

University	Peter the Great St. Petersburg Polytechnic University
Level of English proficiency	Fluent
Courses and fields of studies offered for applicants	1.1.7 Theoretical mechanics, machine dynamics 1.1.8 Mechanics of deformable solids 1.2.2 Mathematical modeling, numerical methods and software packages
Projects for potential academic supervision	<ol style="list-style-type: none"> <li>1. FCP 1.2 14.575.21.0146 "Development of applied software for planning and control of hydraulic fracturing operations in order to improve the efficiency of oil and gas production", 2017-2019 (performer)</li> <li>2. FCP 1.4 14.581.21.0027 "Development of integrated software for modeling, optimization and control of hydraulic fracturing operations in the conditions of hard-to-recover reserves", 2017-2019 (performer)</li> <li>3. RSF 17-71-10213 "Development of approaches to the description of thermal superconductivity in new low-defect materials", 2017-2019 (supervisor)</li> <li>4. RSF 18-11-00201 "Development of mathematical models and software for describing non-stationary thermal processes in ultrapure crystalline materials", 2018-2020 (performer)</li> <li>5. RSF 15-11-00017 "Development of mathematical methods and software for predictive modeling of hydraulic fracturing in real time to improve the efficiency of heavy oil production", 2015-2016 (performer)</li> <li>6. RSF 14-21-00083 "Development of mathematical models and software complexes for predictive modeling of thermomechanical properties of defect-free monocrystalline materials in a wide range of mechanical and thermal loads", 2014-2016 (performer)</li> <li>7. Design part of the state assignment No. 9.2091.2014 / K "Modeling of unique mechanical and thermal properties of nanomaterials with a periodic structure", 2014-2016 (performer)</li> <li>8. RFBR 16-29-15121 "Development of mathematical models and software for core modeling by molecular dynamics methods using a supercomputer", 2016-2018 (performer)</li> <li>9. RFBR 14-01-00845 "Development of theoretical and experimental models of the dynamics of nanoscale deformable bodies in electromagnetic fields", 2014-2016 (performer)</li> <li>10. RFBR 14-01-00802 "Development of discrete and continuous methods for modeling physical and mechanical processes in condensed matter at various scale levels, taking into account the rotational degrees of freedom", 2014-2016 (performer)</li> <li>11. RFBR 13-01-12076 "Development of high-performance algorithms and multilevel mathematical models of the process of coke formation in the cooling path of liquid-propellant rocket engines", 2013-2015 (performer)</li> </ol>

12. RFBR 11-01-12099-ofi-m-2011 "Creation of high-performance software tools for predictive modeling of the process of coke formation in the cooling path of liquid-propellant rocket engines", 2011-2013 (performer)
13. RFBR 11-01-00809-a "Development of an integrated approach to modeling physical and mechanical processes in condensed matter at the nano, micro, meso and macro levels using discrete and continuous methods", 2011-2013 (performer)
14. RFBR 09-05-12071-ofi\_m "Cavitation synthesis of carbon nanostructures", 2009-2011 (performer)
15. RFBR 09-01-92603-KO\_a "Modeling brittle fracture under dynamic loads", 2009-2011 (performer)
16. RFBR 09-01-12096-ofi\_m "Development of technologies for modeling dynamic processes in condensed matter at various scale levels using a petaflop-class supercomputer", 2009-2011 (performer)
17. RFBR 05-01-00094-a "Development of methods of molecular dynamics and particle dynamics for modeling processes in condensed matter at various scale levels", 2005-2007 (performer)
18. Grant from British Petroleum to the research team led by V.A. Kuzkina. Project topic - "Modeling hydraulic fracturing by particle dynamics method", 2011 (supervisor)
19. Research and development work "Development of mathematical models, software tools and demonstration stands for describing the process of hydraulic fracturing", customer - Gazpromneft STC LLC, 2015-2016 (performer)
20. Research work "Development and software implementation of algorithms for modeling the process of hydraulic fracturing", customer - Weatherford ltd, 2013 (performer)
21. Research work "Development of analytical and computer models for the operation of a vibro-viscometer in a multiphase flow", customer - Weatherford ltd, 2013 (performer)
22. Research work "Development of a mathematical model of a submarine cable (MMPK) for managing cable operations on a cable ship of project 15310", customer - JSC "Kronstadt Technologies", 2015 (performer)
23. Research work "Study of the influence of the nature of loading on energy consumption during the destruction of rocks", customer - NPK "Mechanobr-Tekhnika", 2019 (performer)
24. Research work "Algorithms for automatic calculation of the maneuver of an unmanned vessel on the basis of the principle of multi-agent systems" Maneuver BES-KF "" customer - JSC "Kronshtadt Technologies", 2019-2020 (performer)
25. RSF 21-71-10129 "Development of dynamic and kinetic methods for describing heat transfer in low-dimensional systems" 2021-2024 (supervisor)

Topics offered for prospective researches	Analytical and computer models of nonequilibrium thermal processes in ultrapure crystals
 <p>Research supervisor: Vitaly A. Kuzkin, Doctor of Science in Physics and Mathematics (Institute of Mechanical Science Problems of the Russian Academy of Sciences)</p>	<p><i>2.03. Mechanics</i> <i>2.03. Thermodynamics</i></p>
	<p>Mechanics of discrete media and media with microstructure, mechanics of deformable solids, computer modeling of mechanical systems, scientific activity is devoted to the analytical description and computer modeling of thermomechanical processes in crystals, derivation of equations of state, description of negative thermal expansion, solving problems of thermoelasticity taking into account ballistic heat transfer, construction of new models of moment interactions, determination of effective properties of fractured media, rheology of suspensions, description of dynamic loss of stability of rods, hydraulic fracturing modeling and the development of inertial navigation algorithms.</p>
	<p>Study program highlights Mechanics at the interface with other fields of science</p>
	<p>Supervisor's specific requirements: - Practical experience in research activities Fundamental knowledge in the general fields of mathematics and mechanics, Expertise in modern computational methods and information technology Programming skills in C ++ and/or C # and/or JavaScript and/or Python</p>
	<p>Supervisor's publications</p> <ol style="list-style-type: none"> <li>1. Lapin, R.L., Kuzkin, V.A., Krivtsov, A.M. Quasi-static crack growth in three-layer media: a numerical experiment. Letters on Materials, 2023, 13(3), страницы 272–277</li> <li>2. Kuzkin, V.A. Acoustic transparency of the chain-chain interface. Physical Review E, 2023, 107(6), 065004 Q1</li> <li>3. Liazhkov, S.D., Kuzkin, V.A. Unsteady two-temperature heat transport in mass-in-mass chains/ Physical Review E, 2022, 105(5), 054145 Q1</li> <li>4. Panchenko, A.Y., Kuzkin, V.A., Berinskii, I.E. Unsteady ballistic heat transport in two-dimensional harmonic graphene lattice. Journal of Physics Condensed Matter, 2022, 34(16), 165402</li> <li>5. Huppert, H.E., Kuzkin, V.A., Kraeva, S.O. Viscous gravity currents over flat inclined surfaces. Journal of Fluid Mechanics, 2022, 931, 944</li> </ol>
	<p>The results of intellectual activity: 1. 2021610904 (19.01.2021) A program for the growth of quasi-three-dimensional cracks in fractured materials using the particle dynamics method.</p>

	<p>2.2019664544 (08.11.2019) The program for calculating the removal of the proppant from the fracture fracture.</p> <p>3.2021610278 (12.01.2021) A program for modeling ballistic heat propagation in a one-dimensional harmonic crystal by the method of molecular dynamics.</p> <p>4.2019664444 (07.11.2019) A program for calculating the geometry of a fracturing fracture in a layered, anisotropic, fractured medium by the particle dynamics method.</p> <p>5.2022666767 (06.09.2022) A program for calculating and visualizing divergence maneuvers of commercial fleet vessels on the high seas, taking into account navigational hazards.</p> <p>6.2020616531 (18.06.2020) A computational module for modeling the formation of a network of cracks within the framework of the particle dynamics method.</p> <p>7.2022685900 (29.12.2022) A program for automatically determining the dimensions of an object from several photographs using computer vision methods</p> <p>8.2020666868 (17.12.2020) A program for calculating the effect of anisotropy and stratification of the formation on the interaction of fractures of hydraulic fracturing/MGRP with natural fracturing using the balance equation to describe the flow of liquid through a network of cracks.</p> <p>9.2021611927 (02/08/2021) A software tool with the "Agent-manager" architecture for calculating the order of elliptic curves.</p>
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