2007, **2007**(). P. 1–29.

Articles in Serial Editions and Books of Proceedings

1. S. A. Sazhenkov. Solutions of a problem on motion of a viscous incompressible fluid provided with frequently oscillating initial data. *Dinamika Sploshnoi Sredy (Dynamics of Continuum Media)/Collection of Scientific Works*, Novosibirsk, 1998, issue **113**. P. 123–134. (In Russian.)
2. S. A. Sazhenkov. Generalized Lagrange coordinates in a case of non-smooth solenoidal velocity field. *Dinamika Sploshnoi Sredy (Dynamics of Continuum Media)/Collection of Scientific Works*, Novosibirsk, 1999, issue **114**. P. 74–77. (In Russian.)
3. S. A. Sazhenkov. Entropy solutions to a genuinely nonlinear ultraparabolic Kolmogorov-type equation. In *Mathematical Physics, Proceedings of the 12th Regional conference held in Islamabad, Pakistan, on 27 March – 1 April 2006* (eds. Jamil Aslam, Faheem Hussain, Asghar Qadir, et. al.), World Scientific, Singapore, 2007, 6 pages, to appear.

Textbooks for Students

1. S. A. Sazhenkov. *The collection of tests on theoretical mechanics for university undergraduate students* (Textbook for students. Novosibirsk State University, Russia, 2002. 40 pages). (In Russian.)
2. I. V. Basov, O. B. Bocharov, and S. A. Sazhenkov. *Mathematical Models of Continuum Mechanics*. (Lecture Notes for Students. Novosibirsk State University, Russia, 2005. 84 pages.) (In Russian.)

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