

# Curriculum Vitae

Roman Tobias Kalkreuth

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Roman Kalkreuth is currently a postdoctoral researcher at TU Dortmund University in Germany. His research is located in the fields of evolutionary computation and artificial intelligence. Primarily, his research focuses on the analysis and development of graph-based genetic programming algorithms. Besides his academic experience, Roman Kalkreuth has advanced knowledge in the fields of application and web development due to his industrial period.

After receiving a Master of Science in Computer Vision and Computational Intelligence (2012) from South Westphalia University of Applied Sciences, Roman Kalkreuth worked for the companies *HST Systemtechnik* and *Brockhaus AG* as a software development engineer in Meschede and Lünen (Germany). Afterwards, he started his Ph.D. study at the Department of Computer Science of the TU Dortmund University. Since 2015, he has been a research associate of the Computational Intelligence Research Group of Prof. Dr. Günter Rudolph. Roman Kalkreuth defended his dissertation in July last year and then took up a postdoctoral researcher position within Professor Rudolph's research group.

## Personal Data

**Born:** 24/04/1987 in Siegen, Germany

**Nationality:** German

**Languages:** German (mother tongue), English (fluent)

**Personal Interests:** Meditation, Running, Mountain hiking, Piano playing

**Social Commitment:** Fridays for Future Germany, Young Buddhist Coordinator (Arnsberg Buddhist Centre)

## Current Position

Postdoctoral Researcher in Computational Intelligence

## Academic Record

- since 08/2021 **Postdoctoral Researcher in Computational Intelligence**, Computational Intelligence Research Group, Department of Computer Science, TU Dortmund University, Germany
- since 10/2015 **Research Associate in Computational Intelligence**, Computational Intelligence Research Group, Department of Computer Science, TU Dortmund University, Germany
- 05/2014 - 07/2021 **PhD Student in Computer Science**, Computational Intelligence Research Group, Department of Computer Science, TU Dortmund University, Germany
- 10/2010 - 08/2012 **Master of Science in Computer Vision and Computational Intelligence**, South Westphalia University of Applied Sciences, Iserlohn, Germany
- 10/2007-09/2010 **Bachelor in Applied Computer Science**, South Westphalia University of Applied Sciences, Iserlohn, Germany

## Industrial Record

- 12/2014 - 04/2015 **Software Development Engineer**, Brockhaus AG, Lünen, Germany
- 11/2012 - 11/2013 **Software Development Engineer**, HST Systemtechnik / Pegasys, Meschede, Germany
- 10/2010 - 10/2012 **Self-employment**, Freelancer / Kalkreuth-IT, Bestwig, Germany

## Research Interests

- **Graph-based Genetic Programming:** Extension of Cartesian Genetic Programming, development and analysis of genetic operators, formalism and runtime analysis
- **Evolutionary Multi-Criterion Optimization:** Multiobjective genetic programming for determination of small programmes
- **Convolutional Neural Networks:** Automated classification of medical imaging data
- **Deep Reinforcement Learning:** Artificial intelligence applied to games

## Dissertation

**Title:**

*Reconsideration and Extension of Cartesian Genetic Programming*

**Supervisor:** Prof. Dr. rer. nat. Günter Rudolph

**Degree:** Doctor of Natural Sciences (Dr. rer. nat.)

**Date of Submission:** 10/03/2021

**Date of Defense:** 27/07/2021

## Teaching Experience

- **Introduction to Programming**

**Winter terms 2015 - 2019:**

Supervision of practical training in C/C++

**Winter term 2020/21:**

Lecturer of the course (a working proof in German can be accessed through the YouTube channel<sup>1</sup>)

**Scope:** Introduction to the programming language C/C++ and to essential data structures and algorithms

- **Mathematics for Computer Scientists**

**Summer terms 2017 and 2018:**

Supervision of exercises

**Scope:** Analysis, sequences and series, continuity, differentiability, integral calculus, and combinatorics

- **Data structures and Algorithms**

**Summer term 2016:**

Supervision of practical training

**Scope:** Abstract data types, sorting algorithms, hashing, heuristics and dynamic programming

- **Operating Systems**

**Summer terms 2019 and 2020:**

**Scope:** Processes, virtual memory, process & I/O scheduling and memory management

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<sup>1</sup><https://www.youtube.com/user/rtk244/videos>

- **Student Project Groups**

**Summer term 2021 / Winter term 2021/22:**

Project Group 642 *Distributed Training of Game AI for Rocket League with Deep Reinforcement Learning*

(first results<sup>2</sup> <sup>3</sup> have been accepted for publication at the IEEE Conference on Games 2022)

**GitHub:** <https://github.com/PG642>

- **Practical Optimization of Complex Systems**

**Summer term 2022:**

**Scope:** Convex/Non-convex optimization, optimization under uncertainty, multi-objective optimization, symbolic optimization, direct deterministic search methods and evolutionary algorithms

**GitHub:** <https://github.com/RomanKalkreuth/practical-optimization>

- **Supervision of Bachelor and Master Theses**

## Leadership Experience

- **Introduction to Programming (Winter term 2020/21)**

Replacement lecturer, Team leader

**Education team:** 5 research associates, 21 undergraduate assistants

**Size of course:** 283 students

## Awards, Grants and Nominations

2012 Best Graduate

2013 *Edelweiss with star* of the Portal Switzerland for contributions to the German-language Wikipedia

2016 IEEE Computational Intelligence Society Travel Grant (IEEE WCCI 2016)

2019 Best Student Paper Nomination (IJCCI/ECTA 2019)

2019 Best Poster Nomination (IJCCI/ECTA 2019)

## Academic References

**Prof. Dr. rer. nat. Günter Rudolph** Professor for Computational Intelligence, TU Dortmund University, Dortmund, Germany

**Prof. Dr. rer. nat. Paul Kaufmann** Professor for Embedded Systems,

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<sup>2</sup><https://drive.google.com/file/d/1EWYoiVOX6mTNRHap00rL4x0V57MLjWKA/view>

<sup>3</sup><https://drive.google.com/file/d/1eyfBdcEARM5ZNkHnmVJ28udi5d4nuXCU/view>

Westphalian University of Applied Sciences, Bocholt, Germany

**Prof. Ing. Lukáš Sekanina, Ph.D.** Head of Department, Faculty of Information Technology, Evolvable Hardware Research Group, Brno University of Technology, Brno, Czech Republic

**Prof. Dr. rer. nat. Jörg Krone** Professor for Computer Science, Institute for Computer Science, Vision and Computational Intelligence, South Westphalia University of Applied Sciences, Iserlohn, Germany

**Prof. Dr.-Ing. Horst Schirmeier** Professor for Operating Systems, Institute of System Architectures, Dresden University of Technology, Dresden, Germany

**Dr. Julian Miller** Honorary Fellow (formerly Reader), Department of Electronic Engineering, University of York, York, United Kingdom

## Industrial References

**Dipl. Ing. Heiko Sykora**, Executive Director, Briloner Hartstein Werk, Brilon, Germany

**Dipl. Inf. Uwe Frigger**, Division Manager, HST Systemtechnik / Pegasys, Meschede, Germany

## Recent Collaborations

**Dr. Léo François Dal Piccol Sotto**, Fraunhofer Institute for Algorithms and Scientific Computing, St. Augustin, Germany

**Dr. Timothy Atkinson**, NNAISENSE, Lugano, Switzerland

**Dr. med. Felix Döllinger**, Department of Radiology, Charité – Universitätsmedizin Berlin, Berlin, Germany

**Dr. med. Timo Auer**, Department of Radiology, Charité – Universitätsmedizin Berlin, Berlin, Germany

**Dr. med. Roman Klöckner**, University Medicine of the Johannes Gutenberg-University Mainz, Mainz, Germany

**M.Sc. Jannis Born**, Cognitive Healthcare and Lifesciences Department, ETH Zurich and IBM Research Zurich, Zurich, Switzerland

## Scientific Missions

- **Runtime Analysis of Cartesian Genetic Programming (2017)**

Short term scientific mission of the COST Action CA15140: *Improving Applicability of Nature-Inspired Optimisation by Joining Theory and Practice*

**Host:** Evolvable Hardware Research Group, Brno University of Technology, Brno, Czech Republic

**Funding:** European Cooperation in Science and Technology

## Miscellaneous Activities

- **The ECJ Evolutionary Computation Toolkit<sup>4</sup>**

**Role:** Developer/Contributor

- **17th Conference on Parallel Problem Solving from Nature (Dortmund, Germany)<sup>5</sup>**

**Role:** Social Media Chair

- **Genetic and Evolutionary Computation Conference 2022 (Boston, USA)<sup>6</sup>**

**Contribution:** Tutorial on graph-based genetic programming<sup>7</sup>

- **Genetic and Evolutionary Computation Conference 2020 (Cancun, Mexico)<sup>8</sup>**

**Role:** Reviewer

- **IEEE Transactions on Evolutionary Computation<sup>9</sup>**

**Role:** Reviewer

**Publisher:** IEEE

- **Genetic Programming and Evolvable Machines Journal<sup>10</sup>**

**Role:** Reviewer

**Publisher:** Springer International Publishing

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<sup>4</sup><https://github.com/GMUECLab/ecj>

<sup>5</sup><https://ppsn2022.cs.tu-dortmund.de/>

<sup>6</sup><https://gecco-2022.sigevo.org/HomePage>

<sup>7</sup><https://github.com/RomanKalkreuth/graph-based-gp-tutorial>

<sup>8</sup><https://gecco-2020.sigevo.org/index.html/HomePage>

<sup>9</sup><https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4235>

<sup>10</sup><https://www.springer.com/journal/10710>

## External Profiles

- **GitHub:** <https://github.com/RomanKalkreuth>
- **YouTube:** <https://www.youtube.com/user/rtk244/videos>

## List of Publications

### Full Technical Papers:

- [1] Kalkreuth, R., J. Krone, and M. Schneider (2012). “Automatische Generierung von Bildoperationsketten mittels genetischer Programmierung”. In: *Proceedings. 22. Workshop Computational Intelligence, Dortmund, 6. - 7. Dezember 2012*. Schriftenreihe des Instituts für Angewandte Informatik - Automatisierungstechnik, Karlsruher Institut für Technologie. KIT Scientific Publishing, pp. 325–339. ISBN: 978-3-86644-917-6. DOI: 10.5445/KSP/1000029917 (written in German language)
- [2] Kalkreuth, R., G. Rudolph, and J. Krone (2014). “Automatische Generierung von Bildoperationsketten mittels genetischer Programmierung und CMA-Evolutionsstrategie”. In: *Proceedings. 24. Workshop Computational Intelligence, Dortmund, 27. - 28. November 2014*. Schriftenreihe des Instituts für Angewandte Informatik - Automatisierungstechnik, Karlsruher Institut für Technologie. KIT Scientific Publishing, pp. 95–111. ISBN: 978-3-7315-0275-3. DOI: 10.5445/KSP/1000043427 (written in German language)
- [3] Kalkreuth, R., G. Rudolph, and J. Krone (2015). “Improving Convergence in Cartesian Genetic Programming Using Adaptive Crossover, Mutation and Selection”. In: *IEEE Symposium Series on Computational Intelligence, SSCI 2015, Cape Town, South Africa, December 7-10, 2015*. IEEE, pp. 1415–1422. DOI: 10.1109/SSCI.2015.201. URL: <https://doi.org/10.1109/SSCI.2015.201>
- [4] Kalkreuth, R., G. Rudolph, and J. Krone (2016). “More efficient evolution of small genetic programs in Cartesian Genetic Programming by using genotypic age”. In: *IEEE Congress on Evolutionary Computation, CEC 2016, Vancouver, BC, Canada, July 24-29, 2016*. IEEE, pp. 5052–5059. DOI: 10.1109/CEC.2016.7748330. URL: <https://doi.org/10.1109/CEC.2016.7748330>
- [5] Kaufmann, P. and R. Kalkreuth (2017b). “Parametrizing Cartesian Genetic Programming: An Empirical Study”. In: *KI 2017: Advances in Artificial Intelligence - 40th Annual German Conference on AI, Dortmund, Germany, September 25-29, 2017, Proceedings*. Ed. by G. Kern-Isberner, J. Fürnkranz, and M. Thimm. Vol. 10505. Lecture Notes in Computer Science. Springer, pp. 316–322. DOI: 10.1007/978-3-319-67190-1\_26. URL: [https://doi.org/10.1007/978-3-319-67190-1\\_26](https://doi.org/10.1007/978-3-319-67190-1_26)
- [6] Kalkreuth, R., G. Rudolph, and A. Droschinsky (2017). “A New Subgraph Crossover for Cartesian Genetic Programming”. In: *Genetic Programming - 20th European Conference, EuroGP 2017, Amsterdam, The Netherlands,*

- April 19-21, 2017, Proceedings*. Ed. by J. McDermott, M. Castelli, L. Sekanina, E. Haasdijk, and P. García-Sánchez. Vol. 10196. Lecture Notes in Computer Science, pp. 294–310. DOI: 10.1007/978-3-319-55696-3\_19. URL: [https://doi.org/10.1007/978-3-319-55696-3\\_19](https://doi.org/10.1007/978-3-319-55696-3_19)
- [7] Husa, J. and R. Kalkreuth (2018). “A Comparative Study on Crossover in Cartesian Genetic Programming”. In: *Genetic Programming - 21st European Conference, EuroGP 2018, Parma, Italy, April 4-6, 2018, Proceedings*. Ed. by M. Castelli, L. Sekanina, M. Zhang, S. Cagnoni, and P. García-Sánchez. Vol. 10781. Lecture Notes in Computer Science. Springer, pp. 203–219. DOI: 10.1007/978-3-319-77553-1\_13. URL: [https://doi.org/10.1007/978-3-319-77553-1\\_13](https://doi.org/10.1007/978-3-319-77553-1_13)
- [8] Kalkreuth, R. and A. Droschinsky (2019). “On the Time Complexity of Simple Cartesian Genetic Programming”. In: *Proceedings of the 11th International Joint Conference on Computational Intelligence, IJCCI 2019, Vienna, Austria, September 17-19, 2019*. Ed. by J. J. M. Guervós, J. Garibaldi, A. Linares-Barranco, K. Madani, and K. Warwick. ScitePress, pp. 172–179. DOI: 10.5220/0008070201720179. URL: <https://doi.org/10.5220/0008070201720179>
- [9] Kalkreuth, R. (2019). “Two New Mutation Techniques for Cartesian Genetic Programming”. In: *Proceedings of the 11th International Joint Conference on Computational Intelligence, IJCCI 2019, Vienna, Austria, September 17-19, 2019*. Ed. by J. J. M. Guervós, J. Garibaldi, A. Linares-Barranco, K. Madani, and K. Warwick. ScitePress, pp. 82–92. DOI: 10.5220/0008070100820092. URL: <https://doi.org/10.5220/0008070100820092>
- [10] Sotto, L. F. D. P., P. Kaufmann, T. Atkinson, R. Kalkreuth, and M. P. Basgalupp (2020). “A study on graph representations for genetic programming”. In: *GECCO '20: Genetic and Evolutionary Computation Conference, Cancún Mexico, July 8-12, 2020*. Ed. by C. A. C. Coello. ACM, pp. 931–939. DOI: 10.1145/3377930.3390234. URL: <https://doi.org/10.1145/3377930.3390234>
- [11] Kaufmann, P. and R. Kalkreuth (2020). “On the Parameterization of Cartesian Genetic Programming”. In: *IEEE Congress on Evolutionary Computation, CEC 2020, Glasgow, United Kingdom, July 19-24, 2020*. IEEE, pp. 1–8. DOI: 10.1109/CEC48606.2020.9185492. URL: <https://doi.org/10.1109/CEC48606.2020.9185492>
- [12] Kalkreuth, R. (2020). “A Comprehensive Study on Subgraph Crossover in Cartesian Genetic Programming”. In: *Proceedings of the 12th International Joint Conference on Computational Intelligence, IJCCI 2020, Budapest, Hungary, November 2-4, 2020*. Ed. by J. J. M. Guervós, J. M. Garibaldi, C. Wagner, T. Bäck, K. Madani, and K. Warwick. SCITEPRESS, pp. 59–70. DOI: 10.5220/0010110700590070. URL: <https://doi.org/10.5220/0010110700590070>
- [13] Kurz, P., P. Kaufmann, R. Kalkreuth, J. Born, R. Klöcker, F. Hahn, F. Döllinger, and T. A. Auer (2020). “On the Detection of SARS-CoV-2



induced Pneumonia in X-Ray Thorax Images with Convolutional Neural Networks”. In: *Proceedings - 30. Workshop Computational Intelligence : Berlin, 26. - 27. November 2020*. KIT Scientific Publishing. ISBN: 978-3-7315-1051-2. DOI: 10.5445/KSP/1000124139

- [14] Pleines, M., K. Ramthun, Y. Wegener, H. Meyer, M. Pallasch, S. Prior, J. Drögemüller, L. Büttinghaus, T. Röthemeyer, A. Kaschwig, O. Chmurzynski, F. Rohkrähmer, R. Kalkreuth, F. Zimmer, and M. Preuss (2022). “On the Verge of Solving Rocket League using Deep Reinforcement Learning and Sim-to-sim Transfer”. In: *IEEE Conference on Games, CoG 2022, Beijing, China, August 21-24, 2022*. IEEE (accepted as full technical paper at IEEE COG '22 - Preprint version available at arxiv: <https://arxiv.org/abs/2205.05061>)
- [15] Kalkreuth, R. (2022b). “Towards Discrete Phenotypic Recombination in Cartesian Genetic Programming”. In: *Parallel Problem Solving from Nature - PPSN XVII - 17th International Conference, PPSN 2022, Dortmund, Germany, September 10-14, 2022, Proceedings*. Lecture Notes in Computer Science. Dortmund, Germany: Springer (accepted for publication at PPSN XVII)

#### Poster/Short Papers:

- [1] Kaufmann, P. and R. Kalkreuth (2017a). “An empirical study on the parametrization of cartesian genetic programming”. In: *Genetic and Evolutionary Computation Conference, Berlin, Germany, July 15-19, 2017, Companion Material Proceedings*. Ed. by P. A. N. Bosman. ACM, pp. 231–232. DOI: 10.1145/3067695.3075980. URL: <https://doi.org/10.1145/3067695.3075980>
- [2] Kalkreuth, R. (2022a). “Phenotypic Duplication and Inversion in Cartesian Genetic Programming applied to Boolean Function Learning”. In: *Genetic and Evolutionary Computation Conference, Boston, USA, July 9-13, 2022, Companion Material Proceedings*. Genetic and Evolutionary Computation Conference 2022 (GECCO '22). Boston, United States: ACM (accepted as a poster at GECCO '22)

#### Book Chapters:

- [1] Kalkreuth, R. (2021a). “An Empirical Study on Insertion and Deletion Mutation in Cartesian Genetic Programming”. In: *Computational Intelligence: 11th International Joint Conference, IJCCI 2019, Vienna, Austria, September 17–19, 2019, Revised Selected Papers*. Ed. by J. J. Merelo, J. Garibaldi, A. Linares-Barranco, K. Warwick, and K. Madani. Cham: Springer International Publishing, pp. 85–114. ISBN: 978-3-030-70594-7. DOI: 10.1007/978-3-030-70594-7\_4. URL: [https://doi.org/10.1007/978-3-030-70594-7\\_4](https://doi.org/10.1007/978-3-030-70594-7_4)

### Journal Articles:

- [1] Françoso Dal Piccol Sotto, L., P. Kaufmann, T. Atkinson, R. Kalkreuth, and M. Porto Basgalupp (2021). “Graph representations in genetic programming”. In: *Genetic Programming and Evolvable Machines*. ISSN: 1573-7632. DOI: 10.1007/s10710-021-09413-9. URL: <https://doi.org/10.1007/s10710-021-09413-9>

### Theses:

- [1] Kalkreuth, R. T. (2021b). “Reconsideration and Extension of Cartesian Genetic Programming”. PhD thesis. TU Dortmund University. DOI: 10.17877/DE290R-22504. URL: <http://dx.doi.org/10.17877/DE290R-22504>