Viktor Kuncak

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Education

2001-2007	**Massachusetts Institute of Technology**	**Cambridge, MA, USA**
	Ph.D. in Computer Science (degree date February 2007), GPA 5.0/5.0	
	Thesis: Modular Data Structure Verification	Advisor: Prof. Martin Rinard
2000-2001	**Massachusetts Institute of Technology**	**Cambridge, MA, USA**
	M.Sc. in Computer Science, Minor in Physics, September 2001, GPA 5.0/5.0	
	Thesis: Designing an Algorithm for Role Analysis	Advisor: Prof. Martin Rinard
1996-2000	**University of Novi Sad**	**Novi Sad, Serbia**
	B.Sc. in Computer Science, GPA 10.0/10.0, Best Student of the University Award	
	Thesis: Modular Interpreters in Haskell	Advisor: Prof. Mirjana Ivanović

Research Interests

Programming Languages, Software Engineering, Formal Methods

Selected Publications

- **Modular pluggable analyses for data structure consistency**.
  Viktor Kuncak, Patrick Lam, Karen Zee, and Martin Rinard.
  IEEE Transactions on Software Engineering, December 2006.

- **Deciding Boolean Algebra with Presburger Arithmetic**.
  Viktor Kuncak, Hai Huu Nguyen, and Martin Rinard.
  Journal of Automated Reasoning, 2006.

- **Relational analysis of algebraic datatypes**.
  Viktor Kuncak and Daniel Jackson.
  In *Joint 10th European Software Engineering Conference and 13th ACM SIGSOFT Symposium on the Foundations of Software Engineering*, 2005.

- **Structural subtyping of non-recursive types is decidable**.
  Viktor Kuncak and Martin Rinard.
  In *Eighteenth Annual IEEE Symposium on Logic in Computer Science*, 2003.

- **Role analysis**.
  Viktor Kuncak, Patrick Lam, and Martin Rinard.
  In *Proceedings of the 29th Annual ACM Symposium on Principles of Programming Languages*, 2002.

Program committees ACM Conf. Programming Language Design and Implementation **(PLDI)** 2007, Heap Analysis and Verification **(HAV)** 2007, Int. Conf. on Logic for Programming, Artificial Intelligence and Reasoning **(LPAR)** 2006, CSAIL Student Workshop, **(CSW)** 2005

Refereed for ACM Conf. on Programming Language Design and Implementation, *PLDI* 2001, 2002, 2003, 2004; ACM Symposium on the Principles of Programming Languages, *POPL* 2001, 2005, 2006; Static Analysis Symposium, *SAS* 2004; Verification, Model Checking and Abstract Interpretation, *VMCAI* 2006; ACM Conf. on Object-Oriented Programming, Systems, Languages, and Applications, *OOPSLA* 2002; ACM Transactions on Software Engineering and Methodology, *TOSEM*;

IEEE Transactions on Software Engineering, *TSE*; IEEE Symposium on Logic in Computer Science, *LICS* 2004; ACM Transactions on Computational Logic, *TOCL*; Conf. on Automated Deduction, *CADE-20*; ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing, *PODC* 2004; Int. Conf. on Tools and Algorithms for the Construction and Analysis of Systems, *TACAS* 2004; Foundations of Software Technology and Theoretical Computer Science, *FSTTCS* 2002, 2003; *IFIP* World Computer Congress 2004; Aliasing, Confinement and Ownership in Object-Oriented Programming, *IWACO* 2003.

Publication List

- 20 conference papers (in e.g. **POPL, SAS, FSE, LICS, CADE, VMCAI, FOSSACS, ICFEM, AOSD, CC, VSTTE**): [1, 2, 8, 10, 11, 13, 16, 18, 27, 28, 31, 34, 37, 38, 42, 48, 49, 53, 54, 51]
- 3 journal papers (1 under review): [4, 6, 47]
- 7 workshop papers: [7, 17, 21, 23, 39, 45, 50]
- 19 technical reports: [3, 5, 9, 12, 14, 25, 26, 29, 22, 24, 30, 32, 33, 35, 36, 40, 41, 44, 46]
- 7 other: [15, 19, 20, 43, 52, 55, 56]

[1] **Polynomial constraints for sets with cardinality bounds**.
Bruno Marnette, Viktor Kuncak, and Martin Rinard.
In *Foundations of Software Science and Computation Structures (FOSSACS)*, March 2007.

[2] **Using first-order theorem provers in the jahob data structure verification system**.
Charles Bouillaguet, Viktor Kuncak, Thomas Wies, Karen Zee, and Martin Rinard.
In *Verification, Model Checking and Abstract Interpretation*, November 2007.

[3] On using first-order theorem provers in a the jahob data structure verification system.
Charles Bouillaguet, Viktor Kuncak, Thomas Wies, Karen Zee, and Martin Rinard.
Technical Report MIT-CSAIL-TR-2006-072, MIT, November 2006.

[4] **Modular pluggable analyses for data structure consistency**.
Viktor Kuncak, Patrick Lam, Karen Zee, and Martin Rinard.
IEEE Transactions on Software Engineering, December 2006.

[5] On verifying complex properties using symbolic shape analysis.
Thomas Wies, Viktor Kuncak, Karen Zee, Andreas Podelski, and Martin Rinard.
Technical Report MPI-I-2006-2-1, Max-Planck Institute for Computer Science, 2006.

[6] **Deciding Boolean Algebra with Presburger Arithmetic**.
Viktor Kuncak, Hai Huu Nguyen, and Martin Rinard.
Journal of Automated Reasoning, 2006.

[7] **An overview of the jahob analysis system: Project goals and current status**.
Viktor Kuncak and Martin Rinard.
In *NSF Next Generation Software Workshop*, 2006.

[8] **Field constraint analysis**.
Thomas Wies, Viktor Kuncak, Patrick Lam, Andreas Podelski, and Martin Rinard.
In *Proc. Int. Conf. Verification, Model Checking, and Abstract Interpratation*, 2006.

[9] On field constraint analysis.
Thomas Wies, Viktor Kuncak, Patrick Lam, Andreas Podelski, and Martin Rinard.
Technical Report MIT-CSAIL-TR-2005-072, MIT-LCS-TR-1010, MIT CSAIL, November 2005.

[10] **Implications of a data structure consistency checking system**.
Viktor Kuncak, Patrick Lam, Karen Zee, and Martin Rinard.
In *International conference on Verified Software: Theories, Tools, Experiments (VSTTE, IFIP Working Group 2.3 Conference)*, Zürich, Switzerland, 10–13th October 2005.

[11] **Relational analysis of algebraic datatypes**.
Viktor Kuncak and Daniel Jackson.
In *Joint 10th European Software Engineering Conference and 13th ACM SIGSOFT Symposium on the Foundations of Software Engineering*, 2005.

[12] On algorithms and complexity for sets with cardinality constraints.
Bruno Marnette, Viktor Kuncak, and Martin Rinard.
Technical report, MIT CSAIL, August 2005.

[13] **An algorithm for deciding BAPA: Boolean Algebra with Presburger Arithmetic**.
Viktor Kuncak, Hai Huu Nguyen, and Martin Rinard.
In *20th International Conference on Automated Deduction, CADE-20*, Tallinn, Estonia, July 2005.

[14] On relational analysis of algebraic datatypes.
Viktor Kuncak and Daniel Jackson.
Technical Report 985, MIT, April 2005.

[15] **Hob: A tool for verifying data structure consistency**.
Patrick Lam, Viktor Kuncak, and Martin Rinard.
In *14th International Conference on Compiler Construction (tool demo)*, April 2005.

[16] **Cross-cutting techniques in program specification and analysis**.
Patrick Lam, Viktor Kuncak, and Martin Rinard.
In *4th International Conference on Aspect-Oriented Software Development*, March 2005.

[17] **Decision procedures for set-valued fields**.
Viktor Kuncak and Martin Rinard.
In *Workshop on Abstract Interpretation of Object-Oriented Languages*, 2005.

[18] **Generalized typestate checking for data structure consistency**.
Patrick Lam, Viktor Kuncak, and Martin Rinard.
In *Verification, Model Checking and Abstract Interpretation*, 2005.

[19] File refinement.
Karen Zee and Viktor Kuncak.
The Archive of Formal Proofs, December 2004, Formal proof development.

[20] Binary search trees.
Viktor Kuncak.
The Archive of Formal Proofs, April 2004, Formal proof development.

[21] **Modular pluggable analyses for data structure consistency**.
Viktor Kuncak, Patrick Lam, Karen Zee, and Martin Rinard.
In *Monterey Workshop on Software Engineering Tools: Compatibility and Integration*, Vienna, Austria, October 2004.

[22] On decision procedures for set-valued fields.
Viktor Kuncak and Martin Rinard.
Technical Report 975, MIT CSAIL, November 2004.

[23] **Combining theorem proving with static analysis for data structure consistency**.
Karen Zee, Patrick Lam, Viktor Kuncak, and Martin Rinard.
In *International Workshop on Software Verification and Validation*, Seattle, November 2004.

[24] On spatial conjunction as second-order logic.
Viktor Kuncak and Martin Rinard.
Technical Report 970, MIT CSAIL, October 2004.

[25] On our experience with modular pluggable analyses.
Patrick Lam, Viktor Kuncak, and Martin Rinard.
Technical Report 965, MIT CSAIL, September 2004.

[26] The first-order theory of sets with cardinality constraints is decidable.
Viktor Kuncak and Martin Rinard.
Technical Report 958, MIT CSAIL, July 2004.

[27] **Verifying a file system implementation**.
Konstantine Arkoudas, Karen Zee, Viktor Kuncak, and Martin Rinard.
In *Sixth International Conference on Formal Engineering Methods*, Seattle, Nov 8-12, 2004 2004.

[28] **Generalized records and spatial conjunction in role logic**.

Viktor Kuncak and Martin Rinard.
In *International Static Analysis Symposium*, Verona, Italy, August 26–28 2004.

[29] On generalized records and spatial conjunction in role logic.
Viktor Kuncak and Martin Rinard.
Technical Report 942, MIT CSAIL, April 2004.

[30] On verifying a file system implementation.
Konstantine Arkoudas, Karen Zee, Viktor Kuncak, and Martin Rinard.
Technical Report 946, MIT CSAIL, May 2004.

[31] **Boolean algebra of shape analysis constraints**.
Viktor Kuncak and Martin Rinard.
In *Verification, Model Checking and Abstract Interpretation*, 2004.

[32] On computing the fixpoint of a set of boolean equations.
Viktor Kuncak and K. Rustan M. Leino.
Technical Report MSR-TR-2003-08, Microsoft Research, December 2003.

[33] On modular pluggable analyses using set interfaces.
Patrick Lam, Viktor Kuncak, and Martin Rinard.
Technical Report 933, MIT CSAIL, December 2003.

[34] **Generalized typestate checking using set interfaces and pluggable analyses**.
Patrick Lam, Viktor Kuncak, and Martin Rinard.
SIGPLAN Notices, March 2004.

[35] On role logic.
Viktor Kuncak and Martin Rinard.
Technical Report 925, MIT CSAIL, 2003.

[36] On the boolean algebra of shape analysis constraints.
Viktor Kuncak and Martin Rinard.
Technical report, MIT CSAIL, August 2003.

[37] **Structural subtyping of non-recursive types is decidable**.
Viktor Kuncak and Martin Rinard.
In *Eighteenth Annual IEEE Symposium on Logic in Computer Science*, 2003.

[38] **Existential heap abstraction entailment is undecidable**.
Viktor Kuncak and Martin Rinard.
In *10th Annual International Static Analysis Symposium*, San Diego, California, June 11-13 2003.

[39] **In-place refinement for effect checking**.
Viktor Kuncak and Rustan Leino.
In *Workshop on Automated Verification of Infinite-State Systems*, April 2003.

[40] On the theory of structural subtyping.
Viktor Kuncak and Martin Rinard.
Technical Report 879, MIT LCS, 2003.

[41] Typestate checking and regular graph constraints.
Viktor Kuncak and Martin Rinard.
Technical Report 863, MIT LCS, 2002.

[42] **Role analysis**.
Viktor Kuncak, Patrick Lam, and Martin Rinard.
In *Proceedings of the 29th Annual ACM Symposium on Principles of Programming Languages*, 2002.

[43] Designing an algorithm for role analysis.
Viktor Kuncak.
Master's thesis, MIT LCS, 2001.

[44] Roles are really great!
Viktor Kuncak, Patrick Lam, and Martin Rinard.
Technical Report 822, MIT LCS, 2001.

[45] **A language for role specifications**.
Viktor Kuncak, Patrick Lam, and Martin Rinard.
In *Workshop on Languages and Compilers for Parallel Computing*, volume 2624 of *Lecture Notes in Computer Science, Springer*, 2001.

[46] Object models, heaps, and interpretations.
Viktor Kuncak and Martin Rinard.
Technical Report 816, MIT LCS, January 2001.

[47] **Numerical representations as purely functional data structures: A new approach**.
Mirjana Ivanović and Viktor Kuncak.
INFORMATICA, Institute of Mathematics and Informatics, Vilnius, 2002.

[48] **Types and confluence in lambda calculus**.
Silvia Ghilezan and Viktor Kuncak.
In *3rd Panhellenic Logic Symposium*, Anogia, Greece, 2001.

[49] **Confluence of untyped lambda calculus via simple types**.
Silvia Ghilezan and Viktor Kuncak.
In *Proceedings of the 7th Italian Conference on Theoretical Computer Science, ICTCS 2001*, number 2202 in Lecture Notes in Computer Science, Torino, Italy, October 2001.

[50] **Reducibility method for termination properties of typed lambda terms**.
Silvia Ghilezan, Viktor Kuncak, and Silvia Likavec.
In *Fifth International Workshop on Termination*, Utrecht, The Netherlands, May 2001.

[51] **Modular language specifications in haskell**.
Mirjana Ivanović and Viktor Kuncak.
In *Theoretical Aspects of Computer Science with practical application*, September 2000.

[52] Modular interpreters in Haskell.
Viktor Kuncak.
B.Sc. Thesis, University of Novi Sad, 8 June 2000, See [51] for paper.

[53] **Numerical representations as purely functional data structures**.
Mirjana Ivanović and Viktor Kuncak.
In *XIV Conference on Applied Mathematics "PRIM", Palić*, June 2000.

[54] **Reducibility method in simply typed lambda calculus**.
Silvia Ghilezan and Viktor Kuncak.
In *XIV Conference on Applied Mathematics "PRIM", Palić*, June 2000.

[55] **Developing a multigrid solver for standing wave equation**.
Janis Voigtländer and Viktor Kuncak.
In *Proceedings of the 28th Dr. Bessie F. Lawrence International Summer Science Institute Participants, Weizmann Institute of Science*, 1996.

[56] **PLS: Programming language for simulations**.
Viktor Kuncak.
In *Proceedings of the Petnica Science Center Seminar '93*. Science Center Petnica, Valjevo, Yugoslavia, 1993.

Presentations Presented 12 papers at conferences and workshops. Additionally gave talks about research results at IBM Research (December 2005), Dagstuhl Seminar on Deduction (October 2005), Max-Planck-Institute for Computer Science (October 2005, March 2003), University of Novi Sad (October 2005, January 2004), University of Illinois, Urbana-Champaign (March 2005), Ecole Normale Superieure de Cachan, Paris, France (January 2005), MIT Center for Reliable Software Workshop (May 2005), UC Berkeley Chess Workshop (February 2004), Stanford University (February 2004), Dagstuhl seminar Reasoning about Shape (March 2003), Microsoft Research (August 2002).

Research Experience

- 2000- Program Analysis and Verification. MIT Computer Science and AI Lab (previously Laboratory for Computer Science), Advisor: Prof. Martin Rinard.

- Developing Jahob system for verification of data structure consistency properties of Java programs by combining decision procedures, theorem proving, and static analysis. Developed and implemented an algorithm for combined theory of quantified Boolean algebras and Presburger arithmetic, developed field constraint analysis for extending the applicability of existing logics.
    - Developed Hob system (jointly with Patrick Lam), an imperative language and static data structure consistency verifier.
    - Designed a role system for specifying properties of dynamically allocated data structures and developed a compositional role analysis algorithm. Introduced regular graph constraints, boolean shape analysis constraints, and role logic as the foundation of role analysis and shape analysis algorithms. Introduced the notion of term powers for constructing new decidable structures from existing decidable structures, solving an open problem in structural subtyping.

- 2005- With Prof. Daniel Jackson exploring relational analysis of structures with infinite domains using finite model finders such as Alloy Analyzer.

- 12/2003- Ongoing collaboration with Thomas Wies and Prof. Andreas Podelski on a new approach to symbolic shape analysis. Visited Max-Planck Institute for Computer Science in March 2003 and October 2005.

- 2005. Explored automated analysis of cryptographic protocols (with E. Torlak, I. Sachdev, B. Gassend, I. Shlyakhter, M. van Dijk and Prof. Srini Devadas)

- 06/2002-09/2002. Research Summer Intern in Software Productivity Tools Group (Programmer Productivity Research Center, Microsoft Research). With Rustan Leino developed a two-stage checker for verifying that C# methods conform to *modifies clause* specifications. The architecture of the checker is similar to ESC/Java.

- 2000-2001. Developed an Alloy model of NASA's Direct-To air-traffic advisory tool (with D. Marinov, M. Vaziri, and M. Ghassemi)

- 1998-2000. Application of the simply typed lambda calculus for proving properties of terms in the untyped lambda calculus (with Prof. Silvia Ghilezan)

- 07/1996-08/1996. Weizmann Institute of Science, Rehovot. Implemented a standing-wave-equation solver using multigrid techniques (Advisors: Ira Livshits and Boris Diskin)

- Individual student projects in Petnica Science Center, Valjevo, Serbia: *Formal Systems with Applications* (08/1996), *TPL-2 Compiler-Compiler* (07/1995), *TPL: Transformation Programming Language* (08/1994), *PLS: Programming Language for Simulations* (08/1993) (Advisor: Dragan Mašulović).

Supervising, Teaching, Grant Proposals

- Throughout Ph.D. program informally supervised several undergraduate and graduate students on projects related to data structure verification, shape analysis, theorem proving, programming language design and implementation (including Mihai Pătraşcu, Cristian Cadar, Tudor Leu, Peter Schmitt)
- Helped write grant proposals and project reports (NSF, DARPA, MIT-France Seed Fund); presented research results at funding agency site visits
- Teaching assistant for MIT graduate course *Principles of Computer Systems*, Spring term 2002 (Lecturers: Prof. Butler Lampson and Prof. Martin Rinard). Prepared problem sets and solutions, graded and organized grading of problem sets and final projects, held office hours, gave one lecture (*Concurrent Transactions*).
- Led recitations in an MIT undergraduate course *Computer System Engineering*, March 2003.
- Helped organize ACM-style programming contents for students participating in Singapore-MIT Alliance, August 2001.
- A lecture on Automata, Formal Grammars and Compilers at the Science Center Petnica, July 1995.

Awards and Fellowships

- Best Student of University of Novi Sad in Class of 2000.
- Aleksandar Popović Award for Best Science Project (*Modular Interpreters in Haskell*, Advisor: Prof. Mirjana Ivanović), University of Novi Sad, 2000.
- Student of the Year of Faculty of Science, University of Novi Sad, 2000.
- Mileva Marić-Einstein Award for accomplishments in Computer Science, University of Novi Sad, 1999
- Award of Excellence for Student Project (*Early Deadlock Prevention*, Advisor: Prof. Zoran Budimac), University of Novi Sad, 1999; (*Herbrand's Theorem and the Resolution Method*, Advisor: Prof. Gradimir Vojvodic), University of Novi Sad, 1998

- Fellowship from the Republic of Serbia Foundation for Scientific Youth Development, 1995-1998
- University of Novi Sad Fellowship, 1998-2000
- High school contest highlights: Honorable Mention, 27th Int. Physics Olympiad, Oslo, Norway, 1996; First prizes on National Physics Competition of Yugoslavia, 1992, 1994 and 1996; Second prize National Computer Science Competition of Yugoslavia, 1995.

Languages Spoken English, Serbian, Slovak, basic German

Citizen of Serbia

References available on request