

# Dr. Pavel Dvurechensky

## Curriculum Vitae

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Date of birth: April 10, 1987

### Academic Vitae

- 2015–now **Research associate**, *Weierstrass Institute for Applied Analysis and Stochastics, Research Group 6 "Stochastic Algorithms and Nonparametric Statistics"*, Berlin, Germany.  
Research topics: algorithms for finite-dimensional optimization problems, saddle-point problems and variational inequalities (convex and non-convex problems, zero-, first-, second-, and higher-order methods, stochastic and deterministic settings, inexact oracle, randomized methods, such as random coordinate descent), their application to machine learning problems, optimal transport distances and barycenters, resource allocation, congested traffic modeling, web-page ranking, distributed optimization.
- 2014–2015 **Research assistant**, *Institute for Information Transmission Problems, sector 7 of Mathematical Methods of Predictive Modeling*, Moscow, Russia.  
Developing algorithms for convex optimization problems and differential games.
- 2012–2015 **Junior researcher**, *Moscow Institute of Physics and Technology (MIPT), Laboratory of Structural Methods of Data Analysis in Predictive Modeling (PreMoLab)*, Moscow, Russia.  
Developing algorithms for convex optimization problems (including saddle-point and stochastic optimization problems) and differential games. Experience of administrating an industry contract with international telecom company.
- 2010–2013 **PhD in mathematics**, *Moscow Institute of Physics and Technology (MIPT)*, Moscow, Russia.  
New algorithms for non-linear differential games
- 2009–2013 **Junior researcher**, *Moscow Institute of Physics and Technology (MIPT), Department of Mathematics*, Moscow, Russia.  
Developing and programming algorithms for linear and nonlinear differential games
- 2008–2014 **Assistant lecturer**, *Moscow Institute of Physics and Technology (MIPT), Chair of mathematical foundations of control*, Moscow, Russia.  
Exercise lessons on optimization theory and methods for third-year students
- 2008–2010 **Master's Diploma**, *Moscow Institute of Physics and Technology (MIPT)*, Moscow, Russia.  
Grade 4.9/5.0 (Graduated with honors/distinction)

2004–2008 **Bachelor's Diploma**, *Moscow Institute of Physics and Technology (MIPT)*, Moscow, Russia.  
Grade 4.9/5.0 (Graduated with honors/distinction)

## Non-Academic Vitae

2009–2011 **Project manager in IT**, *COMPETENTUM GROUP*, Moscow, Russia.  
Management of the project team consisting of software developers, analysts, QA engineers, and designers for developing web-based Learning Management Systems in corporate and academic segments. Experience with SCRUM. Certificate of company's PMBOK courses. Account management experience.

2008–2009 **IT-analyst**, *COMPETENTUM GROUP*, Moscow, Russia.  
Aggregation and analysis of client's demands, searching for proposals to the client, preparation of solution presentation to the client. Preparation of requirements specification for Learning Management Systems and Information Management Systems, survey reports on processes to be automated, market surveys. Technical support for clients on implemented solutions.

## PhD Thesis

title *Algorithms for constructing epsilon-optimal strategies for nonlinear differential games on a plane*  
supervisor Prof. Dr. Grigory E. Ivanov, Moscow Institute of Physics and Technology (MIPT)

## Research Interests

- First-order algorithms for convex and non-convex large-scale optimization problems
- Randomized algorithms: random coordinate descent, random (zero-order/derivative-free) directional search
- Algorithms for stochastic optimization
- Optimization under inexact information and with adaptivity to unknown smoothness parameters
- Second-order and higher-order (tensor) optimization methods
- Numerical and complexity aspects of Optimal Transport distances and barycenters
- Algorithms for saddle-point problems and variational inequalities
- Distributed optimization (parallel and decentralized)
- Applications to resource allocation, congested traffic modeling, web-page ranking, machine learning

## Selected Publications

- [1] Anikin, A. S., Gasnikov, A. V., Dvurechensky, P. E., Tyurin, A. I., and Chernov, A. V. Dual approaches to the minimization of strongly convex functionals with a simple structure under affine constraints. *Computational Mathematics and Mathematical Physics* 57, 8 (2017), 1262–1276.

- [2] Baimurzina, D. R., Gasnikov, A. V., Gasnikova, E. V., Dvurechensky, P. E., Ershov, E. I., Kubentaeva, M. B., and Lagunovskaya, A. A. Universal method of searching for equilibria and stochastic equilibria in transportation networks. *Computational Mathematics and Mathematical Physics* 59, 1 (2019), 19–33. arXiv:1701.02473.
- [3] Bayandina, A., Dvurechensky, P., Gasnikov, A., Stonyakin, F., and Titov, A. Mirror descent and convex optimization problems with non-smooth inequality constraints. In *Large-Scale and Distributed Optimization*, P. Giselsson and A. Rantzer, Eds. Springer International Publishing, 2018, ch. 8, pp. 181–215. arXiv:1710.06612.
- [4] Bogolubsky, L., Dvurechensky, P., Gasnikov, A., Gusev, G., Nesterov, Y., Raigorodskii, A. M., Tikhonov, A., and Zhukovskii, M. Learning supervised pagerank with gradient-based and gradient-free optimization methods. In *Advances in Neural Information Processing Systems 29*, D. D. Lee, M. Sugiyama, U. V. Luxburg, I. Guyon, and R. Garnett, Eds. Curran Associates, Inc., 2016, pp. 4914–4922. arXiv:1603.00717.
- [5] Chernov, A., Dvurechensky, P., and Gasnikov, A. Fast primal-dual gradient method for strongly convex minimization problems with linear constraints. In *Discrete Optimization and Operations Research: 9th International Conference, DOOR 2016, Vladivostok, Russia, September 19-23, 2016, Proceedings (2016)*, Y. Kochetov, M. Khachay, V. Beresnev, E. Nurminski, and P. Pardalos, Eds., Springer International Publishing, pp. 391–403.
- [6] Dvinskikh, D., Gorbunov, E., Gasnikov, A., Dvurechensky, P., and Uribe, C. A. On primal-dual approach for distributed stochastic convex optimization over networks. In *2019 IEEE Conference on Decision and Control (CDC) (2019)*. (accepted), arXiv:1903.09844.
- [7] Dvurechensky, P., Dvinskikh, D., Gasnikov, A., Uribe, C. A., and Nedić, A. Decentralize and randomize: Faster algorithm for Wasserstein barycenters. In *Advances in Neural Information Processing Systems 31 (2018)*, S. Bengio, H. Wallach, H. Larochelle, K. Grauman, N. Cesa-Bianchi, and R. Garnett, Eds., NeurIPS 2018, Curran Associates, Inc., pp. 10783–10793. arXiv:1806.03915.
- [8] Dvurechensky, P., and Gasnikov, A. Stochastic intermediate gradient method for convex problems with stochastic inexact oracle. *Journal of Optimization Theory and Applications* 171, 1 (2016), 121–145.
- [9] Dvurechensky, P., Gasnikov, A., Gasnikova, E., Matsievsky, S., Rodomanov, A., and Usik, I. Primal-dual method for searching equilibrium in hierarchical congestion population games. In *Supplementary Proceedings of the 9th International Conference on Discrete Optimization and Operations Research*

and Scientific School (DOOR 2016) Vladivostok, Russia, September 19 - 23, 2016 (2016), pp. 584–595. arXiv:1606.08988.

- [10] Dvurechensky, P., Gasnikov, A., and Kamzolov, D. Universal intermediate gradient method for convex problems with inexact oracle. *arXiv:1712.06036, Opt. Meth. & Software (accepted)* (2019).
- [11] Dvurechensky, P., Gasnikov, A., and Kroshnin, A. Computational optimal transport: Complexity by accelerated gradient descent is better than by Sinkhorn's algorithm. In *Proceedings of the 35th International Conference on Machine Learning* (2018), J. Dy and A. Krause, Eds., vol. 80 of *Proceedings of Machine Learning Research*, pp. 1367–1376. arXiv:1802.04367.
- [12] Dvurechensky, P., Gasnikov, A., Nurminsky, E., and Stonyakin, F. Advances in low-memory subgradient optimization. *arXiv:1902.01572, accepted to A. M. Bagirov et al. (eds.), Numerical Nonsmooth Optimization, Springer 2020* (2020).
- [13] Dvurechensky, P., Nesterov, Y., and Spokoiny, V. Primal-dual methods for solving infinite-dimensional games. *Journal of Optimization Theory and Applications* 166, 1 (Jul 2015), 23–51.
- [14] Dvurechensky, P. E., Gasnikov, A. V., and Lagunovskaya, A. A. Parallel algorithms and probability of large deviation for stochastic convex optimization problems. *Numerical Analysis and Applications* 11, 1 (Jan 2018), 33–37. arXiv:1701.01830.
- [15] Dvurechensky, P. E., and Ivanov, G. E. Algorithms for computing Minkowski operators and their application in differential games. *Computational Mathematics and Mathematical Physics* 54, 2 (2014), 235–264.
- [16] Gasnikov, A., Dvurechensky, P., Gorbunov, E., Vorontsova, E., Selikhanovych, D., and Uribe, C. A. Optimal tensor methods in smooth convex and uniformly convex optimization. In *Proceedings of the Thirty-Second Conference on Learning Theory* (Phoenix, USA, 25–28 Jun 2019), A. Beygelzimer and D. Hsu, Eds., vol. 99 of *Proceedings of Machine Learning Research*, PMLR, pp. 1374–1391. arXiv:1809.00382.
- [17] Gasnikov, A., Dvurechensky, P., Gorbunov, E., Vorontsova, E., Selikhanovych, D., Uribe, C. A., Jiang, B., Wang, H., Zhang, S., Bubeck, S., Jiang, Q., Lee, Y. T., Li, Y., and Sidford, A. Near optimal methods for minimizing convex functions with lipschitz  $p$ -th derivatives. In *Proceedings of the Thirty-Second Conference on Learning Theory* (Phoenix, USA, 25–28 Jun 2019), A. Beygelzimer and D. Hsu, Eds., vol. 99 of *Proceedings of Machine Learning Research*, PMLR, pp. 1392–1393. arXiv:1809.00382.

- [18] Gasnikov, A., Dvurechensky, P., Kamzolov, D., Nesterov, Y., Spokoiny, V., Stetsyuk, P., Suvorikova, A., and Chernov, A. Searching for equilibrium in multistage transport models. *Proceedings of Moscow Institute of Physics and Technology* 7, 4 (2015), 143–155. In Russian.
- [19] Gasnikov, A., Dvurechensky, P., and Nesterov, Y. Stochastic gradient methods with inexact oracle. *Proceedings of Moscow Institute of Physics and Technology* 8, 1 (2016), 41–91. In Russian, first appeared in arXiv:1411.4218.
- [20] Gasnikov, A., Dvurechensky, P., Spokoiny, V., Stetsyuk, P., and Suvorikova, A. Superposition of the balancing algorithm and the universal gradient method for search of the regularized Wasserstein brycenter and equilibria in multistage transport models. *Proceedings of Moscow Institute of Physics and Technology* 8, 3 (2016), 5–24. In Russian.
- [21] Gasnikov, A., Dvurechensky, P., and Usmanova, I. On accelerated randomized methods. *Proceedings of Moscow Institute of Physics and Technology* 8, 2 (2016), 67–100. In Russian, first appeared in arXiv:1508.02182.
- [22] Gasnikov, A., Gasnikova, E., Dvurechensky, P., Ershov, E., and Lagunovskaya, A. Search for the stochastic equilibria in the transport models of equilibrium flow distribution. *Proceedings of Moscow Institute of Physics and Technology* 7, 4 (2015), 114–128. In Russian.
- [23] Gasnikov, A. V., and Dvurechensky, P. E. Stochastic intermediate gradient method for convex optimization problems. *Doklady Mathematics* 93, 2 (Mar 2016), 148–151.
- [24] Gasnikov, A. V., Dvurechensky, P. E., Stonyakin, F. S., and Titov, A. A. An adaptive proximal method for variational inequalities. *Computational Mathematics and Mathematical Physics* 59, 5 (May 2019), 836–841.
- [25] Gasnikov, A. V., Dvurechensky, P. E., Zhukovskii, M. E., Kim, S. V., Plaunov, S. S., Smirnov, D. A., and Noskov, F. A. About the power law of the pagerank vector component distribution. Part 2. The Buckley–Osthus model, verification of the power law for this model, and setup of real search engines. *Numerical Analysis and Applications* 11, 1 (2018), 16–32.
- [26] Gasnikov, A. V., Gasnikova, E. V., Dvurechensky, P. E., Mohammed, A. A. M., and Chernousova, E. O. About the power law of the pagerank vector component distribution. Part 1. Numerical methods for finding the pagerank vector. *Numerical Analysis and Applications* 10, 4 (2017), 299–312.
- [27] Guminov, S. V., Nesterov, Y. E., Dvurechensky, P. E., and Gasnikov, A. V. Accelerated primal-dual gradient descent with linesearch for convex, nonconvex, and nonsmooth optimization problems. *Doklady Mathematics* 99, 2 (Mar 2019), 125–128.

- [28] Ivanova, A., Dvurechensky, P., Gasnikov, A., and Kamzolov, D. Composite optimization for the resource allocation problem. *arXiv:1810.00595, Opt. Meth. & Software (accepted)* (2019).
- [29] Kroshnin, A., Tupitsa, N., Dvinskikh, D., Dvurechensky, P., Gasnikov, A., and Uribe, C. On the complexity of approximating Wasserstein barycenters. In *Proceedings of the 36th International Conference on Machine Learning* (Long Beach, California, USA, 09–15 Jun 2019), K. Chaudhuri and R. Salakhutdinov, Eds., vol. 97 of *Proceedings of Machine Learning Research*, PMLR, pp. 3530–3540. *arXiv:1901.08686*.
- [30] Stonyakin, F. S., Dvinskikh, D., Dvurechensky, P., Kroshnin, A., Kuznetsova, O., Agafonov, A., Gasnikov, A., Tyurin, A., Uribe, C. A., Pasechnyuk, D., and Artamonov, S. Gradient methods for problems with inexact model of the objective. In *Mathematical Optimization Theory and Operations Research* (Cham, 2019), M. Khachay, Y. Kochetov, and P. Pardalos, Eds., Springer International Publishing, pp. 97–114. *arXiv:1902.09001*.
- [31] Uribe, C. A., Dvinskikh, D., Dvurechensky, P., Gasnikov, A., and Nedić, A. Distributed computation of Wasserstein barycenters over networks. In *2018 IEEE Conference on Decision and Control (CDC)* (2018), pp. 6544–6549. *arXiv:1803.02933*.
- [32] Vorontsova, E. A., Gasnikov, A. V., Gorbunov, E. A., and Dvurechenskii, P. E. Accelerated gradient-free optimization methods with a non-euclidean proximal operator. *Automation and Remote Control* 80, 8 (2019), 1487–1501.

## Preprints

- [1] Dvurechensky, P., Gasnikov, A., and Gorbunov, E. An accelerated directional derivative method for smooth stochastic convex optimization. *arXiv:1804.02394* (2018). Submitted to European Journal of Operations Research.
- [2] Dvurechensky, P., Gasnikov, A., and Gorbunov, E. An accelerated method for derivative-free smooth stochastic convex optimization. *arXiv:1802.09022* (2018). Submitted to SIAM Journal on Optimization.
- [3] Dvurechensky, P., Gasnikov, A., Ostroukhov, P., Uribe, C. A., and Ivanova, A. Near-optimal tensor methods for minimizing the gradient norm of convex function. *arXiv:1912.03381* (2019).
- [4] Dvurechensky, P., Gasnikov, A., Stonyakin, F., and Titov, A. Generalized Mirror Prox: Solving variational inequalities with monotone operator, inexact oracle, and unknown Hölder parameters. *arXiv:1806.05140* (2018). Submitted to SIAM Journal on Optimization.

- [5] Dvurechensky, P., and Nesterov, Y. Global performance guarantees of second-order methods for unconstrained convex minimization. CORE Discussion Paper 2018/32, CORE UCL, 2018.
- [6] Dvurechensky, P., Staudigl, M., and Uribe, C. A. Generalized self-concordant hessian-barrier algorithms. *arXiv:1911.01522* (2019). Submitted to Mathematics of Operations Research.
- [7] Guminov, S., Dvurechensky, P., and Gasnikov, A. On accelerated alternating minimization. *arXiv:1906.03622* (2019).
- [8] Ivanova, A., Pasechnyuk, D., Dvurechensky, P., Gasnikov, A., and Vorontsova, E. Numerical methods for the resource allocation problem in networks. *arXiv:1909.13321* (2019). (In Russian), submitted to Computational Mathematics and Mathematical Physics.
- [9] Nesterov, Y., Gasnikov, A., Guminov, S., and Dvurechensky, P. Primal-dual accelerated gradient methods with small-dimensional relaxation oracle. *arXiv:1809.05895* (2018). Submitted to Optimization Methods & Software.
- [10] Ogaltsov, A., Dvinskikh, D., Dvurechensky, P., Gasnikov, A., and Spokoiny, V. Adaptive gradient descent for convex and non-convex stochastic optimization. *arXiv:1911.08380* (2019). Submitted to IFAC 2020 Congress.
- [11] Stonyakin, F., Gasnikov, A., Tyurin, A., Pasechnyuk, D., Agafonov, A., Dvurechensky, P., Dvinskikh, D., Kroshnin, A., and Piskunova, V. Inexact model: A framework for optimization and variational inequalities. *arXiv:1902.00990* (2019).
- [12] Tupitsa, N., Dvurechensky, P., Gasnikov, A., and Guminov, S. Alternating minimization methods for strongly convex optimization. *arXiv:1911.08987* (2019).

## Selected Talks

- Workshop on Mathematics of Deep Learning, Germany, 2019
- HSE-Yandex autumn school on generative models, Russia, 2019 (invited lecture)
- Computational and Mathematical Methods in Data Science, Germany, 2019 (poster)
- Recent advances in mass transportation, Russia, 2019 (invited)
- Worksop on Optimization and applications, Russia, 2019 (invited)
- International Conference on Continuous Optimization, Germany, 2019
- Conference on Learning Theory, USA, 2019
- International Conference on Machine Learning, USA, 2019
- Optimization and statistical learning, France, 2019 (invited poster)
- Conference on Neural Information Processing Systems (NeurIPS), Canada, 2018 (spotlight)
- International Conference on Machine Learning, Sweden, 2018

- International Symposium on Mathematical Programming, France, 2018
- Games, Dynamics and Optimization, Austria, 2018 (invited)
- Mathematics and Image Analysis, Germany, 2018 (poster)
- International Matheon Conference on Compressed Sensing and its Applications, Germany, 2017 (poster)
- Co-Evolution of Nature and Society Modelling, Problems & Experience. Devoted to Academician Nikita Moiseev centenary (Moiseev-100), Russia, 2017
- 18th French-German-Italian Conference on Optimization, Germany, 2017
- Foundations of Computational Mathematics, Spain, 2017 (poster)
- Optimization and Statistical Learning, France, 2017 (poster)
- Workshop: Shape, Images and Optimization, Germany, 2017 (poster)
- Conference on Neural Information Processing Systems (NIPS), Spain, 2016 (poster)
- Moscow International Conference on Operations Research (ORM), Russia, 2016
- Workshop on Modern Statistics and Optimization, Russia, 2016
- 30th annual conference of the Belgian Operation Research Society, ORBEL30, Belgium, 2016
- IITP RAS Conference & School "Information Technology and Systems", Russia, 2014, 2015
- International Conference on Optimization Methods and Applications, Montenegro, 2013, 2014, 2016
- Traditional School for Young Researchers "Control, Information, Optimization", Russia, 2012 – 2015

## ■ Funding acquisition

- Optimal Transport for Imaging (co-PI with M. Hintermüller and V. Spokoiny), 2019-2021, Germany's Excellence Strategy – The Berlin Mathematics Research Center MATH+, Funded by German Research Foundation.
- Optimal Transport: Numerical methods and application to data analysis, 2018-2021, Russian Science Foundation
- New universal gradient methods and their application for the analysis of biological and graphical data, 2017-2018, Grant of Russian President for the support of young scientists
- Algorithms for quasi-optimal strategies in differential games, 2012-2013, Federal Target Program of Russian Government

## ■ Teaching experience

- Recent developments in optimization methods and machine learning applications, winter semester 2019/2020, lectures and exercises, Humboldt University, Berlin
- Applied convex optimization, 2012-2014, lectures and exercises, Moscow Institute of Physics and Technology, Moscow
- Differential games on a plane, 2012-2013, optional course, Moscow Institute of Physics and Technology, Moscow
- Optimization methods, 2008-2014, exercises, Moscow Institute of Physics and Technology, Moscow



## Professional activities

Reviewer for

- Foundations of Computational Mathematics
- Numerical Algorithms
- Artificial Intelligence
- Mathematical Programming
- Journal of Optimization Theory and Applications
- Neural Information Processing Systems 2016, 2019 (NIPS 2016, NeurIPS 2019)
- Journal of Inverse and Ill-Posed problems
- International Conference on Machine Learning 2019, 2020 (ICML 2019, 2020)
- Optimization Methods and Software
- Journal of Machine Learning Research
- Computational Optimization and Applications

Workshops and sessions organization

- WIAS internal workshop 2019
- Session co-organizer at International Conference on Continuous Optimization, 2019
- Workshop Foundations of Modern Statistics, WIAS, 2019
- Session co-organizer at SIAM Conference on Optimization, 2020

Miscellaneous

- Co-organizer of a reading group on Deep Learning at Weierstrass Institute.

## Languages

Language 1	<b>Russian</b>	<i>Native</i>
Language 2	<b>English</b>	<i>Fluent</i>

## References

- Prof. Vladimir Spokoiny [spokoiny@wias-berlin.de](mailto:spokoiny@wias-berlin.de)
- Prof. Yurii Nesterov [yurii.nesterov@uclouvain.be](mailto:yurii.nesterov@uclouvain.be)
- Prof. Boris Polyak [boris@ipu.ru](mailto:boris@ipu.ru)
- Prof. Alexander Gasnikov [gasnikov@yandex.ru](mailto:gasnikov@yandex.ru)