Jan Onderka

onderjan@onderjan.net | onderjan.net

jan-onderka | onderjan

Prague, Czech Republic

Research Interest

I am interested in formal verification of electronic systems for increased safety, security, and reliability. I specialise in machine-code verification, which I believe to be under-researched with regards to its its potential for improving the security, safety, and reliability of critical systems. This can be done by verifying properties such as avoidance of stack overflow and illegal memory access or ensuring the correct use of peripherals.
I have researched and published novel techniques that enable feasible verification of machine-code systems and integrated them in my formal verification tool **machine-check**. I intend to continue the research, incorporating techniques from source-code and hardware verification, so that bugs in critical systems can be detected and avoided.

Education

- **Doctor (Informatics)** *2020 – 2025*
  Czech Technical University in Prague, Faculty of Information Technology
  - Thesis: Abstraction-Based Machine-Code Program Verification
- **Bachelor (Electrical Engineering)** *2019 – 2022*
  Czech Technical University in Prague, Faculty of Electrical Engineering
  - Thesis: Analog Modular Music Synthesizer with Digital Control
  - With honours
- **Master (Informatics)** *2018 – 2020*
  Czech Technical University in Prague, Faculty of Information Technology
  - Thesis: Deadline Verification Using Model Checking
  - With honours
- **Bachelor (Informatics)** *2015 – 2018*
  Czech Technical University in Prague, Faculty of Information Technology
  - Thesis: Pitch Shifting of Audio Signals in Real Time Using STFT on a Digital Signal Processor

Experience

- **Researcher** *2024 –*
  Czech Academy of Sciences, Institute of Computer Science
  - Formal verification research
- **Instructor** *2019 – 2021*
  Czech Technical University in Prague, Faculty of Information Technology
  - Digital and Analog Systems (bachelor course)
  - Computer Structures and Architectures (bachelor course)
  - Combinatorial Optimization (master course)
- **Java Developer** *2012 – 2019*
  TriInfo Solutions s.r.o.
  - Mainly Private Branch Exchange (PBX) Java backend development
  - Some C and C++ embedded system development

Projects

- **machine-check (Creator)** *2024*
  Formal verification tool for digital systems, especially machine-code systems (written in Rust) [GitHub]
  - Publicly available, open-source, MIT / Apache 2.0 licence
- **CPAchecker (Developer)** *2023*
  Formal verification tool for source-code systems [GitHub]
  - Participated in development during a month-long study stay at LMU Munich
  - Implemented the support for C functions `memset`, `memcpy`, and `memmove`
  - Improved the support of quantifiers

Publications

[C.1] J. Onderka. **Formal Verification of Machine-Code Systems by Translation of Simulable Descriptions**. *Proceedings of the 13th Mediterranean Conference on Embedded Computing (MECO 2024)*, Institute of Electrical and Electronic Engineers, Budva, Montenegro, 2024. DOI: 10.1109/MECO62516.2024.10577942.

[C.2] J. Onderka, S. Ratschan. **Fast Three-Valued Abstract Bit-Vector Arithmetic**. *Proceedings of the 23rd International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI 2022)*, pp. 242-262, 2022. Springer Nature Switzerland, Cham, 2022. ISBN: 978-3-030-94583-1. DOI: 10.1007/978-3-030-94583-1_12.

Preprints

[X.1] J. Onderka, S. Ratschan. **Input-based Three-valued Abstraction Refinement** (preprint). arXiv:2408.12668 [cs.LO]. https://arxiv.org/abs/2408.12668.

Skills

- **Programming Languages:** Rust, C, C++, Java, JavaScript
- **Hardware Description Languages:** VHDL, Verilog (a bit)
- **Web Technologies:** HTTP, HTML, CSS, WebSockets, WebRTC
- **Embedded Systems:** PIC, AVR, ARM (Cortex-M), ESP32, RISC-V, AD Blackfin, TI C6000
- **Database Systems:** SQL, Lotus Notes
- **Version Control:** Git, SVN
- **Mathematical & Statistical Tools:** Matlab, Mathematica
- **Voice Over IP (VoIP):** SIP, SDP, RTP, RTCP, Asterisk

Awards

- **The Best Paper in Software and Algorithms** *2024*
  The 13th Mediterranean Conference on Embedded Computing (MECO 2024) [🌐]
  ◦ For the paper "Formal Verification of Machine-Code Systems by Translation of Simulable Descriptions"

Additional Information

Languages: Czech (native), English (fluent), German (basic)
Interests: Playing guitar & bass guitar, hobby electronics (especially audio signal processing using embedded systems)