Anna Becchi

lanna.becchi@gmail.com — abecchi@fbk.eu — Web https://annabeks.github.io/

About me — I'm a PhD student working on automated formal verification of infinite-state transition systems. During my PhD, I worked on an industrial project addressing the migration from legacy railway interlocking systems to modern implementations, where I tackled reverse engineering, verification, and automated test case generation from electro-mechanical circuits. I also developed an efficient domain for convex polyhedra, applied to both static analysis and reachability of hybrid systems. My current interests include SMT-based invariant checking techniques and CHC solving.

Current position

Enrolled PhD Student in Computer Science **Nov. 2021 – present**
Institute: Fondazione Bruno Kessler (FBK), Italy and University of Trento, Italy
Supervisor: Prof. Alessadro Cimatti
Topic: Formal verification and reverse-engineering of cyberphysical systems – collaboration with the Italian Railway Network
I developed *Abstraction Modulo Stability (AMS)*, a framework for the analysis and reverse engineering of infinite-state timed transition systems. AMS can be used to extract properties and test cases that are independent of the implementation choices and represent high-level behaviors. I applied AMS in an industrial project supporting the migration from analog to software-based railway interlockings. From the legacy implementation, I effectively extracted test cases and properties useful to verify new systems. I also developed a tool for the digitalization of relay-based circuits, a compiler to timed transition systems and an SMT-based optimizer. **Expected graduation: September 2025**

Work Experience

Research assistant **Nov. 2024 – present**
Fondazione Bruno Kessler, Italy: Formal Methods Unit – head of unit Stefano Tonetta
Software developer **Sept. 2019 – Oct. 2021**
Fondazione Bruno Kessler, Italy: former Embedded Systems Unit – head of unit Alessandro Cimatti

Education

International Graduate Visiting Student **May. – Aug. 2024**
University of Waterloo, Canada; Supervisor: Prof. Arie Gurfinkel
I worked on CHC solving and model based projection for Linear Rational Arithmetic.
Master's Degree in Computer Science **Sept. 2017 – July 2020**
University of Udine, Italy. Thesis supervisor: Prof. Angelo Montanari. Final grade: 110/110 with honors
Bachelor's Degree in Computer Science **Sept. 2014 – Sept 2017**
University of Parma, Italy. Thesis supervisor: Prof. Enea Zaffanella. Final grade: 110/110 with honors
High School Diploma **Sept. 2009 – July 2014**
Liceo Scientifico G. Marconi, Parma, Italy. Final grade: 100/100

Publications

Selected publications as a first author (complete list available on dblp)

- C Testing the migration from analog to software-based railway interlocking systems. *A.B., A. Cimatti, G. Scaglione*. CAV'24
- J Abstraction Modulo Stability. *A.B., A. Cimatti*. FMSD'24
- J P-Stable abstractions of hybrid systems. *A.B., A. Cimatti, E. Zaffanella*. SoSyM'24
- C Abstraction Modulo Stability for Reverse Engineering. *A.B., A. Cimatti*. CAV'22
- C NORMA: a tool for the analysis of Relay-based Railway Interlocking Systems. *A.B., et al.*. TACAS'22
- J PPLite: Zero-overhead encoding of NNC polyhedra. *A.B., E. Zaffanella*. Inf&Comp'20
- C Revisiting Polyhedral Analysis for Hybrid Systems. *A.B., E. Zaffanella*. SAS'19 – Winner of Radhia Cousot Young Researcher Best Paper Award
- C A Direct Encoding for NNC Polyhedra. *A.B., E. Zaffanella*. CAV'18

Awards

Radhia Cousot Young Researcher Best Paper Award **2019**
Awarded by the Static Analysis Symposium program committee for the paper *Revisiting Polyhedral Analysis for Hybrid Systems*

Other Experiences

Seminars

Dagstuhl Seminar on*Theoretical Advances and Emerging Applications in Abstract Interpretation*. July 2023

Summer Schools

Lipari Summer School on *Abstract Interpretation*. Sept. 2024
Marktoberdorf Summer School on *Safety ans Security through Formal Verification*. Aug. 2023
EuroProofNet Summer School *Verification Technology, Systems & Applications*. Sept. 2022

Service

AEC member: TACAS'25, SAS'24-22, CAV'24-23-22
Subreviewer: FM'24, CAV'24-22-20, TACAS'24-23-22-21-20, ATVA'22-21, FMCAD'22, SEFM'22-20,SETTA'20, SEFM'20
Student Volunteer: CAV'24, FMCAD'22, FLoC'22-18

Projects

LRA-BDD: A C++ library combining multi terminal binary decision diagrams (MTBDDs) and convex polyhedra, for reachability analysis and Computational Tree Logic fixpoint computations on timed transition systems. Main developer 2020 – 2022.
Norma: A Tool for the graphical modelling and analysis of Relay-based Railway Interlocking System, leveraging DIA frontend, nuXmv model checker, PySMT library and MathSAT solver. Main developer of SMT-based optimizations and automated property extraction 2020 – 2021.
PPLite: A C++ library for the convex polyhedra abstract domain (github) 2017 – 2020.
PHAVerLite A C++ hybrid systems verifier (web page). Contributor 2018 – 2019.

Languages

Italian: Mother tongue
English: First Certificate in English (FCE) - B2