

# Gleb Pogudin

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## Contact Information

Affiliation **LIX, CNRS, École Polytechnique**, *Institut Polytechnique de Paris*.

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## Employment

- 2020–now **Assistant Professor**, *École Polytechnique*, France.  
Laboratoire d'informatique
- 2019–2020 **Assistant Professor**, *Higher School of Economics*, Moscow.  
Department of Computer Science
- 2017–2019 **Assistant Professor/Faculty Fellow**, *New York University*.  
Courant Institute of Mathematical Sciences
- 2017–2019 **Visiting Scholar**, *City University of New York*.  
Graduate Center
- 2016–2017 **Postdoc**, *Johannes Kepler University*, Linz, Austria.  
Institut für Algebra, mentored by Manuel Kauers
- 2012–2016 **Math Instructor**, *Moscow State University*.  
Department of Mechanics and Mathematics and A.N.Kolmogorov high school
- 2014–2016 **Math Instructor**, *College of Moscow Institute of Physics and Technology*.
- 2012–2013 **Programmer**, *Yandex Company*.  
Banner System: Real-time computations and Data Analysis

## Education

- 2012–2016 **Ph.D. in Mathematics**, *Moscow State University*.  
Advisor: Yu. P. Razmyslov
- 2007–2012 **Diploma in Mathematics and Applied Mathematics**, *Moscow State University*.  
Advisor: Yu. P. Razmyslov. Diploma with honours.

## Grants

- 2023–2026 **Agence Nationale de la Recherche (ANR)**.  
“*OCCAM: TheOry and praCtiCe of differentIAI eliMination*”
- 2022 **Institut des sciences de l'information et de leurs interactions (INS2I)**.  
“*PANTOMIME: PolynomiAlizatioN and quadraTizatiOn of DynaMIcal ModElS*”
- 2021–2022 **Réseau Francilien en Sciences Informatiques (RFSI)**.  
“*Exact ODE Reduction*”

- 2021 **Institut des sciences de l'information et de leurs interactions (INS2I)**.  
"MIMOSA: eliMInation in dynaMical mOdelS and Applications"
- 2019 **National Science Foundation**, *Mathematical Biology*.  
"Efficient Methods for Identifiability of Dynamic Models"

## Publications

### Preprints

1. G. Pogudin, *Persistent components in Canny's resultant*, <https://arxiv.org/abs/2401.01948>
2. R. Ait El Manssour, G. Pogudin, *Wronskians form the inverse system of the arcs of a double point*, <https://arxiv.org/abs/2405.08964>

### Peer-reviewed articles

1. M. Bessonov, I. Ilmer, T. Konstantinova, A. Ovchinnikov, G. Pogudin, P. Soto, *Faster Gröbner bases for Lie derivatives of ODE systems via monomial orderings*, accepted to the ACM International Symposium on Symbolic and Algebraic Computation (ISSAC), 2024.
2. S. Abramov, G. Pogudin, *On the dimension of the solution space of linear difference equations over the ring of infinite sequences*, accepted to the Journal of Symbolic Computation, 2024.
3. T. Novikova, A. Ovchinnikov, G. Pogudin, J. Ramella-Roman, *Time-efficient filtering of imaging polarimetric data by checking physical realizability of experimental Mueller matrices*, accepted to Bioinformatics, 2024.
4. A. Demin, E. Demitraki, G. Pogudin, *Exact hierarchical reductions of dynamical models via linear transformations*, Communications in Nonlinear Science and Numerical Simulation, doi:10.1016/j.cnsns.2024.107816, 2024.
5. A. Bychkov, O. Issan, G. Pogudin, B. Kramer, *Exact and optimal quadratization of nonlinear finite-dimensional non-autonomous dynamical systems*, accepted to the SIAM Journal on Applied Dynamical Systems, 2024.
6. Y. Cai, G. Pogudin, *Dissipative quadratizations of polynomial ODE systems*, accepted to Tools and Algorithms for Construction and Analysis of Systems (TACAS'24), 2024.
7. R. Ait El Manssour, G. Pogudin, *Multiplicity structure of the arc space of a fat point*, accepted to Algebra & Number Theory, 2023.
8. R. Dong, C. Goodbrake, H.A. Harrington, G. Pogudin, *Differential elimination for dynamical models via projections with applications to structural identifiability*, SIAM Journal on Applied Algebra and Geometry, doi:10.1137/22M1469067, 2023.
9. I. Koswara, G. Pogudin, S. Selivanova, M. Ziegler, *Bit-complexity of solving systems of linear evolutionary partial differential equations*, Journal of Complexity, doi: 10.1016/j.jco.2022.101727, 2023.
10. A. Jiménez-Pastor, J. Jacob, G. Pogudin, *Exact linear reduction for rational dynamical systems*, Computational Methods in Systems Biology (CMSB), doi: 10.1007/978-3-031-15034-0\_10, 2022.

11. D. Pavlov, G. Pogudin, *On realizing differential-algebraic equations by rational dynamical systems*, ACM International Symposium on Symbolic and Algebraic Computation (ISSAC), doi:10.1145/3476446.3535492, 2022.
12. A. Ovchinnikov, A. Pillay, G. Pogudin, T. Scanlon, *Multi-experiment parameter identifiability of ODEs and model theory*, SIAM Journal on Applied Algebra and Geometry, doi: 10.1137/21M1389845, 2022.
13. A. Ovchinnikov, G. Pogudin, P. Thompson, *Input-output equations and identifiability of linear ODE models*, IEEE Transactions on Automatic Control, doi:10.1109/TAC.2022.3145571, 2022.
14. D. Pavlov, G. Pogudin, Yu. Razmyslov, *From algebra to analysis: new proofs of theorems by Ritt and Seidenberg*, Proceedings of American Mathematical Society, doi:https://doi.org/10.1090/proc/16065, 2022.
15. A. Ovchinnikov, A. Pillay, G. Pogudin, T. Scanlon, *Computing all identifiable functions of parameters for ODE models*, System & Control Letters, doi: 0.1016/j.sysconle.2021.105030, 2021.
16. W. Li, A. Ovchinnikov, G. Pogudin, T. Scanlon, *Algorithms yield upper bounds in differential algebra*, Canadian Journal of Mathematics, doi: 10.4153/S0008414X21000560, 2021.
17. E. Amzallag, A. Minchenko, G. Pogudin, *Degree bound for toric envelope of a linear algebraic group*, Mathematics of Computation, doi: 10.1090/mcom/3695, 2021.
18. G. Pogudin, X. Zhang, *Interpretable exact linear reductions via positivity*, Computational Methods in Systems Biology (CMSB), doi: 10.1007/978-3-030-85633-5\_6, 2021.
19. J. van der Hoeven, G. Pogudin, *A zero test for  $\sigma$ -algebraic power series*, ACM International Symposium on Symbolic and Algebraic Computation (ISSAC), doi: 10.1145/3452143.3465549, 2021.
20. A. Bychkov, G. Pogudin, *Optimal monomial quadratization for ODE systems*, International Workshop on Combinatorial Algorithms (IWOCA), doi:10.1007/978-3-030-79987-8\_9, 2021.
21. I. C. Pérez Verona, A. Ovchinnikov, G. Pogudin, M. Tribastone, *CLUE: Exact maximal reduction of kinetic models by constrained lumping of differential equations*, Bioinformatics, doi:10.1093/bioinformatics/btab010, 2021.
22. A. Ovchinnikov, G. Pogudin, P. Thompson, *Parameter identifiability and input-output equations*, Applicable Algebra in Engineering, Communication and Computing, doi:10.1007/s00200-021-00486-8, 2021.
23. A. Ovchinnikov, G. Pogudin, N. Thieu Vo, *Bounds for elimination of unknowns in systems of differential-algebraic equations*, International Mathematics Research Notices, doi: 10.1093/imrn/rnaa302, 2020.
24. W. Li, A. Ovchinnikov, G. Pogudin, T. Scanlon, *Elimination of unknowns for systems of algebraic differential-difference equations*, Transactions of American Mathematical Society, doi:10.1090/tran/8219, 2020.

25. M. Buchacher, M. Kauers, G. Pogudin, *Separating variables in bivariate polynomial ideals*, refereed Proceedings of the 2020 ACM International Symposium on Symbolic and Algebraic Computation, pp. 54–61, 2020.
26. H. Hong, A. Ovchinnikov, G. Pogudin, C. Yap, *Global identifiability of differential models*, Communications in Pure and Applied Mathematics, vol. 73(9), pp. 1831–1879, 2020.
27. G. Pogudin, T. Scanlon, M. Wibmer, *Solving difference equations in sequences: Universality and Undecidability*, Forum of Mathematics, Sigma, vol. 8, e33, 2020.
28. A. Ovchinnikov, G. Pogudin, T. Scanlon, *Effective difference elimination and Nullstellensatz*, Journal of the European Mathematical Society, doi: 10.4171/JEMS/968, 2020.
29. E. Paul, G. Pogudin, W. Qin, R. Laubenbacher *The dynamics of canalizing Boolean networks*, Complexity, vol 2020, ID3687961, 2020.
30. G. Pogudin, *Primitive element theorem for fields with commuting derivations and automorphisms*, Selecta Mathematica, 25:57, 2019.
31. H. Hong, A. Ovchinnikov, G. Pogudin, C. Yap, *SIAN: software for structural identifiability analysis of ODE models*, Bioinformatics, vol. 35(16), pp. 2873–2874, 2019.
32. E. Amzallag, G. Pogudin, M. Sun, N. Thieu Vo, *Complexity of triangular representations of algebraic sets*, Journal of Algebra, vol. 523, pp. 342–364, 2019.
33. G. Pogudin, *A differential analog of the Noether normalization lemma*, International Mathematics Research Notices, vol. 2018(4), pp. 1177–1199, 2018.
34. G. Pogudin, A. Szanto, *Irredundant Triangular Decomposition*, refereed Proceedings of the 2018 ACM International Symposium on Symbolic and Algebraic Computation, pp. 311–318, 2018.
35. G. Pogudin, *Products of ideals and jet schemes*, Journal of Algebra, vol. 502, pp. 61–78, 2018.
36. R. Gustavson, A. Ovchinnikov, G. Pogudin, *New order bounds in differential elimination algorithms*, Journal of Symbolic Computation, vol. 85, pp. 128–147, 2018.
37. G. Pogudin, *Power series expansions for the planar monomer-dimer problem*, Physical Review E, vol. 96, 033303, 2017.
38. M. Kauers, G. Pogudin, *Bounds for Substituting Algebraic Functions into D-finite Functions*, refereed Proceedings of the 2017 ACM International Symposium on Symbolic and Algebraic Computation, pp. 245–252, 2017.
39. O. Gerasimova, Yu.P. Razmyslov, G. Pogudin *Rolling Simplexes and Their Commensurability III (Capelli Identities and Their Application to Differential Algebras)*, Journal of Mathematical Sciences, vol. 221(3), pp. 315–325, 2017.
40. G. Pogudin, Yu.P. Razmyslov, *Prime Lie algebras satisfying the standard Lie identity of degree 5*, Journal of Algebra, vol. 468, pp. 182–192, 2016.
41. R. Gustavson, A. Ovchinnikov, G. Pogudin, *Bounds for orders of derivatives in differential elimination algorithms*, refereed Proceedings of the 2016 ACM International Symposium on Symbolic and Algebraic Computation, pp. 239–246, 2016.

42. E.S. Golod, G. Pogudin, *Modules of zero Gorenstein dimension over graph algebras*, Sbornik:Mathematics, vol. 207, issue 7, pp. 81–100, 2016.
43. G. Pogudin, *The primitive element theorem for differential fields with zero derivation on the base field*, Journal of Pure and Applied Algebra, vol 219(9), pp. 4035–4041, 2015.
44. G. Pogudin, *Primary differential nil-algebras do exist*, Moscow University Mathematics Bulletin, vol 69(1), pp 33–36, 2014.
45. Yu.P. Razmyslov, G. Pogudin, *The Heisenberg envelope for the Hochschild algebra of a finite-dimensional Lie algebra*, Journal of Mathematical Sciences, vol. 193(4), pp 580–585, 2013.
46. Yu.P. Razmuslov, G. Pogudin, *Paradigm of Max-Factor and finite-dimensional representation of Lie algebras*, Moscow University Mathematics Bulletin, vol. 67(4), pp 170–172, 2012.
47. G. Pogudin, *Wronskian of derivations*, Moscow University Mathematics Bulletin, Volume 66(1), pp 47–49, 2011.

#### Other publications

1. S. Abramov, G. Pogudin, *Linear difference operators with sequence coefficients having infinite-dimensional solution spaces*, ACM Communications in Computer Algebra, doi: 10.1145/3610377.3610378, 2023
2. M. Drmota, C. Krattenthaler, G. Pogudin, *Problem 11997*, The American Mathematical Monthly, vol. 124, number 7, p.660.

#### Recent presentations

1. *Quadratizations of differential equations*, Computer Algebra for Functional Equations in Combinatorics and Physics, Institute Henri Poincaré, Paris, December 5, 2023, [slides](#).
2. *Software for structural parameter identifiability*, Mathematical Software and High Performance Algebraic Computing, ENS Lyon, July 30, 2023.
3. *Towards Automatic Quadratization for PDEs*, SIAM Conference on Computational Science and Engineering, March 1, 2023.
4. *Exact reductions of dynamical systems*, LACL lab seminar, Univ. Paris Est Creteil, January 30, 2023.
5. *On realizing differential-algebraic equations by rational dynamical systems*, International Symposium on Symbolic and Algebraic Computation (ISSAC), Lille, 4-7 July 2022.
6. *Exact reductions of dynamical systems*, British Applied Mathematics Colloquium, April 13, 2022, [slides](#).
7. *Quadratization of ODE systems*, Conference “Computer Algebra”, June 28, 2021, [video](#), [slides](#).
8. *Attractor structure of Boolean networks of small canalizing depth*, Society for Mathematical Biology Annual Meeting, June 14, 2021, [slides](#).

9. *Differential elimination for dynamical systems (plenary talk)*, Effective Methods in Algebraic Geometry, June 7, 2021, [video](#), [slides](#).
10. *How many experiments?*, Nonlinear Algebra Seminar, March 2, 2021, [video](#).
11. *Algorithms for exploring the structure of differential equations*, Séminaire du LIX, February 11 2021, [video](#).
12. *Elimination problem for ODE systems and parameter identifiability*, joint Pol-Sys/SpecFun seminar, December 4 2020.
13. *Structural parameter identifiability with a view towards model theory*, workshop “Model Theory of Differential Equations, Algebraic Geometry, and their Applications to Modeling” organized online by Banff International Research Station, 1-5 June 2020, [video](#).
14. *SIAN: a tool for assessing structural identifiability of parametric ODEs*, International Symposium on Symbolic and Algebraic Computation (ISSAC), Beijing, 15-18 July 2019.

## Teaching

- École Polytechnique:
  - Computer Programming (CSE101 and CSE102, lab sessions),
  - Concurrent and Distributed Computing (CSE305, lab sessions),
  - C++ Algorithms for Data Analysis (INF442, lab sessions),
  - Project in Computer Science (CSE303).
- Higher School of Economics:
  - Algorithms and Data Structures 1,
  - Computations in Nonlinear Algebra.
- New York University: Basic Algorithms (4 semesters).
- New York Math Circle: “College Bridge” program.
- Johannes Kepler University: Algebra for Computer Scientists, project leader for “Project Week of Applied Mathematics” ([link](#)).
- Moscow State University, Department of Mechanics and Mathematics: Abstract Algebra I, II, Ring theory.
- Moscow State University, A.N. Kolmogorov school: Calculus I, II, Intermediate Algebra.
- College of Moscow Institute of Physics and Technology: Discrete Mathematics, Probability and Statistics.

## Mentoring students

### Ph.D. students

- 2023-now Yulia Mukhina (École Polytechnique), coadvised with Joris van der Hoeven
- 2021-2023 Rida Ait El Manssour (Max Planck Institute for Mathematics in the Sciences), coadvised with Bernd Sturmfels, Thesis title “*Combinatorial methods in differential algebra*”

### Master students

- 2020-2022 Andrey Bychkov (Higher School of Economics, Moscow), Master thesis "*Polynomializations and Quadratizations of ODE systems*"
- 2020-2022 Dmitrii Pavlov (Moscow State University, Moscow), Master thesis "*On realizing differential-algebraic equations by rational dynamical systems*", coadvised with Yu.P. Razmyslov
- 2020 Ruiwen Dong (École Polytechnique), M1 internship (joint with Heather Harrington) "*Global identifiability of differential models*". Received "Prix du centre de recherche" from École Polytechnique.
- 2019-2020 Anton Zakharenkov (Higher School of Economics, Moscow), Master thesis "*Representing Tropical Rational Functions via ReLU Neural Networks*"

### Bachelor students

- 2023 Yubo Cai (École Polytechnique), internship "*Dissipative quadratizations of polynomial ODE systems*"
- 2023 Stefan Vayl (École Polytechnique), Bachelor thesis "*Exploiting conservation laws to assess structural identifiability faster*"
- 2023 Timothé Menard (École Polytechnique), Bachelor thesis "*Chow rank and explainable polynomial models*"
- 2022 Albani Olivieri (Universidad de Chile), internship "*Optimal monomial quadratization for PDEs*"
- 2022 Natali Gogishvili (École Polytechnique), internship "*Disproving the conjecture about removing the leak*".
- 2022 Bogdana Kolić (École Polytechnique), internship "*Quadratization of ODE systems via Laurent monomials*".
- 2021 Xingjian Zhang (École Polytechnique), Bachelor thesis "*Interpretable exact linear reductions via positivity*".
- 2021 Alexander Demin (Higher School of Economics, Moscow), internship "Simplifying identifiable functions for ODE models"
- 2020-2021 Alexander Demin and Elizaveta Demitraki (Higher School of Economics, Moscow), project "Exact ODE reductions"
- 2019-2020 Andrey Bychkov (Higher School of Economics, Moscow), Bachelor thesis "*Monomial quadratization of ODEs*".

### High school students

- 2019-2020 Foyez Alauddin, project "*Parameters of Quadratization of Scalar Polynomial ODE's*". Received High Honors at the New York State Science and Engineering Fair and Best in Mathematics and Computer Science at the Delbarton Science Fair.
- 2018-2019 Eli Paul and William Qin, project "*The Dynamics of Canalizing Boolean Networks*"
- 2017-2018 Esha Sawant, project "*A method for identifying parameters in the May-Leonard system using Gröbner bases*". Advanced to the finals of the NYC Science and Engineering Fair.

## Professional service

- Program Committee Member for ISSAC'19, CASC'20, CASC'21, SYNASC'21, CASC'24, CMSB'24.
- Organizer of a topical day "Elimination for Functional Equations" within the special trimester "Recent Trends in Computer Algebra" at the Institute Henri Poincaré (Paris, France, 2023)
- Co-organizer of a CIMPA summer school "Algebraic and Tropical Methods for Solving Differential Equations" (Oaxaca, México, July 2023)
- Co-organizer of minisymposium "Exact Polynomialization and Quadraticization of Non-linear Dynamics", SIAM Computation Science and Engineering, 2023, Amsterdam, Netherlands.
- Member-At-Large of the Steering Committee of the International Symposium on Symbolic and Algebraic Computation, 2023-2026.
- Co-organizer of minisymposia "Algebra and Geometry of Dynamic Models" and "Differential Equations in Algebraic Geometry and Beyond", SIAM Applied Algebraic Geometry, 2021, Online.
- Treasurer of the 46th International Symposium on Symbolic and Algebraic Computation (ISSAC 2021, St. Petersburg, Russia).
- Co-organizer of the workshop Model Theory of Differential Equations, Algebraic Geometry, and their Applications to Modeling (2020, BIRS, Canada)
- Chair of the Workshop on Symbolic-Numeric Methods for Differential Equations and Applications (NYU, USA, 2018).
- Selection Committee Member for Dean's Undergraduate Research Fund (NYU, USA, 2018).
- Judge of the NYU Undergraduate Research Conference (NYU, USA, 2018).
- Publicity Chair of the 43rd International Symposium on Symbolic and Algebraic Computation (ISSAC 2018, CUNY and NYU).
- Poster Committee Member of the 43rd International Symposium on Symbolic and Algebraic Computation (ISSAC 2018, CUNY and NYU).
- Local Organizer of the 8th Differential Algebra and Related Topics conference (Johannes Kepler University, Linz, Austria, 2017).

## Teaching awards

- 2015, 2016 The Best Teacher of the A.N. Kolmogorov High School (Moscow State University).  
2014 Grant recipient of the Education Department of Moscow.

## Additional skills

Programming languages: C++, Python, Julia, Perl, Maple, Mathematica, Java, SQL, Coq.