

Samuel Teuber

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Office Address

Am Fasanengarten 5, 76131 Karlsruhe, Germany

Languages:

German (native), English (fluent),
French (basic)

RESEARCH INTERESTS

My research develops logical foundations and practical tools for the verification of AI-based heterogeneous systems, that is, systems combining software, AI, and physical components. Concrete applications include the formal verification of neural network control systems and the verification of algorithmic fairness.

EDUCATION

- ◇ **2022-present : PhD Candidate in Computer Science** — Karlsruhe Institute of Technology
Thesis: Provable Correctness of AI-based Heterogeneous Systems
Advisor: Prof. Bernhard Beckert (KIT)
- ◇ **2022 : Master's Thesis via interACT** — Logical Systems Lab, Carnegie Mellon University
Thesis: Transfer of Safety Guarantees from Differential Dynamic Logic Proofs to Neural Network-based Controller Systems — Awarded with KIT Informatic's Best Thesis Award
Referees: Prof. André Platzer (CMU); Prof. Carsten Sinz (KIT)
- ◇ **2020-2022 : M.Sc. in Computer Science** — Karlsruhe Institute of Technology
Subject: Computer Science
Grade: 1.0 (very good; with distinction)
- ◇ **2017-2018 : ERASMUS Exchange** — ENSIMAG, Grenoble
Subject: Ingénierie des Systèmes d'Information
- ◇ **2015-2020 : B.Sc. in Computer Science** — Karlsruhe Institute of Technology
Subject: Computer Science
Grade: 1.5 (very good)
Thesis: Solving difficult SMT instances using abstractions and incremental SMT solving
Referees: Prof. Carsten Sinz (KIT)
- ◇ **2015 : A Levels (Abitur)** — Oskar-von-Miller-Gymnasium, München
Grade: 1.2 (very good)

EXPERIENCE

- ◇ **2022-present :** Researcher, KASTEL Beckert, KIT
- ◇ **2020-2021 :** Student Assistant for Software Safety Quantification Research, ITI Beckert, KIT
- ◇ **2019-2021 :** Student Teaching Assistant for "Programmierparadigmen", IPD Snelting, KIT
- ◇ **2018 :** CERN Openlab Summer Student, EP-SFT, CERN
- ◇ **2015-2016 :** Student Assistant, IT-Centre for the humanities, LMU

AWARDS AND HONORS

- ◇ **2023 :** Best Master's Thesis Award 2022/2023 by the KIT Informatics Department
- ◇ **2018 :** One of the competition winners during the CERN Openlab lightning talks 2018
- ◇ **2016 :** Abitur prize of the German Physics Association (DPG)

SCHOLARSHIPS

- ◇ **2017-2022 :** Scholarship holder at Cusanuswerk e.V.

PUBLICATIONS

Refereed Journal Publications

1. Matthew L. Daggitt, Ekaterina Komendantskaya, Alistair Sirman, Alessandro Bruni, **Samuel Teuber**, Josh Smart, and Grant Passmore. “Compositional Neural-Cyber-Physical System Verification in the Interactive Theorem Prover of Your Choice”. In: **Proc. ACM Program. Lang. ICFP** (2026). arXiv: 2605.02790 [cs.PL]. URL: <https://arxiv.org/abs/2605.02790>.
2. **Samuel Teuber**, Mattias Ulbrich, André Platzer, and Bernhard Beckert. “Heterogeneous Dynamic Logic: Provability Modulo Program Theories”. In: **Proc. ACM Program. Lang. PLDI** (2026). Ed. by Manu Sridharan. DOI: 10.1145/3808295. arXiv: 2507.08581.

Refereed Conference Publications

1. Enguerrand Prebet, **Samuel Teuber**, and André Platzer. “Verification of Autonomous Neural Car Control with KeYmaera X”. In: *11th International Conference on Rigorous State-Based Methods. ABZ 2025* (Düsseldorf, Germany, June 10–13, 2025). Ed. by Michael Leuschel and Fuyuki Ishikawa. Vol. 15728. LNCS. Springer, 2025, pp. 288–307. DOI: 10.1007/978-3-031-94533-5_17.
2. **Samuel Teuber**, Philipp Kern, Marvin Janzen, and Bernhard Beckert. “Revisiting Differential Verification: Equivalence Verification with Confidence”. In: *31st International Conference on Tools and Algorithms for the Construction and Analysis of Systems. TACAS 2025* (Hamilton, ON, Canada, May 3–8, 2025). Ed. by Arie Gurfinkel and Marijn Heule. Vol. 15697. LNCS. Springer, 2025, pp. 257–278. DOI: 10.1007/978-3-031-90653-4_13.
3. **Samuel Teuber**, Debasmita Lohar, and Bernhard Beckert. “Of Good Demons and Bad Angels: Guaranteeing Safe Control under Finite Precision”. In: *25th Conference on Formal Methods in Computer-Aided Design. FMCAD 2025* (Menlo Park, CA, USA, Oct. 6–10, 2025). 2025. DOI: 10.34727/2025/isbn.978-3-85448-084-6_12.
4. Bernhard Beckert, Jonas Klamroth, Wolfram Pfeifer, Patrick Röper, and **Samuel Teuber**. “Towards Combining the Cognitive Abilities of Large Language Models with the Rigor of Deductive Program Verification”. In: *12th International Symposium on Leveraging Applications of Formal Methods, Verification and Validation. Software Engineering Methodologies, Part IV. ISO/FA 2024* (Crete, Greece, Oct. 27–31, 2024). Ed. by Tiziana Margaria and Bernhard Steffen. Vol. 15222. LNCS. Springer, 2024, pp. 242–257. DOI: 10.1007/978-3-031-75387-9_15.
5. Florian Lanzinger, Christian Martin, Frederik Reiche, **Samuel Teuber**, Robert Heinrich, and Alexander Weigl. “Quantifying Software Correctness by Combining Architecture Modeling and Formal Program Analysis”. In: *39th ACM/SIGAPP Symposium on Applied Computing. SAC 2024* (Avila, Spain, Apr. 8–12, 2024). Ed. by Jiman Hong and Juw Won Park. ACM, 2024, pp. 1702–1711. DOI: 10.1145/3605098.3636008.
6. **Samuel Teuber** and Bernhard Beckert. “An Information-Flow Perspective on Algorithmic Fairness”. In: *Thirty-Eighth AAAI Conference on Artificial Intelligence. AAAI 2024* (Vancouver, BC, Canada, Feb. 20–27, 2024). Ed. by Michael J. Wooldridge, Jennifer G. Dy, and Sriraam Natarajan. AAAI Press, 2024, pp. 15337–15345. DOI: 10.1609/AAAI.V38I14.29458.
7. **Samuel Teuber**, Stefan Mitsch, and André Platzer. “Provably Safe Neural Network Controllers via Differential Dynamic Logic”. In: *Advances in Neural Information Processing Systems 38: Annual Conference on Neural Information Processing Systems. NeurIPS 2024* (Vancouver, BC, Canada, Dec. 10–15, 2024). Ed. by Amir Globersons, Lester Mackey, Danielle Belgrave, Angela Fan, Ulrich Paquet, Jakub M. Tomczak, and Cheng Zhang. 2024.
8. **Samuel Teuber**, Marko Kleine Büning, Philipp Kern, and Carsten Sinz. “Geometric Path Enumeration for Equivalence Verification of Neural Networks”. In: *IEEE 33rd International Conference on Tools with Artificial Intelligence. ICTAI 2021* (virtual, Nov. 1–3, 2021). 2021, pp. 200–208. DOI: 10.1109/ICTAI52525.2021.00035.
9. **Samuel Teuber** and Alexander Weigl. “Quantifying Software Reliability via Model-Counting”. In: *Quantitative Evaluation of Systems. QEST 2021* (virtual, Aug. 23–27, 2021). Ed. by Alessandro Abate and Andrea Marin. Cham: Springer, 2021, pp. 59–79. ISBN: 978-3-030-85172-9.

Refereed Workshop Publications

1. **Samuel Teuber** and Bernhard Beckert. “Next Steps in LLM-Supported Java Verification”. In: *1st IEEE/ACM International Workshop on Neuro-Symbolic Software Engineering. NSE@ICSE 2025* (Ottawa, ON, Canada, May 3, 2025). IEEE, 2025, pp. 1–4. DOI: 10.1109/NSE66660.2025.00007.

2. **Samuel Teuber** and Bernhard Beckert. “Formally Verified Algorithmic Fairness Using Information-Flow Tools”. In: *2nd European Workshop on Algorithmic Fairness. EWAF 2023* (Winterthur, Switzerland, June 7–9, 2023). Ed. by José M. Álvarez, Alessandro Fabris, Christoph Heitz, Corinna Hertweck, Michele Loi, and Meike Zehlke. Vol. 3442. CEUR Workshop Proceedings. CEUR-WS.org, 2023.

TALKS

Invited Talks

- ◇ **2026: Guaranteed Safe AI Seminars** — Horizon Omega (online)
- ◇ **2025: Of Good Demons and Bad Angels: Guaranteeing Safe Neural Control under Finite Precision** — ANSR Reading Group, Berkeley, California, US (Online)
- ◇ **2025: Of Good Demons and Bad Angels: Guaranteeing Safe Neural Control under Finite Precision** — Arcak Group (Berkeley, California, US)
- ◇ **2025: Provable Guarantees for Neural Networks** — Meel Group (Online)
- ◇ **2024: Provably Safe Neural Network Controllers via Differential Dynamic Logic** — Laboratory for Foundations of Computer Science Seminar (Edinburgh, UK)

Contributed Talks

- ◇ **2026: Heterogeneous Dynamic Logic: Provability Modulo Program Theories** — Formal Reasoning for Compositional Systems Engineering (FLoC, Lisbon, Portugal)
- ◇ **2026: Differential Verification of Neural Networks: Theory and Applications** — Workshop on Program Equivalence and Relational Reasoning (FLoC, Lisbon, Portugal)
- ◇ **2026: Of Good Demons and Bad Angels: Guaranteeing Safe Control under Finite Precision** — Symposium on AI Verification (FLoC, Lisbon, Portugal)
- ◇ **2025: Replication of the Landscape for LLM-generated Formal Specifications for C Programs** — Contract Languages Seminar (Online)
- ◇ **2025: Dynamic Logic à la Locale** — KeY Symposium (Manigod, France)
- ◇ **2025: Towards LLM-support for Deductive Verification of Java Programs** — Workshop on Theorem Proving and Machine Learning in the age of LLMs (Edinburgh, UK)
- ◇ **2024: Heterogeneous Dynamic Logic** — KeY Symposium (Bad Herrenalb, Germany)
- ◇ **2024: Provably Safe Neural Network Controllers via Differential Dynamic Logic** — Symposium on AI Verification (Montreal, Canada)
- ◇ **2023: An Information-Flow Perspective on Algorithmic Fairness** — KeY Symposium (Bergen, Norway)

TEACHING EXPERIENCE

- ◇ **Summer 2026** : Formal Systems II: Theory (Guest Lecture: Heterogeneous Dynamic Logic)
- ◇ **November 2025** : Verification and Validation of Autonomous Systems with Neural Network Components at Heriot-Watt University, Edinburgh (Guest Lecture & Lab on VerSAILLE)
- ◇ **Winter 2025/26** : Formal Systems (Teaching assistant & lecturer for first order logic)
- ◇ **Summer 2025** : Seminar "Fairness and Non-Discrimination from the viewpoint of Computer Science and Philosophy" (Organizer & Student advisor)
- ◇ **Summer 2025** : Seminar "LLMs in Formal Verification" (Student advisor)
- ◇ **Summer 2025** : Lecture "Formal Systems II: Applications" (2 Guest Lectures: Neural Network Verification together with Philipp Kern)
- ◇ **Winter 2024/25** : Seminar "Neural Networks in Formal Verification" (Co-Organizer & Student advisor)
- ◇ **Winter 2024/25** : Formal Systems (Teaching assistant)
- ◇ **October 2024** : Verification and Validation of Autonomous Systems with Neural Network Components at Heriot-Watt University, Edinburgh (Guest Lecture & Lab on VerSAILLE)
- ◇ **Winter 2023/24** : Formal Systems (Teaching assistant)
- ◇ **Summer 2023** : Seminar "Fairness and Non-Discrimination from the Perspective of Ethics and Computer Sci-

ence" (Co-Organizer)

- ◇ **Summer 2023** : Proseminar "Differentiable Programming" (Co-Organizer & Student advisor)
- ◇ **Winter 2022/23** : Formal Systems (Teaching assistant)
- ◇ **Winter 2020/21** : Programming Paradigms (Student teaching assistant)
- ◇ **Winter 2019/20** : Programming Paradigms (Student teaching assistant)

Student Supervision

- ◇ **Summer 2026** : Bachelor's Thesis — Modelling and Verification of Multi-Obstacle Systems in Heterogeneous Dynamic Logic
- ◇ **Summer 2026** : Bachelor's Thesis — Bernstein Polynomial Set Representations for Optimizable Neural Network Verification
- ◇ **2025/26** : 1 year research internship — Synthesis of Auxiliary Specifications via Large Language Models
- ◇ **Winter 2025/26** : Bachelor's Thesis — Differential Verification of Non-ReLU Neural Networks
- ◇ **Winter 2025/26** : Bachelor's Thesis — LP-free Neuron Splitting for Neural Network Equivalence Verification
- ◇ **Winter 2025/26** : Bachelor's Thesis — Differential Verification for Computational Graphs
- ◇ **Winter 2025/26** : HiWi — Reengineering NCubeV's Backends
- ◇ **Summer 2025** : Research Lab — Experimental Evaluation of Tools and LLMs for Generating Loop Invariants
- ◇ **2024/25** : 1 year research internship — Efficient NN Verification via LP-based Conflict Learning
- ◇ **Summer 2024** : Bachelor's Thesis — Improving Zonotope-Based Neural Network Verification via Gradient-Based Optimization
- ◇ **Summer 2024** : Bachelor's Thesis — Conflict Analysis for Simplex-Based Neural Network Verification via Farkas Vectors
- ◇ **Summer 2024** : Research Lab — Generation of loop specifications using large language models
- ◇ **Summer 2024** : Research Lab — Generation of submethod specifications using large language models (german)
- ◇ **Summer 2023** : Bachelor's Thesis — Abstraction-refinement based Equivalence Verification of Convolutional Neural Networks
- ◇ **Summer 2023** : Bachelor's Thesis — Dimensionality Reduction for Neural Network Verification
- ◇ **Summer 2023** : Research Lab — Large Language Models for the synthesis of JML-Specifications

PROFESSIONAL SERVICE

- ◇ **Conference Reviews** : NeurIPS (2025); AAAI (2025); ICML (2025); AISTATS (2025); AAAI SRAI Track (2024); NeurIPS (2024)
- ◇ **Subreviews** : FM (2026,2024); POPL (2025); LICS (2025); ICTAC (2024); iFM (2023); LICS (2023)
- ◇ **Journal Reviews** : Science of Computer Programming (2024/2025)