

## Ilya BOGAEVSKII

### IDs:

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### E-mail:

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### Research Areas:

- singularity theory and its applications
- sub-Riemannian geometry, optimal control, optimization, variational problems
- mathematical physics of graphene, wave propagation, semi-classical approximations
- shock waves in gas dynamics, viscosity solutions of PDE, differential inclusions
- dynamical systems and bifurcations, implicit ODE
- convex analysis and geometry
- mathematical problems of image processing and computer graphics

### Education:

- 2019    **Doctor of Sciences:** Physics and Mathematics  
Vladimir State University, Russia  
Thesis title: *Fronts of stratified Legendrian submanifolds in problems of differential equation theory and optimization*
- 1990    **Candidate of Sciences (Ph.D.):** Physics and Mathematics  
Lomonosov Moscow State University, Russia  
Thesis title: *Legendrian singularities and their transitions in Hamiltonian systems*  
Thesis advisor: V.I. Arnold
- 1986    **M.S.:** Mathematics, with Honours  
Lomonosov Moscow State University, Russia

### Professional Career:

- Full Professor, Faculty of Mechanics and Mathematics, Lomonosov Moscow State University, Russia, 2019–present
- Docent (Associate Professor), Faculty of Mechanics and Mathematics, Lomonosov Moscow State University, Russia, 2006–2019
- Senior Research Fellow, Scientific Research Institute for System Analysis of the Russian Academy of Sciences, 1997–present
- Docent (Associate Professor), Independent University of Moscow, Russia, 1997–2009
- Visiting Research Fellow, The University of Aizu, Japan, 1995–1996, 1998–1999
- Docent (Associate Professor), Department for Higher Mathematics, Moscow State Forestry University, Russia, 1993–1995
- Senior Research Fellow, Sophus Lie Centre, Moscow, Russia, 1991–1993
- Research Fellow, All-Union Correspondence Institute of Civil Engineering, Moscow, Russia, 1989–1991
- Postgraduate Student, Lomonosov Moscow State University, Russia, 1986–1989

## **Teaching experience:**

### **Lomonosov Moscow State University**

Ordinary Differential Equations (lectures, seminars, exams), 2006–2022  
Various special courses and seminars, 2006–2022

### **Higher School of Economics / New Economic School (Invited Professor)**

Optimal Control and Optimization (lectures, seminars, exams), 2014

### **Independent University of Moscow**

*English:* Program “Math in Moscow”, [mccme.ru/mathinmoscow](http://mccme.ru/mathinmoscow), 2003–2009  
Topology (lectures, exams), 2009  
Various special courses, 1997–2004

### **The University of Liverpool, UK**

*English:* Discrete Mathematics (lectures, exams), 2008  
*English:* Representations of Finite Groups (lectures, exams), 2008

### **Moscow State Forestry University**

Ordinary Differential Equations (lectures, seminars, exams), 1994–1995  
Calculus, Functions of Complex Variable (seminars), 1993–1994

## **Invited Talks at Conferences (last 6 years):**

- International Conferences on Differential Equations and Dynamical Systems, Suzdal, Russia, 2018, 2020, 2022
- International Conferences “Days on Diffraction”, Saint Petersburg, Russia, 2020, 2021
- Workshop “Geometric and Quantum Control”, Sirius University, Sochi, Russia, 2021
- International Conference “Special functions and semi-classical approximation”, Luminy, France, 2020
- 2nd MSU-PkU International Workshop in Geometry, Mathematical Physics, Statistics and Related Topics, Moscow, Russia, 2019
- International Conference “Semi-classical and Geometric Asymptotics in Mathematical Physics”, Toulon, France 2018
- International Conference “Geometric and Algebraic Singularity Theory Goo Ishikawa 60”, Będlewo, Poland, 2017

*The number of all invitations to international conferences: ~50*

## **Organizing Conferences and Seminars:**

- Program Committee Chair, *International Conference “Singularity Theory and its Applications in Differential Equations and Differential Geometry”*, Moscow, Russia, 2019
- Organizing Committee Member, *International Conference “Moscow Mathematical Society and Lomonosov Moscow State University” dedicated to the 150<sup>th</sup> anniversary of MMO*, Moscow, Russia, 2014
- Organizing Committee Member, *International Conference “Analysis and Singularities” dedicated to the 75<sup>th</sup> anniversary of Vladimir Igorevich Arnold*, Moscow, Russia, 2012
- Organizing Committee Member, *International Conference “Analysis and Singularities” dedicated to the 70<sup>th</sup> anniversary of Vladimir Igorevich Arnold*, Moscow, Russia, 2007

## **Memberships:**

- Board Member and Academic Secretary of Moscow Mathematical Society, 2010–present
- Moscow Mathematical Society Member, 1998–present

### **Long-Term Visiting Positions:**

- Sobolev Institute of Mathematics, Novosibirsk, Russia, 2014
- SISSA, Trieste, Italy, 2011
- ICTP, Trieste, Italy, 2010
- The University of Liverpool, UK, 2001–2002, 2008
- SISSA/ISAS, Trieste, Italy, 2007
- The Observatory of Nice, France, 2001, 2004
- Utrecht University, Netherlands, 2003
- Isaac Newton Institute for Mathematical Sciences, Univ. of Cambridge, UK, 2000
- The University of Aizu, Japan, 1995–1996, 1998–1999
- Department of Mathematics, Harvard University, USA, 1995
- Indian Institute of Science, Bangalore, India, 1992

### **Grants & Fellowships:**

- Grant “*Optimal Control on Lie Groups and its Applications to Computer Graphics, Robotics and Modelling of Vision*”, Russian Science Foundation, 2020–2021
- Grant “*Singularity theory and its applications to differential equations and differential geometry*”, Russian Foundation for Basic Research, 2019–2020, Co-Investigator
- Grant “*Complex and real-analytic singularities of implicit ordinary differential equations*”, Russian Foundation for Basic Research, 2016–2018, Principal Investigator
- Russian Government, mega grant №2010-220-01-077 (*Laboratory of Geometrical Methods of Mathematical Physics, head B.A. Dubrovin*); 2011–2012
- Grant “*Arnold’s School (Singularity Theory)*”, Council of Grants of the President of Russian Federation, Russian Foundation for Basic Research, 1997–2013, Co-Investigator
- Grants on *Singularity Theory in Contact and Symplectic Geometry*, Russian Foundation for Basic Research, 1994–2010
- Russian–Dutch Research Cooperation, NWO-RFBR, 2000–2002, 2005–2007
- Grants on *Bifurcation and Singularity Theory*, INTAS, 1997–1999, 2001–2003, 2006–2008
- Leverhulme Fellowship, 2001–2002

### **Reviewing:**

- Izvestiya: Mathematics
- Journal of Dynamical and Control Systems
- Sbornik: Mathematics
- Mathematical Notes
- Proceedings of the Steklov Institute of Mathematics
- Arnold Mathematical Journal
- Moscow Mathematical Journal,
- Journal of the London Mathematical Society
- Bulletin of the London Mathematical Society and others.

### **Non-University Activity:**

- Supervising mathematical section of the [diofant.ru](http://diofant.ru) website which contains problems in natural science for all levels and ages, 2009–2011

### **Languages:**

- Russian (native)
- English (fluent)

## **Selected Publications:**

### REFEREED JOURNALS

- 1) **I.A.Bogaevskii**, “*Metamorphoses of singularities of minimum functions and bifurcations of shock waves of the Burgers equation with vanishing viscosity*”, St. Petersburg (Leningrad) Math. J., 1990, v.1, no. 4, 807–823.
- 2) **I.A.Bogaevskii**, “*Degree of smoothness for visible contours of convex hypersurfaces*”, Adv. Soviet Math., 1990, v.1, 119–127.
- 3) **I.A.Bogaevskii**, “*Singularities of projections of convex hypersurfaces*”, Functional Anal. Appl., 1990, v.24, no.2, 97–103.
- 4) **I.A.Bogaevskii**, “*Transitions of fronts in evolutionary families*”, Proc. Steklov Inst. Math., 1995, v.209, 57–72.
- 5) **I.A.Bogaevskii**, “*Singularities of short wave propagation on plane*”, Sbornik: Mathematics (Russian Acad. Sci. Sb. Math.), 1995, v.186, no.11, 1581–1597, [doi.org/10.1070/SM1995v186n11ABEH000084](https://doi.org/10.1070/SM1995v186n11ABEH000084)
- 6) **I.A.Bogaevskii**, “*Singularities of convex hulls of three-dimensional hypersurfaces*”, Proc. Steklov Inst. Math., 1998, v.221, 71–90, [arxiv.org/abs/math/0302173](https://arxiv.org/abs/math/0302173)
- 7) Yu.Ohtake, A.G.Belyaev, **I.A.Bogaevskii**, “*Polyhedral surface smoothing with modified Laplacian and curvature flows*”, Journal of Three Dimensional Images, 1999, v.13, no.3, 19–24.
- 8) **I.A.Bogaevskii**, “*Singularities of convex hulls as fronts of Legendre varieties*”, Banach Centre Publ., v.50, Institute of Mathematics, Polish Academy of Sciences, Warszawa, 1999, 61–74, [matwbn.icm.edu.pl/ksiazki/bcp/bcp50/bcp5014.pdf](https://matwbn.icm.edu.pl/ksiazki/bcp/bcp50/bcp5014.pdf)
- 9) Yu.Ohtake, A.G.Belyaev, **I.A.Bogaevskii**, “*Mesh regularization and adaptive smoothing*”, Computer-Aided Design, 2001, v.33, 789–800, [doi.org/10.1016/S0010-4485\(01\)00095-1](https://doi.org/10.1016/S0010-4485(01)00095-1)
- 10) **I.A.Bogaevskii**, G.Ishikawa, “*Lagrange mappings of the first open Whitney umbrella*”, Pacific J. Math., 2002, v.203, no.1, 115–138, [msp.org/pjm/2002/203-1/pjm-v203-n1-p06-s.pdf](https://msp.org/pjm/2002/203-1/pjm-v203-n1-p06-s.pdf)
- 11) **I.A.Bogaevskii**, “*Perestroikas of shocks and singularities of minimum functions*”, Physica D: Nonlinear Phenomena, 2002, v.173/1-2, 1–28, [doi.org/10.1016/S0167-2789\(02\)00652-8](https://doi.org/10.1016/S0167-2789(02)00652-8), [arxiv.org/abs/math/0204237](https://arxiv.org/abs/math/0204237)
- 12) **I.A.Bogaevskii**, “*New singularities and perestroikas of fronts of linear waves*”, Moscow Math. J., 2003, v.3, no.3, 807–821, [mathjournals.org/mmj/vol3-3-2003/abst3-3-2003.html#bogaevsky\\_abstract](https://mathjournals.org/mmj/vol3-3-2003/abst3-3-2003.html#bogaevsky_abstract)
- 13) **I.A.Bogaevskii**, “*Perestroikas of shocks in optimal control*”, J. of Mathematical Sciences, 2005, v.126, no.4, 1229–1242, [doi.org/10.1007/PL00021944](https://doi.org/10.1007/PL00021944)
- 14) **I.A.Bogaevskii**, “*Discontinuous gradient differential equations and trajectories in calculus of variations*”, Sbornik: Mathematics (Russian Acad. Sci. Sb. Math.), 2006, v.197, no.12, 1723–1751, [doi.org/10.1070/SM2006v197n12ABEH003820](https://doi.org/10.1070/SM2006v197n12ABEH003820), [arxiv.org/abs/math-ph/0407073](https://arxiv.org/abs/math-ph/0407073)
- 15) **I.A.Bogaevskii**, “*Caustics of interior scattering*”, Proc. Steklov Inst. Math., 2009, v.267, 1–7, [doi.org/10.1134/S0081543809040014](https://doi.org/10.1134/S0081543809040014)
- 16) **I.A.Bogaevskii**, “*Wave front transitions of interior scattering*”, Doklady Mathematics, 2011, v.83, no.1, 26–29, [doi.org/10.1134/S106456241101008X](https://doi.org/10.1134/S106456241101008X)
- 17) **I.A.Bogaevskii**, “*Interaction of the folded Whitney umbrella and swallowtail in fast-slow systems*”, Proc. Steklov Inst. Math., 2012, v.278, 22–26, [doi.org/10.1134/S008154381206003X](https://doi.org/10.1134/S008154381206003X)
- 18) **I.A.Bogaevskii**, “*Implicit ordinary differential equations: bifurcations and sharpening of equivalence*”, Izvestiya: Mathematics, 2014, 78:6, 1063–1078, [doi.org/10.1070/IM2014v078n06ABEH002720](https://doi.org/10.1070/IM2014v078n06ABEH002720)
- 19) **I.A.Bogaevskii**, “*Sub-Lorentzian structures in  $R^4$ : left-Invariance and conformal normal forms*”, Journal of Dynamical and Control Systems, 2018, 24:3, 371–389, [doi.org/10.1007/s10883-018-9396-9](https://doi.org/10.1007/s10883-018-9396-9)

- 20) **I.A.Bogaevskii**, D.V.Tunitsky “*Singularities of multivalued solutions of quasilinear hyperbolic systems*”, Proc. Steklov Inst. Math., 2020, v.308, 67–78,  
[doi.org/10.1134/S008154382001006X](https://doi.org/10.1134/S008154382001006X)
- 21) **I.A.Bogaevskii**, “*Fundamental solution of the stationary Dirac equation with a linear potential*”, Theoretical and Mathematical Physics, 2020, 25:3, 1547–1563,  
[doi.org/10.1134/S0040577920120016](https://doi.org/10.1134/S0040577920120016)
- 22) **I.A.Bogaevskii**, “*Fronts of control-affine systems in  $R^3$* ”, Journal of Singularities, 2020, 21, 15–29, [journalofsing.org/volume21/bogaevsky.pdf](https://journalofsing.org/volume21/bogaevsky.pdf)
- 23) **I.A.Bogaevskii**, “*Asymptotics of the sphere and front of a flat sub-Riemannian structure on the Martinet distribution*”, Sbornik: Mathematics, 2022, 213:5, 624–640,  
[doi.org/10.1070/SM9560](https://doi.org/10.1070/SM9560)
- 24) **I.A.Bogaevskii** “*Asymptotics of the sphere and front of a flat sub-Riemannian structure on the Engel distribution*”, Proc. Steklov Inst. Math., accepted.

#### REFEREED CONFERENCE PROCEEDINGS

- 25) V.Lang, A.G.Belyaev, **I.A.Bogaevskii**, T.L.Kunii, “*Fast algorithms for ridge detection*”, IEEE Comp. Soc. Press. Los Alamitos, CA, 189–197.
- 26) A.G.Belyaev, **I.A.Bogaevskii**, T.L.Kunii, “*Ridges and ravines on a surface and segmentation of range images*”, Vision Geometry VI, Proc. SPIE 3168, San Diego, CA, July, 1997, 106–114.
- 27) **I.A.Bogaevskii**, A.G.Belyaev, T.L.Kunii, “*Qualitative and asymptotic properties of curvature-driven silhouette deformations*”, Vision Geometry VI, Proc. SPIE 3168, San Diego, CA, July, 1997, 167–176.
- 28) **I.A.Bogaevskii**, E.A.Kopylov, A.Khodulev, “*An implicit approach to cloth synthesis*”, Proc. the 9-th International Conference on Computer Graphics & Vision GraphiCon-99, Moscow, 1999, 117–120.
- 29) **I.A.Bogaevskii**, “*Singularities of viscosity solutions of Hamilton--Jacobi equations*”, Proceedings of RIMS Symposium on Singularity Theory and Differential Equations, RIMS Kokyuroku, Research Institute of Mathematical Science, Kyoto University, Japan, 1999, 138–143.
- 30) Yu.Ohtake, A.G.Belyaev, **I.A.Bogaevskii**, “*Polyhedral surface smoothing with simultaneous mesh regularization*”, Geometric Modelling and Processing 2000, Hong Kong, April 2000, 229–237.
- 31) **I.A.Bogaevskii**, V.Lang, A.G.Belyaev, T.L.Kunii, “*Color ridges on implicit polynomial surfaces*”, Proc. the 13-th International Conference on Computer Graphics & Vision GraphiCon-2003, Moscow, Russia, 161–164.

#### CHAPTERS IN BOOKS

- 32) V.I.Arnold, Yu.M.Baryshnikov, **I.A.Bogaevskii**, “*Singularities and bifurcations of potential flows*”, pp. 290–300 in S.N.Gurbatov, A.N.Malakhov, A.I.Saichev “Non-linear random waves and turbulence in non-dispersive media: waves, rays, and particles”, Manchester University Press, 1991.
- 33) **I.A.Bogaevskii**, “*Interior scattering of rays and wave fronts on plane*”, pp. 300–316 in V.I.Arnold “Singularities of caustics and wave fronts”, Russian edn., Phasis, Moscow, 1996.
- 34) **I.A.Bogaevskii**, “*Singularities of short linear waves on the plane*”, Arnold–Gelfand Mathematical Seminars: Geometry and Singularity Theory, Birkhäuser, Boston, 1997, 107–112, [doi.org/10.1007/978-1-4612-4122-5\\_5](https://doi.org/10.1007/978-1-4612-4122-5_5)
- 35) **I.A.Bogaevskii**, *Comments 1974-8, 1978-17, 1981-14, 1981-28, 1988-3, and 1989-10*, pp. 308–309, 367–370, 402–403, 412–414, 464–465, and 492–495 in ARNOLD'S PROBLEMS, Springer & Phasis, 2004, <https://doi.org/10.1007/b138219>