Vadim Zaliva

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OBJECTIVE

I am interested in the Associate/Assistant Professor position at R1 research university. With 30 years of industry experience and academic research focus on formal methods and programming languages, particularly their practical application, I bring a unique blend of computer science and engineering expertise. I am eager to join a dynamic department where I can contribute to the university's mission through research, teaching, and mentoring. I am committed to promoting diversity, equity, and inclusion.

EDUCATION

Carnegie Mellon University, Pittsburgh, PA, USA

Ph.D. in Electrical and Computer Engineering, 2020
Advisor: Dr. Franz Franchetti
Thesis: *"HELIX: From Math to Verified Code"*

Colorado State Univeristy, Fort Collins, CO, USA

MS in Computer Science, 2009
Advisor: Dr. Indrajit Ray
Thesis: *"Applying Static Code Analysis for Anomaly Detection in Firewall Policies"*

Ukraine State Academy of Light Industry, Kyiv, Ukraine. BE (equiv.) in Computer Aided Design Systems, 1995.

College of Radio Electronics, Kyiv, Ukraine. AE (equiv.) in Digital Computers and Peripherals, 1991. *magna cum laude*.

RESEARCH EXPERIENCE

University of Cambridge, Senior Research Associate   *2021-present*

Formal Semantics of CHERI C
As a member of the Rigorous Engineering of Mainstream Systems group, I worked on the semantics of CHERI C, a dialect of the C programming language designed to take advantage of memory protections provided by Capability Hardware Enhanced RISC Instructions (CHERI). I explored semantic differences between CHERI C and ISO C and published rigorously defined CHERI C semantics in standard prose as well as mechanised executable formal semantics.

Formal Proof of Temporal Safety of CHERI C memory model
I formalised the CHERI C memory model in the Coq proof assistant and formally proved security properties related to temporal safety.

Carnegie Mellon University, Ph.D. researcher   *2012-2020*

Project HELIX
As a principal researcher on the HELIX project, I was responsible for developing a formally verified high-performance code synthesis system. I worked mostly independently, setting my own goals and creating my research roadmap. However, I did collaborate with other research groups, such as SPIRAL at CMU and Vellvm at UPenn. As a result, I was able to build a sophisticated system with 45 thousand lines of Coq code, utilizing various languages, translation and validation approaches. Furthermore, I developed a certified DSL compiler that targets LLVM IR. During my work on this project I was also actively involved in the Coq community, participating in discussions and contributing patches and bug reports.

Barometric Sensor Fusion Project
I developed a sensor-fusion approach for reliable vehicle altitude estimation as part of a larger high-assurance vehicle control project. I created Android software for data collection and designed experiments to validate the approach. Through these experiments, I proved the approach's efficacy in providing more accurate altitude measurements.

Passive User Identification on Mobile Devices Project
In this work, I proposed and implemented an innovative approach for user identification on mobile devices that leveraged advanced touchscreen capabilities. I developed software to demonstrate this approach, which included a modified Android kernel and an application. To validate the approach's effectiveness, I designed and conducted a study on human subjects, obtaining approval from the Institutional Review Board (IRB). The study provided valuable insights into the feasibility and accuracy of using touchscreen capabilities for user identification on mobile devices.

Digamma.ai, CEO

<div align="right">2016-present</div>

High Assurance System Management Module
I initiated, planned, and launched a project to formally verify the Coreboot System Management Module (SMI Handler) for the Gemini Lake chipset. To assess the market viability of the project, I evaluated it by pitching the concept to several industry partners. As the leader of a team of three proof engineers, I guided them through a successful proof of concept, which validated the chosen verification approach. The project demonstrated the potential of formal verification in ensuring the reliability and security of firmware.

Formally Verified ASN.1 Protocol Stack
I initiated, planned, and launched a project to formally verify a production-level network protocol (ASN.1) implementation. To support this effort, I identified and evaluated tools such as Coq, VST, and CompCert, and negotiated the terms of their commercial use. I also wrote and submitted two SBIR funding proposals to the National Science Foundation. I assembled a team of engineers and provided training and mentorship in program semantics and proof assistants. After evaluating several approaches, I identified the most feasible ones and completed a successful proof of concept, demonstrating end-to-end verification of a protocol subset.

Land Cover Classification
I proposed and launched a joint project between the U.S. Geological Survey (USGS) and Digamma.ai. I successfully applied for and obtained funding from the AI for Earth Innovation Grant from the National Geographic Society and Microsoft to support this project. This project uses large-scale machine learning to identify landslides from satellite imagery to improve our understanding of this important natural phenomenon and its impact on communities and the environment.

New Renaissance Institute, Consultant

<div align="right">2014-2016</div>

High Dimensional Touch Pad Project
I devised an innovative combination of Machine Learning and Signal Processing approaches for 3D hand posture detection and gesture recognition. I also co-developed new notions of previous gesture grammar constructions and explored the linguistic aspects of gesture recognition. In addition, I participated in the hardware design for custom sensors and designed and developed demo applications for software manipulation and robotic arm control.

Computational Optics Technologies
I was responsible for implementing a closed-form solution for constructing an orthogonal set of eigenvectors for a DFT matrix. I also confirmed and corrected errors in a previously published eigenvector construction, developed improved notation, characterized the numerical complexity, and implemented the solution as a Mathematica module.

PUBLICATIONS

[1]   **V. Zaliva**, Y. Zakowski, I. Zaichuk, V. Huhnin, C. Beck, I. Yoon, and S. Zdancewic. "HELIX: Verified Compilation of Cyber-Physical Control Systems to LLVM IR". In: *TOPLAS* (2024). submitted.

[2]   **V. Zaliva**, K. Memarian, R. Almeida, J. Clarke, B. Davis, A. Richardson, D. Chisnall, B. Campbell, I. Stark, R. N. M. Watson, and P. Sewell. "Formal Mechanised Semantics of CHERI C: Capabilities, Undefined Behaviour, and Provenance". In: ASPLOS '24. Association for Computing Machinery, 2024, pp. 181–196. ISBN: 9798400703720. DOI: 10.1145/3617232.3624859.

[3]   Y. Zakowski, C. Beck, I. Yoon, I. Zaichuk, **V. Zaliva**, and S. Zdancewic. "Modular, Compositional, and Executable Formal Semantics for LLVM IR". In: *Proc. ACM Program. Lang.* 5.ICFP (Aug. 2021). DOI: 10.1145/3473572.

[4]   **V. Zaliva**. "HELIX: From Math to Verified Code". PhD thesis. Carnegie Mellon University, 2020.

[5]   **V. Zaliva**, I. Zaichuk, and F. Franchetti. "Verified Translation Between Purely Functional and Imperative Domain Specific Languages in HELIX". In: *Software Verification*. Springer International Publishing, 2020, pp. 33–49. ISBN: 978-3-030-63618-0.

[6]   N. Pona and **V. Zaliva**. "Formally-Verified ASN.1 Protocol C-language Stack". In: *2020 IEEE Security and Privacy Workshops (SPW)*. IEEE. 2020, pp. 308–317.

[7]   H. Petliak, C. Cerovski-Darriau, **V. Zaliva**, and J. Stock. "Where's the Rock: Using Convolutional Neural Networks to Improve Land Cover Classification". In: *Remote Sensing* 11.19 (2019). ISSN: 2072-4292. DOI: 10.3390/rs11192211. URL: https://www.mdpi.com/2072-4292/11/19/2211.

[8]   **V. Zaliva** and M. Sozeau. "Reification of shallow-embedded DSLs in Coq with automated verification". In: *International Workshop on Coq for Programming Languages (CoqPL)*. 2019.

[9]   **V. Zaliva** and F. Franchetti. "HELIX: A Case Study of a Formal Verification of High Performance Program Generation". In: FHPC 2018. St. Louis, MO, USA: Association for Computing Machinery, 2018, pp. 1–9. ISBN: 9781450358132. DOI: 10.1145/3264738.3264739.

[10] **V. Zaliva** and F. Franchetti. "Formal Verification of HCOL Rewriting". In: *International Conference on Formal Methods in Computer-Aided Design*. *Graduate Student Forum*. 2015.

[11] **V. Zaliva**, W. Melicher, S. Saha, and J. Zhang. "Passive user identification using sequential analysis of proximity information in touchscreen usage patterns". In: *Eighth International Conference on Mobile Computing and Ubiquitous Networking (ICMU)*. IEEE. 2015, pp. 161–166. DOI: 10.1109/ICMU.2015.7061060.

[12] **V. Zaliva** and F. Franchetti. "Barometric and GPS altitude sensor fusion". In: *2014 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. 2014, pp. 7525–7529. DOI: 10.1109/ICASSP.2014.6855063.

[13] **V. Zaliva** and V. Orlov. "Hamake: A Data Flow Approach to Data Processing in Hadoop". In: *The 2nd International Conference on Cloud Computing and Services Science (CLOSER)*. 2012, pp. 457–461.

[14] **V. Zaliva**. "3D finger posture detection and gesture recognition on touch surfaces". In: *2012 12th International Conference on Control Automation Robotics & Vision (ICARCV)*. 2012, pp. 359–364. DOI: 10.1109/ICARCV.2012.6485185.

[15] **V. Zaliva**. "Constructing an orthonormal set of eigenvectors for DFT matrix using Gramians and determinants". In: *arXiv preprint arXiv:1712.06959* (2017).

[16] **V. Zaliva**. "Development of simple motion detection algorithm using Mathematica". In: *Practice of Functional Programming* (2011).

[17] **V. Zaliva**. *Applying Static Code Analysis for Anomaly Detection in Firewall Policies*. MS thesis. 2009.

[18] **V. Zaliva**. "Distributed Compilation". In: *Dr. Dobb's Journal: Software Tools for the Professional Programmer* 29.11 (2004), pp. 62–65.

[19] **V. Zaliva**. "Managing XML Documents Versions and Upgrades with XSLT". In: *IBM Developer Channel* (2003).

[20] **V. Zaliva**. "Introduction to Unix operating system". In: *IndexPro* (1995).

TEACHING

- *Optimising Compilers*, Supervisor, University of Cambridge, Lent 2023
- *Compiler Construction*, Supervisor, University of Cambridge, Lent 2022
- *Engineering Safe Software Systems*, Teaching Assistant, Carnegie Mellon University, Fall 2019
- *Formal Verification of Computer Programs*, Two guest lectures for Special Topics in Computer Systems class at CMU, 2019
- *Advanced Machine Learning*, Teaching Assistant, Carnegie Mellon University, Spring 2016
- *Advanced Machine Learning*, Teaching Assistant, Carnegie Mellon University, Spring 2014

SERVICE

- POPL 2025, *Artifact Evaluation Co-Chair*
- CPP 2024, *PC member*
- ICFP 2022, 2023, *Accessibility co-chair*
- IARA Cloud Computing 2014, *PC member*
- IEEE CloudCom, 2011–2013 *PC member*
- MAPRED, 2010, *PC member*

TALKS

- *Formal Mechanised Semantics of CHERI C*, NASA Intelligent Systems Division, 2024
- *Formal verification of ASN.1 and Coreboot SMI*, New England Systems Verification Day at MIT, 2022
- *HELIX: From Math to Verified Code*, Languages, Systems, and Data Seminar at UC Santa Cruz, 2021
- *HELIX: A Case Study of a Formal Verification of High Performance Program Generation*, Google X, 2018
- *High-Assurance SPIRAL*, Functional programming seminar at Kyiv Institute of Mathematics, 2017
- *Proving HCOL*, CMU ECE Ph.D. seminar, 2014

ISSUED PATENTS

1. *"Curve-fitting approach to touch gesture finger pitch parameter extraction."*, US Patent 10,664,156, 2020
2. *"Gesteme (gesture primitive) recognition for advanced touch user interfaces"*, US Patent 10,430,066, 2019
3. *"Heterogeneous tactile sensing via multiple sensor types using spatial information processing acting on initial image processed data from each sensor"*, US Patent 10,429,997, 2019
4. *Curve-fitting approach to high definition touch pad (HDTP) parameter extraction*, US Patent 10,146,427, 2018

5. *"Heterogeneous tactile sensing via multiple sensor types using spatial information processing"*, US Patent 10,042,479, 2018
6. *"Heterogeneous tactile sensing via multiple sensor types"*, US Patent 9,823,781, 2018
7. *"Human user interfaces utilizing interruption of the execution of a first recognized gesture with the execution of a recognized second gesture"*, US Patent 8,797,288, 2014
8. *"Sequential classification recognition of gesture primitives and window-based parameter smoothing for high dimensional touchpad (HDTP) user interfaces"*, US Patent 8,754,862, 2014
9. *"List Entry Selection for Electronic Devices."*, US Patent 7,996,781, 2011

Summer schools

- *Oregon Programming Language Summer School (OPLSS)*, Eugene, OR, USA, 2015
- *Proof and Computation Autumn School*, Fischbachau, Germany, 2016

Industry Experience

I have built a career in tech, starting as a Software Engineer and later progressing to roles such as Architect and CTO. I have delivered numerous innovative software projects, co-founded Silicon Valley startups, and, for the last two decades, have led a successful software development company with 100 employees as CEO. My current responsibilities focus on strategic planning, financial oversight, and corporate governance.

- *Digamma.ai*, Saratoga, CA, USA, Founder, CEO, 2016-present
- *Tristero Consulting*, Saratoga, CA, USA, Founder, CEO, 2005-present
- *Hexlet LLC*, Fremont, CA, USA, Chief Technology Officer, 2004-2007
- *Avistar Corp*, Redwood, CA, USA, Chief System Architect, 2003-2004
- *SetNet Corp*, Redwood, CA, USA, Chief Architect, 2001-2003
- *MATRAnet Inc.*, Redwood Shores, CA, USA, Chief Architect, 1997-2001
- *Visualtek Solutions Inc.*, Fremont, CA, USA, Chief Architect, 1995-1997
- *Topaz-Inform Ltd.*, Kyiv, Ukraine, Architect, Project manager, 1994-1995
- *Sapphire Ltd.*, Kyiv, Ukraine, Project Leader, Senior Software Engineer, 1993-1994
- *Studio Techniques Ltd.*, Kyiv, Ukraine, Software Engineer, 1991-1992
- *Research Institute of Urban Planning and Theory of Architecture.*, Kyiv, Ukraine, Software Engineer, 1990-1991

Summary of Qualifications

Programming Languages	:	C, C++, Java, Python, Perl, PHP, LUA, Prolog, Datalog, Haskell, OCaml, BASIC, Fortran, Common Lisp, Scheme, Forth, LLVM IR, Assembly language (8008, 8080, 80x86, Z80, 6502, 68000, MIPS, Arm, RISC-V), SQL.
Operating Systems	:	Familiarity with various flavours of Unix operating system (Linux, FreeBSD, Darwin) including setup, configuration, package management, system and network administration.
Dev Tools	:	Build tools (make, cmake, dune), Version Control (git, mercurial, darcs, subversion), Docker, IDEs (Emacs, Eclipse, Visual Studio Code), etc. Led full-cycle production software design and development for large-scale mission-critical industrial systems.
Cloud Services	:	GitHub, GitLab, BitBucket, Travis, Jira, Amazon Web Services, Google Cloud, iTunes Connect, Google Developers Console.
Algebra Systems	:	Wolfram Mathematica, R, GAP.
Proof Assistants	:	Coq, Isabelle

Personal Info

Citizenship	:	United States
Languages:	:	English, Ukrainian, Russian