

Curriculum Vitae

Roman Tobias Kalkreuth

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Roman Kalkreuth is currently a research associate at TU Dortmund University in Germany. His research is located in the fields of computational intelligence techniques such as Evolutionary Algorithms and Convolutional Neural Networks. 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 field 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). Afterward, he started his Ph.D. study at the Department of Computer Science of the TU Dortmund University. Since 2015, he is a research associate of the computational intelligence research group of Prof. Dr. Günter Rudolph at the Department of Computer Science of the TU Dortmund University. Roman Kalkreuth defended his dissertation in July this year. Afterwards he became a Postdoc of Prof. Dr. Günter Rudolph.

Personal Data

Born: 24/04/1987 in Siegen, Germany

Nationality: German

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

Personal Interests: Meditation, Running & Gym, Mountain hiking, Piano playing,

Social Commitment: Scientists for Future, Young Buddhist Coordinator

Current Position

Research Associate in Computational Intelligence

Academic Record

- since 08/2021 **Postdoc in Computer Science**, 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:** Analysis and extension of Cartesian Genetic Programming, development and analysis of genetic operators, runtime analysis
- **Evolutionary Multi-Criterion Optimization:** Multiobjective Genetic Programming for determination of small programmes
- **Hybrid Heuristic Optimization:** Hybrid evolutionary-based approaches for numerical and combinatorial optimization
- **Convolutional Neural Networks:** Automated classification of medical imaging data

Dissertation

Title:

Reconsideration and Extension of Cartesian Genetic Programming

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

Degree: Doctor of Science (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 can be accessed through the YouTube channel¹)

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

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

- **Student Project Groups**
Summer term 2021:
 Project Group 642 *Distributed Training of Deep Reinforcement Learning for Game AI*
- **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
- 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

Jun.-Prof. Dr. rer. nat. Paul Kaufmann Assistant professor for Computational Intelligence, Mainz University, Mainz, Germany

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

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. 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

List of Publications

Conference 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

- [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
- [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 genotype 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 (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>
- [6] 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
- [7] 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
- [8] 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

- [9] 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>
- [10] 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>
- [11] 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>
- [12] 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>
- [13] 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>
- [14] 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

Book Chapters:

- [1] Kalkreuth, R. (2021). “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

Journal Articles:

An extended version of the GECCO 2020 article, titled *A Study on Graph Representations for Genetic Programming*, has been invited for submission to an upcoming special issue of the Springer journal *Genetic Programming and Evolvable Machines*²). The following work has been accepted for publication and is currently in the publishing process.

- [1] Sotto, L. F.D. P., P. Kaufmann, T. Atkinson, R. Kalkreuth, and M. P. Basgalupp (2021). “Graph Representations in Genetic Programming”. In: *Genetic Programming and Evolvable Machines*. Ed. by M. Nicolau, T. Hu, N. Lourenco, and M. Zhang

²<https://www.springer.com/journal/10710>