# Adina Aniculaesei

Postdoctoral Researcher – Department of Computer Science and Engineering, Formal Methods Unit, University of Gothenburg and Chalmers University of Technology

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## Research Profile

My research lies at the intersection of **Software Development**, **Dependable and Safety-Critical Systems**, and **Formal Methods for Autonomous and AI-Enabled Software**. I develop software engineering methods that integrate formal verification, runtime assurance, and model-based testing to improve the reliability and robustness of complex autonomous systems.

In my **doctoral work**, I introduced a methodology for engineering safety in automated safety-critical systems through the explicit specification, design-time verification, and runtime validation of environment assumptions— a framework seamlessly integrated into the software development lifecycle.

My **current research** extends these principles to multi-agent robotic systems using ROS 2, where I explore the automated generation of ROS 2 programs from formal agent models, decentralized coordination algorithms, and distributed runtime monitoring for dependable multi-robot behaviors. My research and teaching practice also incorporate **agile software development methods**, which I apply in both academic and applied research contexts for iterative and collaborative development of dependable autonomous systems.

Overall, my work combines rigorous formal foundations with applied software development for real-world autonomous systems. To date, I have authored or co-authored **25 peer-reviewed publications**, including journal articles, conference papers, and book chapters on dependable autonomous and safety-critical software.

## Education

**2024** **Doctor of Natural Sciences (Dr. rer. nat.)**, *Institute for Software and Systems Engineering, TU Clausthal*, Clausthal-Zellerfeld, Germany
Distinction: *magna cum laude*. Thesis: *Engineering of Safety in Automated Safety-Critical Systems through Design-time Verification and Runtime Validation of Environment Assumptions*. Examination Committee: Prof. Dr. Andreas Rausch (Chief Examiner, TU Clausthal), Prof. Dr. Robert Bredereck (Chair, TU Clausthal), Prof. Dr. Stefan Wagner (Examiner, TU München), Prof. Dr. Alois Christian Knoll (Examiner, TU München).

**2011** **M.Sc. in Computer Science**, *TU Braunschweig*, Braunschweig, Germany
Grade: 1.3 (very good). Thesis: *UML-Based Analysis of Power Consumption in Real-Time and Embedded Systems*.

**2007** **B.Sc. in Computer Science**, *Alexandru Ioan Cuza University*, Iași, Romania
Erasmus–Socrates Scholar (TU Braunschweig 2005–2006).

## Academic and Professional Experience

**2024–present** **Postdoctoral Researcher**, *Formal Methods Unit, Department of Computer Science and Engineering, Göteborgs Universitet and Chalmers Tekniska Högskola*, Göteborg, Sweden
○ Research on decentralized mechanisms for coordination that support asynchronous, anonymous and opportunistic group formation and choreography in multi-agent systems.
○ Development of a domain specific language that enables automated generation of ROS 2 programs from formal agent models.
○ Supervision of student theses AI-related topics, decentralized coordination approaches for multi-agent systems and systematic testing of multi-robot coordination infrastructures.

| 2024 | **Postdoctoral Researcher**, *Institute for Software and Systems Engineering, TU Clausthal*, Germany |
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- Coordinated academic–industrial collaborations, with contributions in formal methods, testing, and runtime monitoring of safety-critical systems.
- Contributed to project proposal preparation; supervised student research.

| 2018–2024 | **Doctoral Researcher**, *Institute for Software and Systems Engineering, TU Clausthal*, Germany |
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- Formal verification and runtime monitoring for autonomous safety-critical systems.
- Model-based testing for legal/NCAP compliance.
- Technical lead for the institutes work packages in various projects (VanAssist, Mobil-e-Hub, LogiSmile).
- Supervised student theses.

| 2011–2018 | **Research Assistant**, *Institute for Computer Science, TU Clausthal*, Germany |
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- Model-driven development and formal verification in projects with industrial partners, e.g., Volkswagen.
- Developed an introductory course in software testing for industrial partners, e.g., Volkswagen.
- Teaching in software engineering, formal verification, programming.

## Selected Research Projects and Leadership

**2025–present** **Hazard-Aware Runtime Adaptation over Assumption–Guarantee Lattices for Autonomous Safety Control** — Development of adaptive safety-control software integrating hazard analysis, runtime monitoring, and formal assumption–guarantee reasoning for autonomous systems. Leading the design of the software architecture and the implementation and integration of runtime assurance mechanisms.

**2024–present** **SynTM – Synthesis of Teamwork Multi-Agent Systems** — Researcher on coordination mechanisms for asynchronous, anonymous, and opportunistic group formation and choreography in multi-agent systems. Design of a domain-specific language and toolchain for automated generation of ROS 2 programs from formal agent models, following agile and iterative development practices. Responsibilities include supervision of students and dissemination of research results.

**2022–2024** **Methods for ODD Specification** — Design of YAML-based ODD specification languages and automated ODD-consistency checking with SMT solvers. Responsible for bridging requirements analysis, formal modeling, and tool-supported verification within the system development process. Included coordination with project partners and publication of results.

**2020–2024** **LogiSmile and Mobil-e-Hub** — Design and development of safety concepts, runtime monitoring, and failure-mitigation strategies for autonomous delivery vehicles and drones in last-mile logistics. Responsibilities included defining user stories for the automated hub vehicle, coordinating the development of an integrated safety concept providing fail-safe solutions in critical driving situations, concept development for drone monitoring systems, supervision of students, coordination with project partners, and publication of results in scientific venues.

**2019–2021** **VanAssist** — Development of offboard and onboard runtime monitoring systems for automated delivery vehicles operating on company premises and in urban environments. Responsibilities included requirements elicitation and analysis with project partners, serving as Scrum Master for a student team of five to seven developers, reviewing the software architecture of the online monitoring system, supervision of students, and publication of results in scientific outlets.

2018–2021 **Automated Test Case Generation 1.0 & 2.0** — Automated generation of executable test cases from formalized system requirements using model checking, including extension of concepts integrated with the SCADE development environment. Responsibilities included creation of algorithms and methodologies for automated and manual test-case derivation, communication with industry partners, supervision of students, and publication of results in scientific publications.

Earlier Projects (Selected)

*Earlier foundational projects include the following:*

2019–2020 **Formal Verification of Exhaust Gas After-Treatment Function** — Formal verification of the vehicle function responsible for exhaust gas after-treatment with respect to expert-defined requirements and sensor error and tolerance models. Responsibilities included function analysis, development of verification models, supervision of students, collaboration with industry partners, and dissemination of results.

2018–2019 **Verification of the Speed Estimation Function** — Formal verification of speed estimation algorithms against NCAP and legal requirements. Construction of mathematical proofs and tolerance analyses based on an abstract algorithmic model; derivation of application parameters ensuring compliance; and generation of test cases from formal models. Responsibilities included algorithmic analysis, supervision of students, communication with project partners, and publication of results.

## Teaching and Supervision

I teach across programming, software development, formal verification, software testing, and requirements analysis, with a strong emphasis on their role within the software development process. I connect theory and practice to foster analytical thinking and rigorous software engineering habits. My teaching approach integrates **project-based learning**, **agile development methods** (including definition of epics and user stories, task decomposition, specification of acceptance criteria, and structured team coordination), and **iterative refinement** of software artefacts—core elements that I apply both in classroom instruction and in student supervision.

**Recent teaching highlights:**

o *Introduction to Programming in Python* — Lab supervision, focusing on algorithmic thinking, systematic debugging, and clean coding practices (WS 2025/26)
o *Object-Oriented Programming Projects* — Supervision of student teams developing software applications using agile workflows (epics, user stories, sprints, acceptance criteria), with emphasis on design patterns and modular software architecture (WS 2025/26)
o *Connected and Autonomous Automotive Engineering* — Lectures & Exercises on AI-controlled autonomous vehicles, dependability, and software integration (WS 2023/24)
o *Software Systems Engineering* — Lectures & Exercises on formal verification and model checking within the software development lifecycle (WS 2018/19)

**Selected thesis supervision:**

o *AI-Powered Behavioral Analysis of Vehicle Communication* — M.Sc., Gothenburg (2025)
o *Runtime Monitoring of Autonomous Vehicles at Traffic Lights* — B.Sc., Clausthal (2024)
o *End-to-End Learning for Autonomous Drone Control* — M.Sc., Clausthal (2024)

## Selected Publications

*Below there is a list of five relevant publications. Full publication list is available on my Google Scholar profile.*

2025 A. Aniculaesei, Y. Elhajji. *Runtime Monitoring Approach to Safeguard Behavior of Autonomous Vehicles at Traffic Lights*. In *Electronics*, 14(2366), 2025. DOI: 10.3390/electronics14122366.

2025  A. Aniculaesei, I. Aslam, M. Zhang, A. Buragohain, A. Vorwald, A. Rausch. *Improving Safety of Autonomous Vehicles: A Verifiable Method for Graceful Degradation of Decision and Control Responsibilities.* In *SAE International Journal of Connected and Automated Vehicles*, Vol. 8, Issue 2, 2025. DOI: 10.4271/12-08-02-0021.

2023  A. Aniculaesei, C. Schindler, C. Knieke, A. Rausch. *A Method for ODD Specification and Verification with Application for Industrial Automated Driving Systems.* In *Proc. CSCI 2023*, Las Vegas, NV, USA. DOI: 10.1109/CSCI62032.2023.00251.

2021  A. Aniculaesei, A. Vorwald, M. Zhang, A. Rausch. *Architecture-based Hybrid Approach to Verify Safety-Critical Automotive System Functions by Combining Data-driven and Formal Methods.* In *18th IEEE International Conference on Software Architecture Companion (ICSA-C)*, Stuttgart, Germany, 2021. DOI: 10.1109/ICSA-C52384.2021.00036.

2019  A. Aniculaesei, A. Vorwald, A. Rausch. *Using the SCADE Toolchain to Generate Requirements-Based Test Cases for an Adaptive Cruise Control System.* In *ACM/IEEE 22nd International Conference on Model Driven Engineering Languages and Systems Companion (MODELS-C)*, München, Germany, 2019. DOI: 10.1109/MODELS-C.2019.00079.

## Honours and Awards

2007–2009  Siemens Master Program Scholarship

2005–2006  Erasmus–Socrates Scholarship

## Technical and Language Skills

Programming  Python, C/C++, Java, Bash

Software Engineering  Agile and Scrum methods; Software Testing; Test Case Generation; Requirements Analysis; Model-driven Development; Runtime Monitoring; Safety-critical Systems Engineering

Modeling & Verification  UML; SCADE; Lustre; PRISM; SMV; SPIN; NuSMV; STORM; Z3; CVC5

Frameworks & Tools  ROS 2; Git; Docker; CI/CD pipelines (basic); Linux development environment

Languages  German (Full professional), English (Full professional), Swedish (Beginner)

## Community and Academic Service

Reviewer: *Reliability Engineering & System Safety*, *Electronics*, *Future Transportation*, *Technologies* (2024–2025).

Programme Committee Member: MoDeVVa @ MODELS (2020–2023, 2025).

Reviewer: TACAS 2017; ACSW 2016.

Academic commissions & appointment committees, TU Clausthal (2015–2024).

## References

Prof. Dr. Andreas Rausch - Institute for Software and Systems Engineering, TU Clausthal, Germany - andreas.rausch@tu-clausthal.de

Assoc. Prof. Dr. Yehia Abd Alrahman - Department of Computer Science and Engineering, Formal Methods Unit, University of Gothenburg and Chalmers University of Technology, Gothenburg Sweden - yehiaa@chalmers.se

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