

## Artem S. Novozhilov, Ph.D.

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### RESEARCH INTERESTS

The primary interests are in mathematical modeling of various evolutionary processes. In particular:

- development of epidemiological models that include heterogeneous structure of populations;
  - the selection–mutation equilibria in quasispecies model;
  - the role of the explicit spatial structure in the replicator equation.
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### EDUCATION

- Ph.D., Applied Mathematics, 2002**  
Moscow State University of Communication Means (MIIT), Moscow, Russia
  - M.S., Applied Mathematics, 1999**  
Moscow State University of Communication Means (MIIT), Moscow, Russia
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### POSITIONS HELD

- Assistant Professor** (08/2012 – present)  
Department of Mathematics, North Dakota State University, Fargo, ND, USA
  - Associate Professor** (09/2009 – 06/2012)  
Department of Applied Mathematics–1, Moscow State University of Communication Means (MIIT), Moscow, Russia
  - Visiting Fellow** (09/2004 – 08/2009)  
National Center for Biotechnology Information (NCBI), National Library of Medicine (NLM), National Institutes of Health (NIH), Bethesda, Maryland, USA.
  - Assistant Professor** (09/2002 – 07/2004)  
Department of Applied Mathematics–1, Moscow State University of Communication Means (MIIT), Moscow, Russia.
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### PUBLICATIONS

1. Koonin, E.V., Novozhilov, A.S.: Origin and evolution of the universal genetic code, submitted
2. Bratus, A.S., Novozhilov, A.S., Semenov, Y.S.: Adaptive Fitness Landscape for Replicator Systems: To Maximize or not to Maximize, submitted
3. Bratus, A.S., Posvyanskii, V.P., Novozhilov, A.S.: Solutions with a bounded support promote permanence of a distributed replicator equation, in press, *Applicable Analysis*, 2017
4. Semenov, Y.S., Novozhilov A.S.: On Eigen's quasispecies model, two-valued fitness landscapes, and isometry groups acting on finite metric spaces, *Bulletin of Mathematical Biology*, 2016, **78**(5): 991–1038

5. Bratus, A.S., Hu, C.-K. Safro, M.V., and Novozhilov, A.S.: On diffusive stability of Eigen's quasispecies model, *Journal of Dynamical and Control Systems*, 2016, **22**(1):1–14
6. Semenov, Y.S., Novozhilov, A.S.: Exact solutions for the selection-mutation equilibrium in the Crow-Kimura evolutionary model, *Mathematical Biosciences*, 2015, **266**:1–9
7. Semenov, Y.S., Bratus, A.S., Novozhilov, A.S.: On the behavior of the leading eigenvalue of Eigen's evolutionary matrices, *Mathematical Biosciences*, 2014, **258**:134–147
8. Bratus, A.S., Novozhilov, A.S., Semenov, Y.S.: Linear algebra of the permutation invariant Crow-Kimura model of prebiotic evolution, *Mathematical Biosciences*, 2014, **256**:42–57
9. Bratus, A.S., Posvyanskii, V.P., Novozhilov, A.S.: Replicator equations and space, *Mathematical Modelling of Natural Phenomena*, 2014, **9**(3): 47-67
10. Novozhilov, A.S.: Epidemiological models with parametric heterogeneity: Deterministic theory for closed populations, *Mathematical Modelling of Natural Phenomena*, 2012, **7**(3): 147–167
11. Novozhilov, A.S., Posvyanskii, V.P., Bratus, A.S.: On the reaction-diffusion replicator systems: Spatial patterns and asymptotic behavior, *Russian Journal of Numerical Analysis and Mathematical Modelling*, 2012, **26**(6):555–564
12. Bratus, A.S., Posvyanskii, V.P., Novozhilov, A.S.: Replicator equation and explicit space: The case of global regulation, *Mathematical Biosciences & Engineering*, 2011, **8**(3):659–676
13. Karev, G.P., Novozhilov, A.S., Berezovskaya, F.S.: On the asymptotic behavior of the solutions to the replicator equation. *Mathematical Medicine & Biology*, 2011, **28**(2):89–110
14. Bratus, A.S., Posvyanskii, V.P., Novozhilov, A.S.: Existence and stability of stationary solutions to spatially extended autocatalytic and hypercyclic systems under global regulation and with nonlinear growth rates. *Nonlinear Analysis Series B: Real World Applications*. 2010, **11**(3):1897-1917, doi: 10.1016/j.nonrwa.2009.04.013
15. Bratus', A.S., Novozhilov, A.S., Platonov, A.P.: *Dynamical Systems and Models in Biology*, Moscow: Fizmatlit, 2010, 400 pages, ISBN: 978-5-9221-1192-8 (*in Russian*)
16. Novozhilov, A.S., Koonin, E.V.: Exceptional error minimization in putative primordial genetic codes. *Biology Direct*. 2009, **4**(44), doi:10.1186/1745-6150-4-44
17. Koonin, E.V., Novozhilov, A.S.: Origin and evolution of the genetic code: The universal enigma. *IUBMB Life*. 2009, **61**(2), 99–111, doi:10.1002/iub.146
18. Novozhilov A.S.: Heterogeneous Susceptibles–Infectives model: Mechanistic derivation of the power law transmission function. *Dynamics of Continuous, Discrete and Impulsive Systems (Series A, Mathematical Analysis)*. 2009, **16**(S1), Suppl., 136–140
19. Berezovskaya, F.S., Karev, G.P., Novozhilov, A.S.: Pure cross-diffusion models: Implications for traveling wave solutions. *Dynamics of Continuous, Discrete and Impulsive Systems (Series A, Mathematical Analysis)* 2009, **16**(S1), Suppl., 141–146
20. Novozhilov, A.S.: On the spread of epidemics in a closed heterogeneous population. *Mathematical Biosciences*. 2008, **215**, 177-185, doi:10.1016/j.mbs.2008.07.010
21. Berezovskaya, F.S., Novozhilov, A.S., Karev, G.P.: Families of traveling impulses and fronts in some models with cross-diffusion. *Nonlinear Analysis: Real World Applications*. 2008, **9**: 1866–1881, doi: 10.1016/j.nonrwa.2007.06.001
22. Karev, G.P., Novozhilov, A.S., Berezovskaya F.S.: Modeling the dynamics of inhomogeneous natural rotifer populations under toxicant exposure. *Ecological Modeling*. 2008, **212**(1-2): 80–85, doi:10.1016/j.ecolmodel.2007.10.011
23. Novozhilov, A.S., Wolf, Y.I., Koonin, E.V.: Evolution of the genetic code: partial optimization of a random code for robustness to translation error in a rugged fitness landscape. *Biology Direct*. 2007, **2**(24), doi: 10.1186/1745-6150-2-24

24. Berezovskaya, F.S., Novozhilov, A.S., Karev, G.P.: Traveling fronts, impulses and trains in some taxis models. *Neural, Parallel & Scientific Computations*. 2007, **15**: 561–570
25. Berezovskaya, F.S., Novozhilov, A.S., Karev, G.P.: Population models with singular equilibrium. *Mathematical Biosciences*. 2007, **208**(1):270–299
26. Karev, G.P., Novozhilov, A.S., Koonin, E.V.: Mathematical modeling of tumor therapy with oncolytic viruses: Effects of parametric heterogeneity on cell dynamics. *Biology Direct*. 2006, **1**(1):30
27. Novozhilov, A.S., Berezovskaya, F.S., Koonin, E.V., Karev, G.P.: Mathematical modeling of tumor therapy with oncolytic viruses: Regimes with complete tumor elimination within the framework of deterministic models. *Biology Direct*. 2006, **1**(1):6
28. Novozhilov, A.S., Karev, G.P., Koonin, E.V.: Biological applications of the theory of birth-and-death processes. *Briefings in Bioinformatics*. 2006, **7**(1):70–85
29. Novozhilov, A.S., Karev, G.P., Koonin, E.V.: Mathematical modeling of evolution of horizontally transferred genes. *Molecular Biology and Evolution*. 2005, **22**(8):1721–1732
30. Bratus, A.S., Novozhilov, A.S.: Stabilizing effect of nonlinear damping for a system with follower force. *Functional Differential Equation*. 2005, **12**(1-2):109–118
31. Novozhilov, A.S.: Analysis of a generalized population predator-prey model with a parameter distributed normally over the individuals in the predator population. *Journal of Computer and Systems Sciences International*. 2004, **43**(3):378–382
32. Novozhilov, A.S.: Parameter identification for one dynamical system that simulates the interaction of pollutants with the active environment. *Journal of Computer and Systems Sciences International*. 2002, **41**(3):433–436
33. Bratus, A.S., Mescherin, A.N., Novozhilov, A.S.: Mathematical models of interaction between pollutant and environment. *Vestnik MGU, Vychislitel'naya matematika i kybernetika*. 2001, **1**:23–28 (*in Russian*)
34. Novozhilov, A.S., Bratus, A.S.: Nonlinear damping as a stabilizing factor and resolving Ziegler's paradox. *Proceeding of the 5th Symposium "Nonlinear Control and Oscillations"(NOLCOS'01)*, July, St. Petersburg, Russia, 2001, **2**:973–978
35. Bratus, A.S., Mescherin, A.N., Novozhilov, A.S.: Mathematical Models of Interaction between Pollutant and Environment. *Proceeding of the 2nd international conference "Control of Oscillations and Chaos" (COC 2000)*, July, St. Petersburg, Russia, 2000, **3**:569–572

### PhD Thesis

- Novozhilov, A.S.: Mathematical models of interaction between pollutant and environment. Thesis for Ph.D. degree in Physics and Mathematics. Moscow, Moscow State University of Communication Means. 2002, 84 p. (*in Russian*)

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### INVITED PRESENTATIONS, CONFERENCES, AND VISITS<sup>1</sup>

**2016** Midwest Mathematical Biology Conference: On the evolution of parameter distributions in epidemiological models, May, La Crosse, Wisconsin, USA

**2016** Spring Central Sectional Meeting, NDSU, Fargo, Special Session on Topological and Smooth Dynamics: On Eigen's quasispecies model and isometry groups acting on finite metric spaces, April, Fargo, North Dakota, USA

**2015** Colloquium of the Department of Mathematics, NDSU: On Eigen's quasispecies model, two-valued fitness landscapes, and isometry groups acting on finite metric spaces, September, Fargo, North Dakota, USA

<sup>1</sup>Not including presentations at local Math Department seminars, such as Applied Math Seminar, Junior Colloquium, Math Club, etc at NDSU

- 2015** The Society for Mathematical Biology Annual Meeting and Conference: Exact Solutions Of The Quasispecies Evolutionary Model, July, Atlanta, Georgia, USA
- 2014** NCBI Scientific Visitor's Program, Seminar at Dr. Koonin lab, NCBI/NLM/NIH: What we know and what we do not know about the quasispecies, October 8–12, Bethesda, Maryland, USA
- 2014** Colloquium of the Department of Mathematics, NDSU: Linear Algebra of the quasispecies model, September, Fargo, North Dakota, USA
- 2014** SIAM Conference on the Life Sciences: Linear algebra of the quasispecies model, August, Charlotte, North Carolina, USA
- 2014** Midwest Mathematical Biology Conference: Linear algebra of the quasispecies model, May, La Crosse, Wisconsin, USA
- 2014** Joint Mathematics Meeting: Linear algebra of the Crow-Kimura quasispecies model, January, Baltimore, Maryland, USA
- 2013** The Society for Mathematical Biology Annual Meeting and Conference: Epidemiological models with parametric heterogeneity, June, Tempe, Arizona, USA
- 2013** Biology Department Seminar, NDSU: Origin and evolution of the standard genetic code, May, Fargo, ND, USA
- 2013** Joint Mathematics Meeting: Analysis of a stochastic SIR model with parametric heterogeneity, January, San Diego, CA, USA
- 2012** Physics Department Seminar, NDSU: On mathematical modeling of biological evolution, October, Fargo, ND, USA
- 2012** Mathematics Colloquium, NDSU: On the asymptotic behavior of the solutions to a replicator equation, September, Fargo, ND, USA
- 2012** Workshop at Moscow State University of Communication Means: On mathematical models of prebiotic evolution and their mathematical analysis, May, Moscow, Russia
- 2012** Computational Mathematics and Cybernetics Department, Moscow State University (Lomonosov): Mathematical approaches to random networks, March, Moscow, Russia
- 2012** NCBI Scientific Visitor's Program, NCBI/NLM/NIH, January–February, Bethesda, MD, US
- 2012** Joint Mathematics Meeting, January 4–7, AMS Special Session on Recent Advances in Mathematical Biology, Ecology, and Epidemiology, I: On the spread of epidemics in a closed heterogeneous population, January, Boston, Massachusetts, US (Skype presentation)
- 2012** Joint Mathematics Meeting, January 4–7, AMS Session on Mathematical Biology and Related Fields: Reaction-diffusion replicator equation: Stability and asymptotic behavior, January, Boston, Massachusetts, US (Skype presentation)
- 2011** Seminar at the NDSU Department of Mathematics: On the mathematical modeling of the spread of epidemics in heterogeneous populations, December, Fargo, North Dakota, US (Skype presentation)
- 2011** Workshop on Critical Phenomena and Complex Systems, Laboratory of Statistical and Computational Physics, Institute of Physics, Academia of Sinica: On the Spread of Epidemics in a Closed Heterogeneous Population, December, Taipei, Taiwan
- 2011** Workshop on Critical Phenomena and Complex Systems, Laboratory of Statistical and Computational Physics, Institute of Physics, Academia of Sinica: On the Origin and Evolution of the Standard Genetic Code, December, Taipei, Taiwan
- 2011** Seminar at Steklov Institute, Department of Mathematical Physics: Asymptotic behavior of the solutions to the replicator equation in evolutionary game theory, November, Moscow, Russia
- 2011** The 3d Workshop "Mathematical models and numerical methods in biomathematics": On the spread of epidemics in a closed heterogeneous population, October 27–28, Institute of Numerical Mathematics, Russian Academy of Science, October, Moscow, Russia
- 2011** The 8th European Conference on Mathematical and Theoretical Biology: On the Spread of Epidemics in a Closed Heterogeneous Population, Krakow, Poland, June 28–July 2
- 2011** Seminar at Systems Analysis, Computational Mathematics and Cybernetics Department, Moscow State University (Lomonosov) (the host is Prof. A.B. Kurzhanski): On the mathematical modeling in Systems Biology, May, Moscow, Russia

- 2011** Seminar at Computing Center, Russian Academy of Science, Department of Simulation Systems and Operational Research: On the spread of epidemics in a closed heterogeneous population, May, Moscow, Russia
- 2011** Seminar at Steklov Institute (the host is prof. Y. Ilyashenko): On the asymptotic behavior of the solutions to the replicator equation, April, Moscow, Russia
- 2011** Seminar at Computational Mathematics and Cybernetics, Moscow State University (Lomonosov): Universality of the power law distributions and mechanisms to generate them, April, Moscow, Russia
- 2011** Seminar at Laboratory of Complex Systems, Moscow State University of Communication Means (MIIT): Origin and evolution of the standard genetic code, April, Moscow, Russia
- 2011** Mathematics Department at Moscow State University (Lomonosov): Asymptotic behavior of some replicator equations, February, Moscow, Russia
- 2011** Conference “Education, Computing, Mathematics–2011”: Exceptional error minimization in putative primordial genetic codes, January 24–29, Puschino, Russia
- 2011** Conference “Mathematical models and numerical methods in biomathematics”: Replicator equations and explicit space, January 11–12, Institute of Numerical Mathematics, Russian Academy of Science, January, Moscow, Russia
- 2010** Seminar at Biophysics Department at Moscow State University (Lomonosov): Mathematical theories of epidemic spread: Homogeneous vs Heterogeneous models, November, Moscow, Russia
- 2010** Seminar at Steklov Institute: Replicator equation: The principle of global regulation and explicit space, October, Moscow, Russia
- 2010** Moscow Bioinformatics Seminar at Engelhardt Institute of Molecular Biology: On the origin and evolution of the standard genetic code, March, Moscow, Russia
- 2009** Mathematics Department at Moscow State University (Lomonosov): On the use of differential equations in theoretical population genetics: Quasi-species theory and beyond, December, Moscow, Russia
- 2009** Computational Mathematics and Cybernetics, Moscow State University (Lomonosov): On the spread of epidemics in closed heterogeneous populations, November, Moscow, Russia
- 2009** Department of Applied Mathematics–1 at Moscow State University of Communication Means (MIIT): Replicator equation: Equation of Life, October, Moscow, Russia
- 2009** Mathematics Department at Howard University: On the mathematical modeling of epidemics in a closed heterogeneous population, February, Washington, DC, USA
- 2008** The 6th International Conference On Differential Equations and Dynamical Systems: Influence of heterogeneity in disease parameters on the disease evolution within the basic SIR model, May, Baltimore, MD, USA
- 2008** The 6th International Conference On Differential Equations and Dynamical Systems: Traveling wave solutions in some models with cross-diffusion, May, Baltimore, MD, USA
- 2008** CBB NCBI seminar: Evolution of the genetic code: Partial optimization for robustness to translation errors. April, NCBI/NLM/NIH, MD, USA
- 2006** CBB NCBI seminar: Mathematical modeling of horizontally transferred genes: a stochastic birth-and-death model. October, NCBI/NLM/NIH, MD, USA
- 2003** Moscow Institute of Mathematics and Electronics: Generalized model of the predator–prey interaction, September, Moscow, Russia
- 2002** Center of Ecology Problem and Forest Productivity of Russian Academy of Sciences: Mathematical models of the system “pollutant–environment”, April, Moscow, Russia
- 2002** Moscow Institute of Mathematics and Electronics: Mathematical models of the system “pollutant–environment”, March, Moscow, Russia
- 2002** Institute of Problems in Mechanics: Mathematical models of the system “pollutant–environment”, February, Moscow, Russia
- 2001** The 5th IFAC Symposium “Nonlinear Control Systems”: Nonlinear damping as a stabilizing factor and resolving Ziegler’s paradox, July 4–6, St. Petersburg, Russia (*poster session*)
- 2000** The 2nd International “Conference Control of Oscillations and Chaos”: Mathematical models of interaction between pollutant and environment, July 5–7, St. Petersburg, Russia

## GRANTS

- ❑ Dean's travel grant, College of Science and Math, NDSU, Spring 2015
- ❑ Start-up package from ND EPSCoR, College of Science and Mathematics, and from Department of Mathematics, North Dakota State University, 2012–2014
- ❑ Grant for young researchers from Moscow State University of Communication Means, 2009–2012
- ❑ Grant from Russian Foundation for Basic Research, #10-01-00474, 2010–2012
- ❑ Fellowship at NCBI/NLM/NIH, 2004–2009
- ❑ Grant from Russian Foundation for Basic Research, # 98-01-00483, project "Mathematical Models of Interaction Between Pollutant and Environment"

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## COURSES TAUGHT<sup>2</sup>

1. Math 166: Calculus II (Summer 2016, NDSU)
2. Math 266: Introduction to Ordinary Differential Equations (Spring 2014, Fall 2013, Spring 2013, Fall 2012, NDSU)
3. Math 270: Intro to Abstract Mathematics (Spring 2015, NDSU)
4. Math 329: Intermediate Linear Algebra (Fall 2016, Spring 2017, NDSU)
5. Math 452/652: Complex Analysis (Spring 2017)
6. Math 460/660: Intensive Mathematica (Fall 2015, Fall 2016, NDSU)
7. Math 483/683: Partial Differential Equations (Spring 2013, Spring 2015, Spring 2016, NDSU)
8. Math 484/684: Mathematical Methods of Biological Processes (Spring 2014, Fall 2015, NDSU)
9. Math 760: Ordinary Differential Equations I (Fall 2014, Fall 2015, NDSU)
10. Math 867: Topics in Applied Mathematics: Mathematics of Networks (Fall 2013, Summer 2015, NDSU)
11. Introduction to Set Theory, Mathematical Logic, and Theory of Algorithms (2012, MIIT, Russia)
12. Discrete and Continuous Dynamical Systems and Their Applications in Biology (2011, MIIT, Russia) Monte Carlo methods (2011, MIIT, Russia)
13. Mathematical Foundations of Evolutionary Theory (Deterministic models) (2010-2011, MSU, Russia)
14. Computational Mathematics with Maple (2003, MIIT, Russia) Introduction to Probability Theory and Applied Statistics (2002, MIIT, Russia)

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## ADVISING

- ❑ Eric Sarfo Amponsah, graduate student, Fall 2016–Present, NDSU
- ❑ Halley Fritze, McNair Scholars Program: "Permanence of trophic webs," Fall 2015–Spring 2016, NDSU
- ❑ Alexander Yuriev, Moscow State University, Computational Mathematics and Cybernetics Department, M.S. thesis "Analysis of a problem of Eigen's quasispecies," 2010

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<sup>2</sup>Not including reading courses

- ❑ Dmitry Sokolov, Moscow State University of Communication Means (MIIT), Applied Mathematics–1 Department, M.S. thesis “Algorithmic and computational aspects of the robustness assessment of the standard genetic code,” 2011
- ❑ Dmitry Vasilenkov, Moscow State University of Communication Means (MIIT), Applied Mathematics–1 Department, M.S. thesis “On the spread of epidemics on random graphs,” 2011

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## SERVICES

- ❑ 2012–2015 — Organizer of K.N.Rao mathematics contest, 2012, 2013, 2014, 2015
- ❑ 2013 — Newsletter and public relations committee member
- ❑ 2014 — Local organizing committee for a MAA meeting member
- ❑ 2014–2015 — Department search committee member
- ❑ 2014–present — Curriculum committee member
- ❑ 2015–2016 — Local organizing committee for AMS Central Sectional Meeting member
- ❑ 2016–present — Outreach committee

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## REVIEWER

- ❑ AMS Mathematical Reviews
- ❑ 2015 Panel reviewer for NDSU Bioinformatics seed grant
- ❑ Ad hoc referee for NSF, CONICYT (Chile)
- ❑ *Reviewer for the journals:* Biology Direct; Nonlinear Analysis: Modelling and Control; Journal of Evolutionary Biology; Applied Mathematical Modelling; Journal of Theoretical Population Biology; Computer Research and Modelling; Biophysical Reviews & Letters; Journal of Mathematical Biology; Physical Biology; Journal of the Royal Society Interface; Genome Biology and Evolution; Russian Journal of Numerical analysis and Mathematical Modelling; Mathematical Modelling of Natural Phenomena; BMC Bioinformatics; ICARUS; Proceedings of American Mathematical Society; IIE Transactions; Physics Letters A; Theoretical Biology and Medical Modelling; Journal of Theoretical Biology; IEEE Transactions on Automatic Control; Journal of Mathematical Analysis and Applications; PLOS ONE; Physica A; Chinese Physics B; SpringerPlus; IEEE Transactions on Control of Network Systems; Journal of Biological Systems; Bioinformatics; Mathematische Nachrichten; Scientific Reports - Nature; Applied Mathematics and Computation

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## MEMBERSHIP

- ❑ American Mathematical Society
- ❑ Society for Mathematical Biology
- ❑ FORWARD (ally)