

Alëna Rodionova

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- Ph.D. candidate with expertise in **formal methods**, **robust control** and **verification** graduating in Sept 2022.
- Published **20+ papers** including multiple **best student paper awards** in major conferences and journals in control theory and **artificial intelligence**.
- Filed **2 patents** on automated vehicles safety and optimization of deep neural networks.
- Industry experience (**Research & Development**) at **Intel Labs** (Autonomous Driving Research Lab) and **General Motors** (Controls, Software, Methods and Tools group).
- Experienced in **machine learning**, **reinforcement learning** and **optimization**.
- High analytical and research skills. Years of experience of working independently and as part of multidisciplinary team. Passionate about finding elegant solutions to difficult problems.

Research Interests

Autonomous Systems, Robust Control, Verification, Machine Learning

Education

- 2017–09/2022 (expected) **Ph.D. in Electrical and Systems Engineering, University of Pennsylvania (UPenn), Philadelphia, PA** GPA: 3.89/4.
Advisor: George J. Pappas
- 2012–2014 **Master in Applied Mathematics and Informatics, Siberian Federal University (SibFU), Russia** Magna cum laude.
- 2008–2012 **Bachelor of Mathematics, Siberian Federal University (SibFU), Russia** Magna cum laude.

Experience

- 2017–present **University of Pennsylvania, Philadelphia, PA.**
Research: Safe and Robust Control of Cyber-Physical Systems
 - Theoretical foundations of time robustness. See [talk](#) and publication [C14](#) [**Best Student Paper Award**].
 - Designed a framework for time-robust control using Mixed-Integer Linear Programming (MILP) in which the time robustness of a dynamical system is maximized. See [Code](#).
 - Risk analysis of not satisfying the specification in time. See [J7](#), [C15](#) [**Finalist for Best Paper Award**].**Research: Safe Trajectory Planning for Autonomous Drones**
 - Learning-based mission-aware collision avoidance for scalable urban mobility using Long Short-Term Memory (LSTM) recurrent neural network (RNN). See [talk](#) and publications [J6](#), [C11](#), [C13](#).
 - Autonomous drone safety using temporal logic-based trajectory planning. See publication [J5](#)
- 2019 **Intel Labs, Autonomous Driving Research, Hillsboro, OR.**
Graduate Technical Intern
 - Automated driving safety analysis and software integration with RSS Library. See [talk](#) and [C12](#), [C8](#).
 - Designed a method for automatic exploration of the performance limits of AV safety models using robustness as a continuous metric of safety. See patent [P2](#).
- 2018 **General Motors (GM), ECS Process, Methods and Tools Group, Warren, MI.**
Research and Development Intern
 - Correctness preserving optimization of Deep Neural Networks (DNNs). See patent [P1](#).
 - Coverage analysis in DNNs testing.
- 2015–2017 **Vienna University of Technology (TU Wien), Institute of Computer Engineering, Austria.**
Researcher at Cyber-Physical Systems Group
 - A specification language for emergent properties.
 - Designed and implemented qualitative and quantitative filtering semantics for Metric Temporal Logic (MTL). See publications [B1](#), [C6](#) [**Best Student Paper Award**].
 - Designed a formalization of medical-device algorithms (e.g., arrhythmia-detection) in the language of Quantitative Regular Expressions (QRE). See publications [J4](#), [J3](#).

- 2013-2015 **Russian Academy of Sciences, Siberian Branch, Institute of Computational Modeling, Russia.**
Project Assistant
- Convection motions with interfaces and their stability. See publications [J1](#), [J2](#).
 - Analysis of the non-linear heat and mass transfer regimes and their stability in binary mixtures. See publications [C4](#), [C5](#), [C7](#).

Honors and Awards

- 2022 **Finalist for Best Paper Award** at the 25th ACM International Conference on Hybrid Systems: Computation and Control (HSCC).
- 2021 **Best Student Paper Award** at the 60th IEEE Conference on Decision and Control (CDC).
- 2020 **Best of Session Award** at the 39th IEEE/AIAA Digital Avionics Systems Conference (DASC).
- 2019 Travel Grant by CRA-W Grad Cohort Workshop.
- 2018 **MIT EECS Rising Star award**, awarded annually to outstanding early-career women in electrical engineering and computer science (EECS), MIT.
- 2017 The Dean's Fellowship Award from University of Pennsylvania (UPenn), awarded to PhD students in recognition of exceptional performance.
- 2016 **Best Student Paper Award** at the 19th ACM International Conference on Hybrid Systems: Computation and Control (HSCC).
- 2015 Career Grant by The Federal Ministry for Transport, Innovation and Technology (BMVIT), Austria.
- 2014 **Best Presentation Award** at the 10th National Scientific Students Conference "Youth & Science".
- 2014 Master's Degree with Distinction, SubFU Russia.
- 2012 Bachelor's Degree with Distinction, SubFU Russia.
- 2011, 2012 Scholarship by Vladimir Potanin Foundation, awarded annually to top Bachelor and Master students nation-wide, Russia.

Teaching

- Fall 2020 **Linear Systems Theory**, ESE500 UPenn.
Teaching Assistant with George J. Pappas
- Spring 2020 **Machine Learning**, CIS520 UPenn.
Teaching Assistant with Shivani Agarwal
- Spring 2018 **Model-Based Embedded Systems**, ESE680 UPenn.
Guest Lecturer for "Parametric Timed Automata" and "Quantitative Semantics of TL"
- Sept 2012 - **Mathematics**, School of Physics and Mathematics, SibFU, Russia.
Feb 2015 High School Teacher

Patents

- P2 **Method and device for determining a configuration for an autonomous vehicle.**
A. Rodionova, I. Alvarez.
Patent Application 16/726,276, US2020130709A1 (12/24/2019). [\[pdf\]](#)
- P1 **Correctness preserving optimization of Deep Neural Networks.**
P. M. Peranandam, R. Sethu, A. Rodionova.
Patent Application 16/227,195, US2020202214A1, (12/20/2018). [\[pdf\]](#)

Developed Software

Safe and Robust Control

- S6 Time-robust control using Mixed-Integer Linear Programming (MILP). [\[code\]](#), [\[C14\]](#)
- S5 Robustness-guided testing: automatic safety constraints boundary estimation for decision-making in automated vehicles. [\[code\]](#), [\[C12\]](#)
- S4 FADS: Framework for Autonomous Drone Safety. [\[code\]](#), [\[J5\]](#)

Machine Learning

- S3 Learning-to-Fly: learning-based collision avoidance for scalable urban air mobility. [\[J6\]](#), [\[C11\]](#)
- S2 Neprune: DNN pruning framework. [\[P1\]](#)
- S1 DNN classification algorithms for cardiac arrhythmias discrimination. [\[code\]](#)

Publications [\[Google Scholar Citations: 158, h-index: 7, i10-index: 6 as of June 22, 2022\]](#)

Journals

- J8 **A. Rodionova**, L. Lindemann, M. Morari, G. J. Pappas. Combined Temporal Robustness of STL. IEEE Control Systems Letters (L-CSS), 2022. [\[Submitted\]](#)
- J7 **A. Rodionova**, L. Lindemann, M. Morari, G. J. Pappas. Temporal Robustness of Temporal Logic Specifications: Analysis and Control Design. ACM Transactions on Embedded Computing Systems (TECS), 2022. [\[Submitted\]](#)
- J6 **A. Rodionova**, Y. V. Pant, C. Kurtz, K. J. Jang, H. Abbas, R. Mangharam. Learning-'N'-Flying: A Learning-based, Decentralized Mission Aware UAS Collision Avoidance Scheme. ACM Transactions on Cyber-Physical Systems, 2021. [\[pdf\]](#)
- J5 Y. V. Pant, M. Z. Li, **A. Rodionova**, R. A. Quaye, H. Abbas, M. S. Ryerson, R. Mangharam. FADS: A Framework for Autonomous Drone Safety Using Temporal Logic-Based Trajectory Planning. Transportation Research Part C: Emerging Technologies, 2021. [\[pdf\]](#)
- J4 H. Abbas, **A. Rodionova**, K. Mamouras, E. Bartocci, S. A. Smolka, R. Grosu. Quantitative regular expressions for arrhythmia detection. IEEE/ACM transactions on computational biology and bioinformatics, 2018. [\[pdf\]](#)
- J3 H. Abbas, R. Alur, K. Mamouras, R. Mangharam, **A. Rodionova**. Real-time decision policies with predictable performance. Proceedings of the IEEE, 2018. [\[pdf\]](#)
- J2 **A. Rodionova**, E. Rezanova. Stability of two-layer fluid flow. Journal of Applied Mechanics and Technical Physics, 2016. [\[pdf\]](#)
- J1 V. Bekezhanova, **A. Rodionova**. Longwave stability of two-layer fluid flow in the inclined plane. Fluid Dynamics, 2015. [\[pdf\]](#)

Conferences and Workshops

- C15 L. Lindemann*, **A. Rodionova***, G. J. Pappas. Temporal Robustness of Stochastic Signals. The 25th ACM International Conference on Hybrid Systems: Computation and Control (HSCC), 2022. [\[pdf\]](#) – **Finalist for Best Paper Award**
- C14 **A. Rodionova**, L. Lindemann, M. Morari, G. J. Pappas. Time-Robust Control for STL Specifications. IEEE Conference on Decision and Control (CDC), 2021. [\[pdf\]](#) – **Best Student Paper Award**
- C13 K. Jang, Y. V. Pant, **A. Rodionova**, R. Mangharam. Learning-to-Fly RL: Reinforcement Learning-based Collision Avoidance for Scalable Urban Air Mobility. The 39th IEEE/AIAA Digital Avionics Systems Conference (DASC), 2020. [\[pdf\]](#) – **Best of Session Award**
- C12 **A. Rodionova**, I. Alvarez, M. S. Elli, F. Oboril, J. Quast, R. Mangharam. How safe is safe enough? Automatic safety constraints boundary estimation for decision-making in automated vehicles. IEEE Intelligent Vehicles Symposium, 2020. [\[pdf\]](#)
- C11 **A. Rodionova***, Y. V. Pant*, K. J. Jang, H. Abbas, R. Quaye, R. Mangharam. Learning-to-Fly: learning-based collision avoidance for scalable urban air mobility. IEEE International Conference on Intelligent Transportation Systems, 2020. [\[pdf\]](#)
- C10 H. Abbas, K. Mamouras, **A. Rodionova**, R. Alur, J. Liang, S. Dixit, R. Mangharam. A novel programming language to reduce energy consumption by arrhythmia monitoring algorithms in implantable cardioverter-defibrillators. The 39th Heart Rhythm Scientific Sessions, 2018. [\[pdf\]](#)
- C9 **A. Rodionova**, M. E. O'Kelly, H. Abbas, V. Pacelli, R. Mangharam. An Autonomous Vehicle Control Stack. The 4th International Workshop on Applied Verification of Continuous and Hybrid Systems (ARCH), 2017. [\[pdf\]](#)
- C8 H. Abbas, M. E. O'Kelly, **A. Rodionova**, R. Mangharam. Safe at any speed: A simulation-based test harness for autonomous vehicles. International Workshop on Design, Modeling, and Evaluation of Cyber Physical Systems (CyPhy), 2017. [\[pdf\]](#)

- C7 H. Abbas, **A. Rodionova**, E. Bartocci, S. A. Smolka. Quantitative regular expressions for arrhythmia detection algorithms. International Conference on Computational Methods in Systems Biology, 2017. [\[pdf\]](#)
- C6 **A. Rodionova**, E. Bartocci, D. Nickovic, R. Grosu. Temporal logic as filtering. The 19th International Conference on Hybrid Systems: Computation and Control, 2016. [\[pdf\]](#) – **Best Student Paper Award**
- C5 **A. Rodionova**, V. Bekezhanova. Longwave stability of two-layer fluid flow in the inclined plane. The 15th National Young Scientists Conference on Mathematical Modeling and Information Technologies, 2014. [\[pdf\]](#)
- C4 **A. Rodionova**, V. Bekezhanova. Stability of two-layer fluid flow with evaporation effect and long-wave perturbations. The 10th National Scientific Conference of Students and Young Scientists: Youth & Science, 2014. [\[pdf\]](#) – **Best Presentation Award**
- C3 **A. Rodionova**, V. Bekezhanova. Microscale static two-layer fluid flow in the inclined plane. 9th National Scientific Conference of Students and Young Scientists: Youth & Science, 2013. [\[pdf\]](#)
- C2 **A. Rodionova**, I. Panfilov. Static and dynamic penalty functions for constrained optimization in genetic algorithms. 8th National Scientific Conference of Students and Young Scientists: Youth & Science, 2012. [\[pdf\]](#)
- C1 S. Senashov, **A. Rodionova**, I. Shefer. New contact transformations. 14th International Scientific Conference Reshetnev Readings, 2010. [\[pdf\]](#)

Book Chapters

- B1 **A. Rodionova**, E. Bartocci, D. Nickovic, R. Grosu. Temporal logic as filtering. Dependable Software Systems Engineering, NATO Science for Peace and Security Series - D: Information and Communication Security, 2017. [\[pdf\]](#)

Magazine Articles

- M1 H. Abbas, M. E. O'Kelly, **A. Rodionova**, R. Mangharam. A driver's license test for driverless vehicles. Mechanical Engineering Magazine (ASME), 2017. [\[pdf\]](#)

Invited Talks

- 04/2022 U. Waterloo Invited Lecture – Temporal Robustness of Temporal Logic Specifications: Analysis and Control. Waterloo, Canada. Virtual.
- 01/2022 UPenn PGM Research Seminar – Time Robustness of Temporal Logic Specifications: Analysis and Control. Philadelphia, PA.
- 04/2021 UPenn PGM Research Seminar – Robust Planning for STL Specifications. Philadelphia, PA.
- 09/2020 Grace Hopper Celebration – Verifying Safety Laws for Automated Vehicles. Orlando, FL. Virtual.
- 09/2020 UPenn PGM Research Seminar – Learning-to-Fly: Learning-based Collision Avoidance for Scalable Urban Mobility. Philadelphia, PA.
- 11/2019 Intel Autonomous Driving Community Of Practice 2019: RSS Workshop – Robustness-Guided Testing of RSS Rules. Intel Labs, Hillsboro, OR.
- 10/2019 Intel Science and Technology Center (WAS-ISTC) Monthly Seminar – Test harness for guided search of unsafe driving instances. Virtual.
- 10/2019 PRECISE Industry Day – Verifying Robot Safety Laws for Autonomous Vehicles. University of Pennsylvania (UPenn), Philadelphia, PA.
- 10/2018 EECS Rising Stars – Foundations of Safe Autonomy: On-Board Verification and Formally-Constrained Machine Learning. Massachusetts Institute of Technology (MIT), Cambridge, MA.
- 04/2018 CyberCardia (NSF Frontiers) PI Meeting – Quantitative Regular Expressions for Arrhythmia Detection Algorithms. Georgia Institute of Technology (Georgia Tech), Atlanta, GA.
- 04/2016 CyberCardia (NSF Frontiers) PI Meeting – Cardiac Arrhythmias Analysis: VT/SVT Discrimination Algorithm. Stony Brook University (SBU), Stony Brook, NY.
- 12/2015 ARVI Meeting – Temporal Logic as Filtering. Estonian Academy of Science, Tallinn, Estonia.
- 09/2015 CyberCardia (NSF Frontiers) PI Meeting – On Temporal Logic and Signal Processing. NSF Stafford Place, Arlington, VA.

Professional Services

Reviewer **Journal Reviewer**

Chaos: An Interdisciplinary Journal of Nonlinear Science, 2018
Journal of Formal Methods in System Design (FMDS), 2017
Journal on Software Tools for Technology Transfer (STTT), 2017

Conference Reviewer

Conference on Decision and Control (CDC), 2022
Conference on Cyber-Physical Systems (ICCPS), 2022, 2020, 2018
Intelligent Vehicles Symposium (IV), 2022, 2021
Workshop on Autonomous Systems Design (ASD), 2020
Conference on Embedded Software (EMSOFT), 2019, 2018
Symposium on Model Checking of Software (SPIN), 2017
Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), 2016
Conference on Runtime Verification (RV), 2016
Symposium on Automated Technology for Verification and Analysis (ATVA), 2016
Workshop on Hybrid Systems Biology, (HSB), 2016
Conference on Formal Modeling and Analysis of Timed Systems (FORMATS), 2015
Conference on Computational Methods in Systems Biology (CMSB), 2015

Conference Organization ACM Conference on Hybrid Systems: Computation and Control (HSCC), 2016.

Technical Skills

Programming Python, MATLAB, C++
Optimization S-TLiRo CPLEX, CVX, CVXPY, YALMIP, MPT, CasADi, Gurobi, Simulink
Miscellaneous CARLA Simulator, RSS, UPPAAL
Machine Learning TensorFlow, Keras, DeepXplore, OpenCV-Python

Language Skills

English Proficient
Russian Native
German Basic