Vladimir Bratov

Professor in Mathematics, Edinburgh Napier University

Edinburgh, UK · vladimir@bratov.com · bratov.com · Google Scholar · ORCID · GitHub

Profile

Researcher in applied mathematics and solid mechanics with 25 years of experience in computational mechanics, nonlinear dynamics and dynamic fracture. 90+ peer-reviewed papers and a book; PI on 9 grants, Co-I on about 40, and one of the lead researchers on 7 major industrial research projects for clients including Shell, Gazprom Neft, and Russian Railways. Writes and runs own simulation and optimisation codes (Python, C++, Fortran, MPI), and has applied neural (CPPN) and evolutionary methods to shape optimisation.

Direction: moving into AI safety research: evaluating and verifying how frontier models reason on hard quantitative problems.

Research leadership

- **Set and led research agendas** in dynamic fracture and wave dynamics for two decades, from problem choice through theory, simulation and experimental validation.
- **Funding:** PI on 9 competitive grants (incl. two President Grants for Young Russian Scientists, a Russia–Slovenia bilateral grant, and the Israel Academy of Sciences fellowship); Co-I on about 40, incl. 4 Royal Society, 3 Swiss NSF and 3 Chinese NSF collaboration grants.
- **Conference chair** and principal organiser, Topical Problems of Solid Mechanics (2013, 2019); keynote or invited speaker at 15 conferences, incl. IMPLAST 2016 and 2025.
- **Elected Scientific Secretary**, ESIS Technical Committee on Dynamics of Fracture and Structural Transformations (2015); reviewer for 16 journals.

AI, ML and computational work

- **Neural generative design with CPPNs:** a small neural network (CPPN) generates the unit-cell geometry, a genetic algorithm evolves it and sensitivity analysis refines the boundaries, to maximise band gaps of 2D phononic crystals (2026, paper in preparation). The same approach is now applied to void layouts that raise the ballistic limit of protective armour.
- **Evolutionary optimisation:** designed a genetic algorithm that finds optimal geometric shapes for seismic protective barriers (*Mathematics*, 2024).

- **Frontier-model evaluation, MathScanBench (2026):** built an open-source benchmark of how language models solve and check maths and mechanics problems, including phone photos of handwritten work. Compared ten models on 96 photo problems and four of them on 60 typed mechanics problems: 75 of 88 wrong answers came from misreading the page, and the student's own working pulled models towards the student's answer. Code and report: github.com/vovkabratov/MathScanBench.
- **Numerical methods:** built the incubation-time fracture criterion into finite-element simulation of dynamic crack propagation, applied to impact fracture of ceramics, PMMA and rock.

Experience

Co-founder — Lewis Carrot, AI-assisted maths learning · 2026 – present

- Co-founded an early-stage startup building AI tools that teach maths and work through problems with learners. Lead maths, AI design and software development.

Professor in Mathematics — Edinburgh Napier University, UK · Nov 2022 – present

- Research in nonlinear dynamics, chaos and shock waves in solids.
- Teaches advanced mathematics, mechanics and smart materials at undergraduate and graduate level.

Visiting Professor — Weizmann Institute of Science, Israel · Aug – Nov 2022

Visiting Research Fellow — University of Haifa, Israel · Apr – Jul 2022

Senior Research Fellow — Institute for Problems of Mechanical Engineering, Russian Academy of Sciences · 2004 – Feb 2022

- Led fundamental research and co-led industrial projects on dynamic fracture, impact and wave propagation, combining theory, large-scale simulation and experiment.
- Won and managed grants as PI; worked on industrial research projects for Shell, Gazprom, Gazprom Neft, Russian Railways and IHC Merwede.

Associate Professor — St. Petersburg State University (2008 – 2022) and Peter the Great St. Petersburg Polytechnic University (2020 – 2022)

- Supervised 7 PhD students; created and taught graduate courses in computational mechanics, computational fracture mechanics and numerical methods.

Visiting Professor — Middle East Technical University, Ankara · 2016 – 2017

Education

- **PhD, Applied Mathematics and Physics** — joint programme, St. Petersburg State University and Malmö University, 2004.
- **MSc, Applied Mathematics and Mechanics** — St. Petersburg State University, 2000.

Selected publications

1 book, 2 book chapters, 90+ peer-reviewed journal papers. Full list and citation metrics: Google Scholar.

1. V. Bratov, S.V. Kuznetsov (2026). Chaotic dynamics of oscillators with combined elastic and dry friction nonlinearities. *Z. Angew. Math. Phys.*, 77:180.
2. V. Bratov, A.M. Iqbal, S.V. Kuznetsov (2026). Chaos emergence in structures with seismic isolation bearings. *Commun. Nonlinear Sci. Numer. Simul.*, 161:110171.
3. V. Bratov, A. Murachev, S.V. Kuznetsov (2024). Utilization of a genetic algorithm to identify optimal geometric shapes for a seismic protective barrier. *Mathematics*, 12:492.
4. V. Bratov (2021). Numerical simulations of dynamic fracture: crack propagation and fracture of initially intact media. *Mater. Phys. Mech.*, 47:455–474.
5. N.A. Kazarinov, V.A. Bratov et al. (2020). Experimental and numerical analysis of PMMA impact fracture. *Int. J. Impact Eng.*, 143:103597.
6. Y.V. Petrov, B.L. Karihaloo, V.A. Bratov (2012). Multi-scale dynamic fracture model for quasi-brittle materials. *Int. J. Eng. Sci.*, 61:3–9.
7. V. Bratov (2011). Incubation time fracture criterion for FEM simulations. *Acta Mech. Sin.*, 27:541–549.
8. V. Bratov, Y. Petrov (2007). Application of incubation time approach to simulate dynamic crack propagation. *Int. J. Fract.*, 146:53–60.

Skills and memberships

- **Programming & Simulation:** Python (NumPy, PyTorch, TensorFlow), C++, Fortran, MPI, ANSYS, ABAQUS, LAMMPS
- **Memberships:** ESIS, EUROMECH, FHEA
- **Languages:** Russian (native), English (fluent), Swedish (fluent), Spanish (good), Chinese (intermediate)