

CV of the PI

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Education

2006-2008	Institute for Information Transmission Problems (IITP RAS), Postgraduate course. Specialty: theoretical principles of informatics. PhD thesis: "On minimax and extended Bayesian problems of early disorder detection for the Poisson process". Scientific supervisor: RAS academician Shiryaev A.N.
2004-2006	Moscow Institute of Physics and Technology (MIPT), Master's degree. Specialty: applied physics and mathematics (diploma with honors, grade point average: 5/5). Chair of mathematic modeling of complex processes and systems. Graduation paper: "Nonparametric modeling and prediction of nonstationary financial time series volatility".
2000-2004	Moscow Institute of Physics and Technology (MIPT), Bachelor's degree. Specialty: applied physics and mathematics (diploma with honors, grade point average: 5/5). Chair of mathematic modeling of complex processes and systems. Graduation paper: "Some aspects of stationary and non-stationary time series analysis by means of wavelets".

Professional experience

07.2016 – to date	Main Position: Associate Professor, Skolkovo Institute of Science and Technology, Head of Advanced Data Analytics in Science and Engineering group
01.2009 – to date	Head of Intellectual Data Analysis and Predictive Modeling Lab, IITP RAS
01.2009 – 01.2016	Head of Intellectual Data Analysis and Modeling Group, IITP RAS
06.2011 – 04.2013	Vice Chairman, Chair of Predictive Modeling and Optimization, Department of Control and Applied Mathematics, MIPT
01.2008 – 06.2011	Vice Chairman, Chair of Information Transmission and Processing Problems, Department of Radio Engineering and Cybernetics, MIPT
01.2007 – 12.2008	Junior Researcher, Laboratory 1 (named after Pinsker) – Theory of information transmission and control, IITP RAS
09.2006 – 06.2007	Junior Researcher, Department of Mathematical Modeling of Economic Systems, RAS Computing Center

Project activities

- Applied mathematical modeling of physical processes. July 2005 – September 2005: Summer Student Program at DESY, PITZ group, Zeuthen, Germany (<http://www-zeuthen.desy.de/main/html/arbeiten/summerstudents.html>). Report: Impact of the photo cathode laser temporal modulations onto longitudinal phase space (<http://www-zeuthen.desy.de/students/2005/doc/Burnaev.pdf>).

- 2005-2006: Division of Mathematical Modeling of Economic Systems, RAS Computing Center (http://www.ccas.ru/mmes/INDEX_RU.HTM):
 - a. Generation and development of information and computational resources for parallel cluster computations in mathematical modeling of complex systems.
 - b. Investigation of the Kirov region's innovative potential for the creation and development of technology transfer centers.
 - c. Research and development of scientific applications in a distributed supercomputer computational environment on the basis of the RAS Computing Center.
 - d. Study of the effects of global climate change on Mongolia's environmental and economic systems.
 - e. Intel Corporation (Educational Program). Development of teaching course "Parallel programming in MPI and OpenMP for mathematical modeling of ecological-economical systems".
- Project "Quick aerodynamic calculations of passenger aircraft layout", ordered by Airbus company, 2007. Construction of surrogate models for prediction of airplane characteristics depending on its layout.
- Project "Development of the system for passenger wing airfoil analysis", ordered by Airbus company, 2008-2009. Development of algorithms for passenger aircraft wing airfoil geometry dimension reduction.
- 2013 – 2015: development of algorithms for prediction of clients' behavior (churn/not churn, scoring) for TOP 5 Russian banks, Peer Lending USA companies, etc.
- 2013 – 2016: consulting of USA hedge fund on volatility modeling, forecasting and trading, etc.
- 2008 – 2015: development of the algorithmic library for predictive modeling and optimization (surrogate modeling, feature selection, dimension reduction, data fusion, sensitivity analysis, design of experiments etc.)
- 2012 – 2015: regular training (each 3-4 month) of engineers from various technological companies (Airbus, Eurocopter, Astrium, Safran, CNES, SAFT, etc.) about application of machine learning in engineering multidisciplinary modeling and optimization
- **2008 – 2017**: applied projects about solving various engineering problems using methods of statistics and data analysis (optimization, prediction of characteristics of various complex engineering systems, predictive maintenance based on disorders/anomalies detection algorithms, etc.). Customers - Airbus, Eurocopter, Astrium, Safran, CNES, SAFT, Mitsubishi, Porsche, several teams of Formula 1, IHI, etc.
- **2016 – 2018**: head of scientific RFBR project 16-29-09649 "Mathematical foundations of intelligent adaptive systems for control of events for information security of large scale networks".
- **2017 – 2018**: head of scientific project supported The Ministry of Education and Science of Russian Federation, grant No. 14.606.21.0004, grant code: RFMEFI60617X0004, topic "Application of Neural Networks for monitoring and prediction of state of the main roads"

- **2017 – 2019:** head of scientific project in the framework of Next Generation Program: Skoltech – MIT Joint Projects, title “Simulation and Transfer Learning for Deep 3D Geometric Data Analysis”
- **2017 – 2019:** participant of the Skoltech Biomedical Initiative (SBI) “Machine Learning and Pattern Recognition for the development of diagnostic and clinical prognostic prediction tools in psychiatry, borderline mental disorders, and neurology”
- **2017 – 2018:** participant of the project “Metamodeling of multiphase well flows”, ordered by Gazpromneft-NTC
- **2017 – 2018:** participant of the project “System for prediction of rock properties and rock type at a drilling bit”, ordered by Gazpromneft- NTC
- **2017 – 2019:** participant of the project “AeroNet project: monitoring services of protected zones of extended objects”, ordered by NTI

Teaching experience

09.2016 – to date	Associate Professor, Skolkovo Institute of Science and Technology. Lectures/seminars on machine learning and Bayesian methods of machine learning
09.2013 – 12.2016	Associate professor, Chair of Information Transmission Problems and Data Analysis, MIPT (inter-faculty chair). Lectures/seminars on the <ul style="list-style-type: none"> • foundations of statistical modeling and regression modeling, • modern nonparametric Bayesian statistics
06.2011 – 09.2013	Associate professor, Chair of Predictive Modeling and Optimization, Department of Control and Applied Mathematics, MIPT. Lectures/seminars on the fundamentals of statistical modeling and regression modeling
09.2008 – to date	Yandex School of Data Analysis (http://shad.yandex.ru/about/). Seminars on Stochastics and Quickest Disorder Detection Theory, lectures and seminars on Applied Statistics in Machine Learning
09.2008 – 06.2011	Assistant of professor, Chair of Information Transmission and Processing Problems, MIPT. Course of lectures “Data analysis II. Dimension reduction and classification”
09.2005 – 06.2011	Assistant of professor, Chair of Mathematical Foundations of Control, MIPT. Seminars on the probability theory, stochastic processes and mathematical statistics. Course of lectures “Use of wavelet-transformation for signal analysis” (2009-2010).
09.2006 – 07.2007	Assistant of professor, Chair of Logistic Systems and Technologies, MIPT. Course of lectures on applied mathematical statistics for logisticians.

Area of scientific interests

1. Regression based on Gaussian Processes, bootstrap, confidence sets, conformal predictors, kernel methods for anomaly detection
2. Optimal stopping rules and statistical decisions
3. Wavelet thresholding, denoising and compression

Research Introduction of PI and his team

Since 2012 the main results of PI/team were development of machine learning methodological approaches and corresponding algorithms for predictive modeling and optimization in industrial engineering, as well as application of these approaches to solve industrial problems. The focus was on modeling variable fidelity data including noisy data, large datasets; data, generated by

inhomogeneous dependences; data having specific structure (belonging to manifolds, grids, incomplete grids, etc.); modeling rare events, anomaly detection; estimating accuracy of predictions. The machine learning methods, developed by PI/team, formed the core of the algorithmic library for predictive modeling and optimization [14], ordered by Airbus and certified on the highest Technology Readiness Level according to the NASA classification. Airbus claimed that the use of the developed methods and the corresponding software library (produced by the corresponding spin-off company) enabled to reduce lead times in numerical analysis activities for aircraft design by 10%, see [L1,L2]. All these developments and applied results were possible only thanks to deep scientific investigation of methodological issues of machine learning and the corresponding algorithms. In particular, results of [10,37] about parameters tuning and boosting approaches allowed to efficiently construct models based on neural networks. Thanks to elaborated algorithms for Nonstationary Gaussian Process regression model learning [11,12] we constructed efficient approaches to multi-fidelity learning [1,2,21], adaptive design of experiments and sensitivity analysis [23,3,13], Bayesian inference [36,38], etc. In [29] theory for conformal regression prediction was elaborated and recently applied to develop approaches for construction of non-parametric prediction intervals [16]. Using developed approaches PI/team was able to solve a number of applied problems, e.g. prediction of aerodynamic properties [31], surrogate modeling and optimization of aircraft structures [35], study 5'-UTR influence on translation efficiency [15], etc. Developed methods were further extended to perform signal processing, anomaly detection and failures prediction, see e.g. [5,6,9,17,18,25-28,39-42] as well as their applications to cyber security, predictive maintenance of aircrafts, etc. [18,32]. The algorithms, developed by PI/team, took the third place in a competition devoted to online anomaly detection. This competition was a part of the IEEE World Congress on Computational Intelligence [L3].

Links:

[L1] <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-to-reduce-lead-times-in-numerical-analysis-activities-for-aircraft-design/>

[L2] <http://www.aerospace-technology.com/news/newsairbus-uses-datadvances-macos-software-structural-analysis-a350-xwb-aircraft-4362144>

[L3] Zuha Agha. NAB Competition 2016 Winners. <http://numenta.com/blog/2016/08/10/numenta-anomaly-benchmark-nab-competition-2016-winners/>

References: Main papers of the PI and his team

2017

1. Burnaev E., Zaytsev A. Minimax approach to variable fidelity data interpolation // Proceedings of Machine Learning Research 54:652-661, Volume 54: Artificial Intelligence and Statistics, 20-22 April 2017, Fort Lauderdale, FL, USA.
2. Burnaev E., Zaytsev A. Large Scale Variable Fidelity Surrogate Modeling // Ann Math Artif Intell (2017), pp. 1-20. doi:10.1007/s10472-017-9545-y
3. Burnaev E., Panin I., Sudret B. Efficient Design of Experiments for Sensitivity Analysis based on Polynomial Chaos Expansions // Ann Math Artif Intell (2017). doi:10.1007/s10472-017-9542-1
4. Kuleshov A., Bernstein A., Burnaev E. Mobile Robot Localization via Machine Learning

- // Machine Learning and Data Mining in Pattern Recognition - 13th International Conference, MLDM 2017, New York, NY, USA, July 15-20, 2017, LNCS (volume 10358), pp. 276-290.
5. Burnaev E., Ishimtsev V., Bernstein A., Nazarov A. Conformal k-NN Anomaly Detector for Univariate Data Streams // The 6th Symposium on Conformal and Probabilistic Prediction with Applications (COPA) 2017. Proceedings of Machine Learning Research, 60:213-227, 2017
 6. Volkhonsky D., Burnaev E., Nouretdinov I., Gammernan A., Vovk V. Inductive Conformal Martingales for Change-Point Detection // The 6th Symposium on Conformal and Probabilistic Prediction with Applications (COPA) 2017. Proceedings of Machine Learning Research, 60:132-153, 2017
 7. Notchenko A., Kapushev E., Burnaev E. Large Scale Shape Retrieval with Sparse 3D Convolutional Neural Networks // Proceedings of the 6th International Conference on Analysis of Images, Social Networks and Texts (AIST-2017), July 27-29 2017, LNCS (Springer), 2017. arXiv preprint arXiv:1611.09159. Vol. 10716, LNCS, pp. 236-245.
 8. Бурнаев Е.В., Голубев Г.К. Об одной задаче многоканального обнаружения сигналов // Проблемы Передачи Информации, 53 (4), 2017. [In Russian]
 9. Kuleshov A., Bernstein A., Burnaev E., Yanovich Yu. Machine Learning in Appearance-based Robot Self-localization // ICMLA, 2017
 10. Safin A., Burnaev E. Conformal Kernel Expected Similarity for Anomaly Detection in Time-Series data // Advances in Systems Science and Applications, 2017, Volume 3, pp. xx-xx, 2017. <http://ijassa.ipu.ru/ojs/ijassa>
 11. Rodrigo R., Burnaev E. GP for Demand Forecasting // Proceedings of ICDM Workshop, 2017
 12. Bernstein A., Burnaev E. Reinforcement Learning in Computer Vision // *Proc. SPIE*, 10th International Conference on Machine Vision (ICMV 2017), 2017

2016

13. Artemov, E. Burnaev. Optimal sequential estimation of a signal, observed in a fractional gaussian noise // Theory of Probability and Its Applications, 2016, vol. 60, № 1, pp. 126-134.
14. E. Burnaev, P. Erofeev. The Influence of Parameter Initialization on the Training Time and Accuracy of a Nonlinear Regression Model, Journal of Communications Technology and Electronics, 2016, Vol. 61, No. 6, pp. 646–660.
15. E. Burnaev, M. Belyaev, E. Kapushev. Computationally efficient algorithm for Gaussian Processes based regression in case of structured samples // Computational Mathematics and Mathematical Physics, 2016, Vol. 56, No. 4, pp. 499–513, 2016.
16. E. Burnaev, M. Panov, A. Zaytsev. Regression on the Basis of Nonstationary Gaussian Processes with Bayesian Regularization, Journal of Communications Technology and Electronics, 2016, Vol. 61, No. 6, pp. 661–671.
17. E. Burnaev, I. Panin, B. Sudret. Effective Design for Sobol Indices Estimation based on Polynomial Chaos Expansions // Lecture Notes in Artificial Intelligence, Vol. 9653, pp. 165-184, Springer, 2016.
18. Mikhail Belyaev, Evgeny Burnaev, Ermek Kapushev, Maxim Panov, Pavel Prikhodko, Dmitry Vetrov, Dmitry Yarotsky. GTApprox: Surrogate modeling for industrial design // Advances in Engineering Software 102 (2016) 29–39
19. Sergey A. Evfratov, Ilya A. Osterman, Ekaterina S. Komarova, Alexandra M. Pogorelskaya, Maria P. Rubtsova, Timofei S. Zatsepin, Tatiana A. Semashko, Elena S. Kostryukova, Andrey

- A. Mironov, Evgeny Burnaev, Ekaterina Krymova, Mikhail S. Gelfand, Vadim M. Govorun, Alexey A. Bogdanov, Petr V. Sergiev and Olga A. Dontsova. Application of sorting and next generation sequencing to study 5'-UTR influence on translation efficiency in *Escherichia coli* // *Nucleic Acids Research*, 2016, 16 P. doi: 10.1093/nar/gkw1141
20. Burnaev E, Nazarov I. Conformalized Kernel Ridge Regression // 15th IEEE International Conference on Machine Learning and Applications (ICMLA), IEEE Conference Publications, pp. 45 - 52, 2016. DOI: 10.1109/ICMLA.2016.0017
21. Artemov A., Burnaev E. Detecting Performance Degradation of Software-Intensive Systems in the Presence of Trends and Long-Range Dependence // 16th International Conference on Data Mining Workshops (ICDMW), IEEE Conference Publications, pp. 29 - 36, 2016. DOI: 10.1109/ICDMW.2016.0013
22. Burnaev E, Smolyakov D. One-Class SVM with Privileged Information and Its Application to Malware Detection // 16th International Conference on Data Mining Workshops (ICDMW), IEEE Conference Publications, pp. 273 - 280, 2016. DOI: 10.1109/ICDMW.2016.0046
23. Evgeny Burnaev, Ivan Koptelov, German Novikov, Timur Khanipov. Automatic Construction of a Recurrent Neural Network based Classifier for Vehicle Passage Detection // *Proc. SPIE* 10341, Ninth International Conference on Machine Vision (ICMV 2016), 1034103 (March 17, 2017); doi:10.1117/12.2268706

2015

24. E. Burnaev, S. Chernova. On an Iterative Algorithm for Calculating Weighted Principal Components // *Journal of Communications Technology and Electronics*, 2015, Vol. 60, No. 6, pp. 619–624.
25. E. Burnaev, A. Zaytsev. Surrogate modeling of multifidelity data for large samples. *Journal of Communications Technology and Electronics*, 2015, Vol. 60, No. 12, pp. 1348–1355.
26. M. Belyaev, E. Burnaev, and Y. Kapushev. Gaussian process regression for structured data sets. In *Lecture Notes in Artificial Intelligence. Proceedings of SLDS 2015*. A. Gammerman et al. (Eds.), volume 9047, pages 106–115, London, UK, April 20–23 2015. Springer.
27. E. Burnaev and M. Panov. Adaptive design of experiments based on gaussian processes. In *Lecture Notes in Artificial Intelligence. Proceedings of SLDS 2015*. A. Gammerman et al. (Eds.), volume 9047, pages 116–126, London, UK, April 20–23 2015. Springer.
28. E. Burnaev and I. Panin. Adaptive Design of Experiments for Sobol Indices Estimation Based on Quadratic Metamodel. In *Lecture Notes in Artificial Intelligence. Proceedings of SLDS 2015*. A. Gammerman et al. (Eds.), volume 9047, pages 86–96, London, UK, April 20–23 2015. Springer.
29. E. Burnaev, P. Erofeev, D. Smolyakov. Model Selection for Anomaly Detection // *Proc. SPIE* 9875, Eighth International Conference on Machine Vision, 987525 (December 8, 2015); 5 P. doi:10.1117/12.2228794; <http://dx.doi.org/10.1117/12.2228794>
30. Alexey Artemov, Evgeny Burnaev and Andrey Lokot. Nonparametric Decomposition of Quasi-periodic Time Series for Change-point Detection // *Proc. SPIE* 9875, Eighth International Conference on Machine Vision, 987520 (December 8, 2015); 5 P. doi:10.1117/12.2228370; <http://dx.doi.org/10.1117/12.2228370>
31. Artemov A., Burnaev E. Ensembles of Detectors for Online Detection of Transient Changes //

Proc. SPIE 9875, Eighth International Conference on Machine Vision, 98751Z (December 8, 2015); 5 P. doi:10.1117/12.2228369; <http://dx.doi.org/10.1117/12.2228369>

32. E. Burnaev, P. Erofeev, A. Papanov. Influence of Resampling on Accuracy of Imbalanced Classification // Proc. SPIE9875, Eighth International Conference on Machine Vision, 987521 (December 8, 2015); 5 P. doi:10.1117/12.2228523; <http://dx.doi.org/10.1117/12.2228523>

2014

33. E. Burnaev, V. Vovk. Efficiency of conformalized ridge regression. JMLR W&CP 35:605-622, 2014
34. E. Burnaev, S. Alestra, P. Prikhodko, K. Sato. Construction of Low Dimensional Structures from Object Surface Description using Feature Extraction Technique // Journal of the Japan Society of Mechanical Engineers, 2014 / 5 / Vol 117 N° 1146, pp. 322 - 325 (in Japanese)
35. S. Alestra, E. Kapushev, M. Belyaev, E. Burnaev, M. Dormieux, A. Cavailles, D. Chaillot and E. Ferreira. Building Data Fusion Surrogate Models for Spacecraft Aerodynamic Problems with Incomplete Factorial Design of Experiments // Advanced Materials Research, Vol. 1016 (2014), pp. 405-412.
36. S. Alestra, C. Bordry, C. Brand, E. Burnaev, P. Erofeev, A. Papanov and C. Silveira-Freixo. Application of Rare Event Anticipation Techniques to Aircraft Health Management // Advanced Materials Research, Vol. 1016 (2014), pp. 413-417.
37. G. Sterling, P. Prikhodko, E. Burnaev, M. Belyaev and S. Grihon. On Approximation of Reserve Factors Dependency on Loads for Composite Stiffened Panels // Advanced Materials Research, Vol. 1016 (2014), pp. 85-89.
38. A. Zaytsev, E. Burnaev, V. Spokoyny. Properties of the Bayesian Parameter Estimation of a Regression Based on Gaussian Processes // Journal of Mathematical Sciences, Volume 203, Issue 6, pp. 789-798, 15 Nov 2014.

2013

39. Grihon S., Burnaev E.V., Belyaev M.G. and Prikhodko P.V. Surrogate Modeling of Stability Constraints for Optimization of Composite Structures // Surrogate-Based Modeling and Optimization. Engineering applications. Eds. by S. Koziel, L. Leifsson. Springer, 2013. P. 359-391.
40. E. Burnaev, A. Zaytsev, V. Spokoyny. The Bernstein-von Mises theorem for regression based on Gaussian processes // Russ. Math. Surv. 68, No. 5, 954-956 (2013)
41. E. Burnaev, P. Prikhod'ko. On a method for constructing ensembles of regression models // Automation and Remote Control, Volume 74, Issue 10, pp. 1630-1644, 12 Oct 2013.
42. A. Zaitsev, E. Burnaev, V. Spokoyny. Properties of the posterior distribution of a regression model based on Gaussian random fields // Automation and Remote Control, Volume 74, Issue 10, pp. 1645-1655, 12 Oct 2013.

2009

43. E. Burnaev. Disorder Problem for Poisson Process in Generalized Bayesian Setting // Theory Probab. Appl., 53(3), p. 500-518, 2009.
44. E. Burnaev, E. Feinberg, A. Shiryayev. On Asymptotic Optimality of the Second Order in the Minimax Quickest Detection Problem of Drift Change for Brownian Motion // Theory Probab.

Appl., 53(3), 519–536, 2009.

45. Burnaev E.V., Menshikov I.S. A model of the functional state of participants of laboratory markets // Journal of Computer and Systems Sciences International, 2009, Vol. 48, No. 6, pp. 1002 – 1019.

2007

46. E. Burnaev. Disorder problem for a Poisson process in the generalized Bayesian setting // Russian Mathematical Surveys (2007), 62(4):790

2006

47. E. Burnaev. Application of wavelet bases in linear and nonlinear approximation to functions from Besov spaces // Computational Mathematics and Mathematical Physics. December 2006, Volume 46, Issue 12, pp. 2051-2060.
48. E. Burnaev. Inversion formula for infinitely divisible distributions // Russian Mathematical Surveys (2006), 61(4):772

Other papers:

49. E. Burnaev, F. Gubarev, S. Morozov, A. Prohorov, D. Khominich. Multidisciplinary optimization, data analysis and automatization engineering computations using software system pSeven // CAD/CAM/CAE Observer #4 (88), C. 54-61, 2014. (In Russian)
50. E. Burnaev, P. Erofeev, P. Prikhodko. Extraction of principal directions for approximation based on Gaussian Processes // Proceedings of MIPT. Vol. 5, No. 3, P. 24-35, 2013. (In Russian)
51. E. Burnaev, P. Prikhodko. Methodology for surrogate models construction for approximation of spatially inhomogeneous functions // Proceedings of MIPT. Vol. 5, No. 4. P. 122-132. 2013. (In Russian)
52. M. Belyaev, E. Burnaev. Approximation of a multidimensional dependency based on linear expansion in a dictionary of parametric functions // Informatics and its Applications, 7:3 (2013), 114–125.
53. E. Burnaev. Application of wavelet-transformation for signal analysis. A Tutorial. MIPT, Moscow. 2007. 120 P. (In Russian)
54. E. Burnaev. Non-parametric modeling and forecasting of volatility of non-stationary financial time series // Technical report. Computing Center of RAS, Moscow, 2006. 79 P. (In Russian)
55. E. Burnaev. Modeling and forecasting volatility of financial time series based on a process with unconditional non-stationary variance // Reviews of applied and industrial mathematics, 2005. Vol. 12, No. 3, P. 785-809. (In Russian)