# Ilona Kulikovskikh

[in] linkedin.com/in/ilona-k
✉ kulikovskikh.i@gmail.com
🖥 www.ilonakulikovskikh.github.io
⌨ yukinoi

Explainable AI, Safety, Ethics AI, AGI, Embodied cognition, Machine cognition and communication, Cognitive ecology, Dynamic and control systems, Optimization, Evolutionary computation

## Work Experience in Academia

**May 2020 – Present**
**Full Professor**,
Department of Information Systems and Technologies,
Institute of Informatics, Mathematics and Electronics,
Samara National Research University, Samara, Russia.

Teaching postgraduate and undergraduate courses. Supervising PhD's, Master's, and Bachelor's theses

**Nov 2018 – Nov 2019**
**Visiting Scholar**,
Centre of Research Excellence for Data Science and Advanced Cooperative Systems,
Faculty of Electrical Engineering and Computing (FER), University of Zagreb, Croatia,
Laboratory for Machine Learning and Knowledge Representation, Ruđer Bošković Institute, Croatia.

Participated in the DATACROSS project of The Centre of Research Excellence for Data Science and Advanced Cooperative Systems (CRE ACROSS-DataScience) co-financed by the Croatian Government and the European Union through the European Regional Development Fund – the Competitiveness and Cohesion Operational Programme (KK.01.1.1.01.0009).

**Jan 2018 – Present**
**Senior Research Associate, SELF Founder and Group Leader**,
Department of Information Systems and Technologies,
Institute of Informatics, Mathematics and Electronics,
Samara National Research University, Samara.

Founded the SELF (Tran**S**parency **ExpL**ainability Sa**F**ety) research group. Led the research projects financed by the Russian Foundation for Basic Research (18-37-00219) and Russian Federation President Grant (MK-6218.2018.9).

**June 2014 – June 2016**
**Research Associate**,
Laboratory of Automated Research Systems,
Samara State Aerospace University, Samara.

Participated in the project financed by the National Program for Supporting Fundamental and Applied Science.

**Sep 2011 – Apr 2020**
**Associate Professor**,
Department of Information Systems and Technologies,
Institute of Informatics, Mathematics and Electronics,
Samara National Research University, Samara.

Taught postgraduate and undergraduate courses. Supervised Master's theses and students research.

**Sep 2008 – Sep 2011**
**Assistant Professor**,
Department of Information Systems and Technologies,
Samara State Aerospace University, Samara.

Taught postgraduate course. Supervised students research. Led the research project financed by the National Program for Innovate Science U.M.N.I.K.

**May 2007 – Dec 2007**
**Research Assistant**,
Department of Biomedical and Laser Systems,
Samara State Aerospace University, Samara.

Participated in the project financed by the Russian Foundation for Basic Research.

## Work Experience in Industry

**Jan 2018 – Present**    **Chief Scientific Officer (CSO), Co-Founder**,
Team Chemistry LLC, Samara.

> Co-leading the start-up project financed by the National Program for Innovate Science START-1-18 (C1-51885).

**Jan 2012 – Jul 2013**    **Data Scientist**,
Centre for Neuropsychological Assessment, Samara.

**Feb 2008 – Jun 2010**    **Data Scientist**,
Laboratory of Catalytic Converter Analysis,
JSC RosEco, VAZ Car Factory, Tolyatti.

## Qualifications

**2013–2020**    **Higher Attestation Commission (VAK), Moscow**, *Russia*,
*Doctor of Sciences (Dr.Sc., Habil.) in **Theoretical Computer Science.
Diploma DOK 001900 issued 26 Nov 2020

> \* A post-doctoral degree called Doctor of Sciences is given to reflect the second advanced research qualification or a higher doctorate in ISCED 2011. Less than 10 % of Candidate of Sciences holders earn Doctor of Sciences degree. It requires fundamental research or a new research direction, which is of significant scientific, industrial, or social value.

> ** Built the learning theory on the universal equation which describes learning processes in technical, social, and natural environments. It is principally directed towards creating explainable and reliable AGI systems with the primary focus on identifying, formulating, and solving safety problems that emerge from bidirectional transitions between the environments.

**2019**    **Ministry of Education and Science**, *Russia*,
Associate Professor Rank.
Diploma DOC 000525 issued 11 Sep 2019

**2008–2011**    **Higher Attestation Commission (VAK), Moscow**, *Russia*,
*Candidate of Sciences (Ph.D.) in **Applied Mathematics and Computer Science.
Diploma DKN 144158 issued 25 Nov 2011

> \* According to the International Standard Classification of Education (ISCED) 2011, Candidate of Sciences belongs to ISCED level 8 - "doctoral or equivalent", together with PhD, DPhil, D.Lit, D.Sc, LL.D, Doctorate or similar. Candidate of Sciences allows its holders to reach the level of an Associate Professor.

> ** Complemented the Fourier decomposition method with the extended orthogonality relations to ensure computationally efficient time series analysis. The proposed method establishes orthogonality criterion between convergence rate and generalisation capability.

**2002–2008**    ***Samara State Aerospace University**, Samara,
Specialist in Computer Science.
Diploma VSA 0712081 issued Feb 4, 2008 with an overall mark of 5.0/5.0

> \* One of the leading centers of the aerospace industry, which is responsible for the development of space technology including strategic information technologies.

## Projects

**2019 – 2020**    **Enabling efficient "human-human", "machine-machine", and "human-machine" interactions in business and the public sector**, *National Program for Innovate Science START-1-18 (project no. C1-51885)*,
Role: **Co-PI**.

> Created a model of the ideal "human-human" interaction based on behavioral observations of successful interactions in dynamic questionnaires. Adopted the model to enable reliable "human-human", "machine-machine", and "human-machine" interactions in business and the public sector with controllable internal biases in decision making.

| | |
|---|---|
| 2018 – 2019 | **DATACROSS project: Robust Machine learning**, *The Centre of Research Excellence for Data Science and Advanced Cooperative Systems (CREACROSS-Data-Science) co-financed by the Croatian Government and the European Union through the European Regional Development Fund - the Competitiveness and Cohesion Operational Program (KK.01.1.1.01.0009)*,<br>Role: **Visiting Scholar**.<br>Modelled safe and explainable machine learning environments with the principles of population dynamics. |
| 2018 – 2019 | **Building explainable deep learning models with the phenomenon of retrieval-induced forgetting (RIF)**, *Russian Foundation for Basic Research (project no. 18-37-00219)*,<br>Role: **PI**.<br>Modelled a memory phenomenon where remembering causes forgetting (retrieval-induced forgetting, RIF) inside neural networks, which allowed to explain and regulate the dynamics of a learning process. |
| 2018 – 2019 | **Modelling principles of machines cognition and communication with the phenomenon of retrieval-induced forgetting (RIF)**, *Russian Federation President Grant (project no. MK-6218.2018.9)*,<br>Role: **PI**.<br>Created a model of shared memory with the phenomenon of retrieval-induced forgetting (RIF), where remembering causes forgetting. Formulated novel principles of machine cognition and communication based on the proposed memory model. Adopted these principles to regulate convergence rate/generalization error trade-off in neural networks. |
| 2015 – 2017 | **Recovering knowledge models from Earth remote sensing data**, *National Program for Supporting Fundamental and Applied Science*,<br>Role: **Research Fellow**. |
| 2010 – 2011 | **Reducing data redundancy and models complexity with analytical decomposition method**, *National Program for Innovate Science U.M.N.I.K.*,<br>Role: **PI**.<br>Proposed the Fourier decomposition method with extended orthogonality relations. Implemented the method to balance convergence rate with generalisation capability by regulating the revealed orthogonality criterion between them. |

## Teaching

| | |
|---|---|
| May 2020 – Present | **Full Professor**, Samara National Research University.<br>Preparing study materials and giving lectures:<br>○ Mathematical Modelling, *postgraduate program in Applied Mathematics and Computer Science*.<br>○ Digital Signal and Image Processing, *postgraduate program in Informatics and Computing Tools*.<br>○ Modern Problems of Informatics and Computing Tools, *postgraduate program in Informatics and Computing Tools*.<br>Mentoring postgraduate students. |
| Sep 2017 – Apr 2020 | **Associate Professor**, Samara National Research University.<br>Preparing study materials and giving lectures:<br>○ Mathematical Modelling, *postgraduate program in Applied Mathematics and Computer Science*.<br>○ Digital Signal and Image Processing, *postgraduate program in Informatics and Computing Tools*.<br>○ Data Mining and Big Data, *postgraduate program in Data Analysis and Software Quality Assurance*.<br>○ Automated Software Testing, *postgraduate program in Data Analysis and Software Quality Assurance*.<br>○ Programming in Modern Fortran, *postgraduate program in Programming Technologies for Intel Computing Platforms*.<br>○ Software Testing and Debugging, *postgraduate program in Programming Technologies for Intel Computing Platforms*.<br>○ Performance Engineering of Software Systems, *postgraduate program in Programming Technologies for Intel Computing Platforms*.<br>Mentoring postgraduate students. |

| | |
|---|---|
| Sep 2011 – Sep 2017 | **Associate Professor**, Samara State Aerospace University. |

Prepared study materials and gave lectures:

- Mathematical Modelling, *postgraduate program in Applied Mathematics and Computer Science*.
- Digital Signal and Image Processing, *postgraduate program in Informatics and Computing Tools*.
- Data Mining and Big Data, *postgraduate program in Data Analysis and Software Quality Assurance*.
- Model-Driven Software Engineering, *postgraduate program in Informatics and Computing Tools*.
- Complex Systems Modelling, *postgraduate program in Informatics and Computing Tools*.
- Computer Graphics, *undergraduate program in Informatics and Computing Tools*.
- Numerical Methods, *undergraduate program in Informatics and Computing Tools*.
- Information Technologies, *undergraduate program in Informatics and Computing Tools*.

Mentored undergraduate and postgraduate students.

| | |
|---|---|
| Sep 2008 – Sep 2011 | **Assistant Professor**, Samara State Aerospace University. |

- Automated Research Systems Engineering, *postgraduate program in Data Processing and Automation Control*.

Mentored diploma students

## Skills

| | |
|---|---|
| Programming languages | C/C++, C#, Java, JavaScript, MATLAB, Octave, LabView, R, Python, Prolog, Erlang, Scala, Haskell, Julia |
| Frameworks | Keras, PyTorch, Tensorflow, MXNet, Gluon, ONNX |
| Languages | English, Russian (native) |

## Training

| | |
|---|---|
| Online | Deep Learning Lecture Series by DeepMind x UCL (2020), Fast AI by Fast.ai (2019), Reinforcement Learning Lecture Series by DeepMind x UCL (2018), Machine Learning by Stanford University (Mar 30th, 2016; with distinction), Introduction to Machine Learning by Higher School of Economics (Mar 14th, 2016; with distinction), The Data Scientist's Toolbox by Johns Hopkins University (Nov 6th, 2014), R Programming by Johns Hopkins University (Nov 6th, 2014; with distinction), Getting and Cleaning Data by Johns Hopkins University (Nov 6th, 2014; with distinction), Principles of Written English. Part III by University of California at Berkeley (May 8th, 2014; with distinction), Principles of Written English. Part II by University of California at Berkeley (Feb 28th, 2014; with distinction), Introduction to Computer Science and Programming (Python) by MIT (Jan 1st, 2014; with distinction), Writing in Sciences by Stanford University (Nov 22nd, 2013), Digital Signal Processing by Ecole Polytechnique Federale de Lausanne (Dec 26th, 2013; with distinction), Computing for Data Analysis by Johns Hopkins University (Dec 20th, 2013; with distinction), Principles of Written English. Part I by University of California at Berkeley (Dec 15th, 2013), Crafting an Effective Writer: Tools of the Trade (Fundamental English Writing) by Mt. San Jacinto College (Dec 2nd, 2013), Functional Programming Principles in Scala by Ecole Polytechnique Federale de Lausanne (Dec 1st, 2013; with distinction), Introduction to Mathematical Thinking by Stanford University (Nov 11th, 2013; with distinction), Quantum Mechanics and Quantum Computation by University of California at Berkeley (Oct 24th, 2013; with distinction), Coding the Matrix: Linear Algebra Through Computer Science Application by Brown University (Oct 10th, 2013; with distinction) |
| Schools and workshops | 4th International Summer School on Data Science (Split, Croatia, Sep 9-13, 2019): Lectures on Statistics and Symbolic data analysis; International Workshop on EU and Business R&D Project Management (Zagreb, Croatia, Dec 5-7, 2018): Training on writing EU Horizon H2020 proposals |

## Scientific Community Activities

| | |
|---|---|
| Academy membership | **Junior Member of Academy**, International Academy of Navigation and Motion Control, Saint-Petersburg |

| | |
|---|---|
| Journal reviewing | Mathematical Modelling and Analysis, International Journal of Adaptive Control and Signal Processing, Digital Signal Processing, Pattern Recognition and Image Processing, Computer Optics, Journal of Difference Equations and Applications, Computers in Human Behavior, IEEE Industrial Electronics, Electronics, Entropy, Machine Learning |
| Conference proceedings reviewing | ECML PKDD 2019; DS 2019-2020, NeurIPS 2020 |
| Program Committee membership | ECML PKDD 2020 |

## Academic Honors

| | |
|---|---|
| 2020 | **Outstanding Teaching Award**, Samara National Research University. |
| 2018 – 2020 | **National Award for Outstanding Research**, Ministry of Education and Science of the Russian Federation. |
| 2018 | **Winner of Science Innovation Competition**, National Innovation Promotion Fund, START. |
| 2018 | **Russian Federation President Grant**, President Grant Committee, Interview for the official newspaper of the Russian Academy of Sciences. |
| 2013 | **Best Young Researcher**, Ministry of Education and Science of the Russian Federation. |
| 2010 – 2011 | **Best PhD Student Scholarship Award**, Government of the Russian Federation. |
| 2009 | **Best Book in Russian Education**, National Education Development Fund. |
| 2009 | **Best PhD student**, Ministry of Education and Science of the Russian Federation. |
| 2009 | **Winner of Youth Science and Innovation Competition**, National Innovation Promotion Fund, U.M.N.I.K. |

## Selected publications

Journal papers in English

42. **Kulikovskikh I.** Legović T. (2021). Painless step size adaptation for SGD (submitted)

41. **Kulikovskikh I.**, Lipić T., Šmuc T. (2020). From knowledge transmission to knowledge construction: A step towards human-like active learning. Entropy. 22(8): 906.

40. **Kulikovskikh I.**, Prokhorov S., Lipić T., Legović T., Šmuc T. (2019). BioGD: Bio-inspired robust gradient descent. PLoS ONE. 14(7): e0219004.

39. **Kulikovskikh I.**, Prokhorov S., Legović T., Šmuc T. (2019). An SGD-based meta-learner with "growing" descent. Journal of Physics: Conference Series. 1368: 052008.

38. **Kulikovskikh I.M.**, Prokhorov S.A. (2018). Psychological perspectives on implicit regularization: A model of retrieval-induced forgetting. Journal of Physics: Conference Series. 1096(1): 012079.

37. **Kulikovskikh I.M.** (2018). Meixner nonorthogonal filters. Automation and Remote Control. 79(8): 1458-1473.

36. **Kulikovskikh I.M.** (2017). Cognitive validation maps for early occupancy detection in environmental sensing. Engineering Applications of Artificial Intelligence. 65: 330-335.

35. **Kulikovskikh I.M.**, Prokhorov S.A., Suchkova S.A. (2017). Promoting collaborative learning through regulation of guessing in clickers. Computers in Human Behavior. 75: 81-91.

34. **Kulikovskikh I.M.**, Prokhorov S.A. (2017). Minimizing the effects of floor and ceiling to improve the convergence of loglikelihood. Procedia Engineering. 201: 779–788.

33. Prokhorov S.A. **Kulikovskikh I.M.** (2016). Pole position problem for Meixner filters. Signal Processing. 120: 8-12.

32. Prokhorov S.A., **Kulikovskikh I.M.** (2015). Unique condition for generalized Laguerre functions to solve pole position problem. Signal Processing. 108: 25-29.

Conference proceedings in English

31. **Kulikovskikh I.** (2021) Neurons learn slower than they think (submitted)

30. **Kulikovskikh I.** Legović T. (2021) Stop looking for bio-inspiration. Let machines have their own world (submitted)

29. **Kulikovskikh I.** Legović T. (2021) Grow slower, converge faster: Towards better convergence dynamics (submitted)

28. **Kulikovskikh I.** Legović T. (2021) Growth and harvest induce essential dynamics in neural networks (submitted)

27. Prokhorov S.A., **Kulikovskikh I.M.** Fuzzy learning performance assessment based on decision making under internal uncertainty. In: Proceedings of the 7th Computer Science and Electronic Engineering Conference (CEEC'15). Sep 24-25, 2015. Colchester, UK. pp. 65-70.

Presentations in English

26. **Kulikovskikh I.**, Lipić T., Šmuc T. Neurons in 'active learning' learn less than they think. 5th Workshop on Data Science (IWDS 2020). Nov 24, 2020. Zagreb, Croatia.

25. **Kulikovskikh I.**, Šmuc T. Machines in a classroom: Towards human-like active learning. 22nd Conference on Discovery Science (DS 2019). Oct 28-30, 2019. Split, Croatia.

24. **Kulikovskikh I.**, Šmuc T. Bio-inspired robust machine learning. 4th Workshop on Data Science (IWDS 2019). Oct 15, 2019. Zagreb, Croatia.

23. **Kulikovskikh I.**, Šmuc T. Robust machine learning inspired by the models of population dynamics. 12th International Ljubljana-Zagreb Workshop on Knowledge Technologies and Data Science. Oct 24-25, 2019. University of Zagreb, Zagreb, Croatia.

22. **Kulikovskikh I.** Modelling machine-machine interactions with the generalized logistic equation. Seminar on Data Science. Nov 8, 2018. Laboratory for Machine Learning and Knowledge Representation, Ruđer Bošković Institute, Zagreb, Croatia.

21. **Kulikovskikh I.** Implicit regularization in machine-machine interactions. Seminar on Machine Learning. Mar 29, 2018. Computational Center of Russian Academy of Sciences, Moscow.

20. **Kulikovskikh I.** Implicit regularization of regression models. Seminar on Problems in Mathematics. Dec 8, 2017. Department of Mathematics, Samara National Research University, Samara.

Books in Russian

19. Prokhorov S.A., **Kulikovskikh I.M.** Numerical methods and algorithms for time series analysis with orthogonal decomposition method. Samara: Insoma-press, 2019. 254 p. [in Russian]

18. Prokhorov S.A., **Kulikovskikh I.M.** Numerical methods, algorithms, and programs for computational and natural experiments. Samara: Insoma-press, 2019. 208 p. [in Russian]

17. Prokhorov S.A., **Kulikovskikh I.M.** Classical orthogonal functions and its applications. Part I. Orthogonal functions of exponential type. Samara: Samara Scientific Center of the Russian Academy of Sciences, 2013. 200 p. [in Russian]

16. Prokhorov S.A., **Kulikovskikh I.M.** Orthogonal models of correlation and spectral characteristics of stochastic processes. Samara: Samara Branch of Russian Academy of Sciences, 2008. 301 p. [in Russian]

15. **Kulikovskikh I.M.** (2007). Algorithms and programs for correlation-spectral analysis with Jacobi elliptic functions. In Prokhorov S.A. (ed.) Applied analysis of stochastic processes. Samara: Samara Scientific Center of the Russian Academy of Sciences, pp. 347-360. [in Russian]

Journal
papers in
Russian

14. **Kulikovskikh I.** (2020). Reducing computational costs in deep learning on almost linearly separable training data. Computer Optics. 44(2): 282-289. [in Russian]

13. **Kulikovskikh I.M.**, Prokhorov S.A. (2018). Regulating complexity of adaptive multiple-choice testing with fuzzy cognitive maps. Software systems and computational methods. 4: 15-26. [in Russian]

12. **Kulikovskikh I.M.** (2017). Reinterpreting regression models with a tree-step cognition model. Software & Systems. 30(4): 601-608. [in Russian]

11. **Kulikovskikh I.M.**, Prokhorov S.A., Suchkova S.A., Matytsin E.V. (2016). Fuzzy collaborative learning with partial knowledge. Izvestia of Samara Scientific Center of the Russian Academy of Sciences. 18(4-4): 760-765. [in Russian]

10. Prokhorov S.A., Suchkova S.A., **Kulikovskikh I.M.** (2015). Clustering diagnostic tests on English prepositions with the Bloom's taxonomy. Izvestia of Samara Scientific Center of the Russian Academy of Sciences. 17(2-5): 1097-1103. [in Russian]

9. Prokhorov S.A., **Kulikovskikh I.M.** (2012). Building software systems with objects interaction diagram. Software & Systems. 3: 5-8. [in Russian]

Software
patents

8. **Kulikovskikh I.M.**, Shaldybina O.N. Web platform for enabling efficient "machine-machine" and "human-human" interactions with cognitive maps. Patent RU 2020611141 issued Jan 24, 2020 by Federal Institute for Industrial Property.

7. **Kulikovskikh I.M.** Explicit regulation of convergence rates of gradient methods with induced retrieval-induced forgetting. Patent RU 2019667794 issued Dec 27, 2019 by Federal Institute for Industrial Property.

6. **Kulikovskikh I.M.** Robust machine learning algorithms inspired by the models of population dynamics. Patent RU 2019667690 issued Dec 26, 2019 by Federal Institute for Industrial Property.

5. **Kulikovskikh I.M.**, Bezrukov D.V. Long-term memory equipped with the mechanisms of retrieval-induced forgetting. Patent RU 2018664362 issued Oct 30, 2018 by Federal Institute for Industrial Property.

4. **Kulikovskikh I.M.**, Nazarova E.A. Fuzzy-based machine communication. Patent RU 2018664363 issued Oct 30, 2018 by Federal Institute for Industrial Property.

3. **Kulikovskikh I.M.**, Ponomarev E.A. Machine communication framework based on the phenomenon of retrieval-induced forgetting. Patent RU 2018665162 issued Nov 6, 2018 by Federal Institute for Industrial Property.

2. **Kulikovskikh I.M.**, Prokhorov S.A., Suchkova S.A. Fuzzy learning assessment for measuring learning performance under internal uncertainty. Patent RU 2015660296 issued Dec 16, 2015 by Federal Institute for Industrial Property.

1. **Kulikovskikh I.M.**, Prokhorov S.A., Suchkova S.A. Learning prepositional polysemy with state machines. Patent RU 2015618129 issued Jul 31, 2015 by Federal Institute for Industrial Property.

Preprints

2. **Kulikovskikh I.** Legović T. (2021) Painless step size adaptation for SGD (arXiv:2102.00853)

1. **Kulikovskikh I.** Legović T. (2020) Why to "grow" and "harvest" deep learning models? (arXiv:2008.03501)