

# Cătălin Hrițcu

## Curriculum Vitae

### Contact

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### Research Interests

My research is primarily focused on *developing rigorous formal techniques for solving security problems*. I am particularly interested in:

- formal methods for computer and network security: security protocols, privacy, anonymity, zero-knowledge, information flow control, access control, integrity protection
- programming-languages techniques: rigorous semantics, type systems, verification, automatic testing, formal metatheory, formally certified tools
- design and verification of security-critical systems: reference monitors, microkernel components, electronic voting systems, crypto devices, security-preserving compilers, mobile devices, etc.

### Positions

- 10/2013–now      Researcher (chargé de recherche) at INRIA Paris-Rocquencourt in the Prosecco team
- 05/2011–09/2013   Research Associate at University of Pennsylvania; DARPA CRASH/SAFE project; Supervisor: Benjamin C. Pierce

### Education

- 06/2007–01/2012   Ph.D. in Computer Science from Saarland University, Saarbrücken, Germany, Summa cum Laude, Advisors: Michael Backes, Matteo Maffei, and Andrew D. Gordon
- 10/2005–05/2007   M.Sc. in Computer Science from Saarland University, Saarbrücken, Germany, Honors degree, Thesis advisors: Gert Smolka and Jan Schwinghammer
- 09/2001–06/2005   Licentiate (4 years undergrad degree) in Computer Science from “Alexandru Ioan Cuza” University, Iași, Romania, Honors degree

### Awards

- 02/2008      Günter Hotz Medal for outstanding CS graduates, Saarland University

### Fellowships and Scholarships

- 06/2008–04/2011   Ph.D. fellowship from Microsoft Research Cambridge (UK) and the IMPRS-CS
- 10/2005–05/2008   M.Sc. and then Ph.D. fellowship from the International Max Planck Research School for Computer Science (IMPRS-CS)
- 04/2004–09/2004   Socrates-ERASMUS scholarship at Technical University Braunschweig

### Internships

- 09/2009–11/2009   Microsoft Research Cambridge (UK), Semantic Subtyping with an SMT Solver
- 2005, 2006, 2007   Google Summer of Code participant with XWiki.org

## Publications

### Drafts

- [1] Arthur Azevedo de Amorim, Maxime Dénès, Nick Giannarakis, Cătălin Hrițcu, Benjamin C. Pierce, Antal Spector-Zabusky, and Andrew Tolmach. Micro-policies: A framework for verified, tag-based security monitors. Under Review, November 2014.
- [2] Cătălin Hrițcu, Leonidas Lampropoulos, Antal Spector-Zabusky, Arthur Azevedo de Amorim, Maxime Dénès, John Hughes, Benjamin C. Pierce, and Dimitrios Vytiniotis. Testing noninterference, quickly. arXiv:1409.0393; Submitted to Special Issue of Journal of Functional Programming for ICFP 2013, September 2014.

### Journals

- [3] Michael Backes, Cătălin Hrițcu, and Matteo Maffei. Union, intersection, and refinement types and reasoning about type disjointness for secure protocol implementations. *Journal of Computer Security (JCS); Special Issue on Foundational Aspects of Security*, 22(2):301–353, February 2014.
- [4] Gavin M. Bierman, Andrew D. Gordon, Cătălin Hrițcu, and David Langworthy. Semantic subtyping with an SMT solver. *Journal of Functional Programming (JFP)*, 22(1):31–105, March 2012.
- [5] Cătălin Hrițcu and Jan Schwinghammer. A step-indexed semantics of imperative objects. *Logical Methods in Computer Science (LMCS)*, 5(4:2):1–48, December 2009.

### Book

- [6] Benjamin C. Pierce, Chris Casinghino, Marco Gaboardi, Michael Greenberg, Cătălin Hrițcu, Vilhelm Sjöberg, and Brent Yorgey. *Software Foundations*. Electronic textbook, 2013.

### Conferences

- [7] Udit Dhawan, Cătălin Hrițcu, Rafi Rubin, Nikos Vasilakis, Silviu Chiricescu, Jonathan M. Smith, Thomas F. Knight, Jr., Benjamin C. Pierce, and André DeHon. Architectural support for software-defined metadata processing. To appear in ASPLOS, 2015.
- [8] Arthur Azevedo de Amorim, Nathan Collins, André DeHon, Delphine Demange, Cătălin Hrițcu, David Pichardie, Benjamin C. Pierce, Randy Pollack, and Andrew Tolmach. A verified information-flow architecture. In *41st ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL)*, pages 165–178. ACM, January 2014. (Acceptance rate: 51/220=0.23).
- [9] Cătălin Hrițcu, John Hughes, Benjamin C. Pierce, Antal Spector-Zabusky, Dimitrios Vytiniotis, Arthur Azevedo de Amorim, and Leonidas Lampropoulos. Testing noninterference, quickly. In *18th ACM SIGPLAN International Conference on Functional Programming (ICFP)*, pages 455–468. ACM, 2013. (Acceptance rate: 40/133=0.30).
- [10] Cătălin Hrițcu, Michael Greenberg, Ben Karel, Benjamin C. Pierce, and Greg Morrisett. All your IFCEException are belong to us. In *34th IEEE Symposium on Security and Privacy (Oakland 2013)*, pages 3–17. IEEE Computer Society Press, May 2013. (Acceptance rate: 38/315=0.12).
- [11] Michael Backes, Alex Busenius, and Cătălin Hrițcu. On the development and formalization of an extensible code generator for real life security protocols. In *4th NASA Formal Methods Symposium (NFM 2012)*, pages 371–387. Springer, April 2012. (Acceptance rate: 36/93=0.39).
- [12] Michael Backes, Cătălin Hrițcu, and Thorsten Tarrach. Automatically verifying typing constraints for a data processing language. In *First International Conference on Certified Programs and Proofs (CPP 2011)*, pages 296–313. Springer, December 2011. (Acceptance rate: 24/49=0.49).

- [13] Michael Backes, Cătălin Hrițcu, and Matteo Maffei. Union and intersection types for secure protocol implementations. In *Theory of Security and Applications (TOSCA 2011; part of ETAPS and the precursor of POST)*, pages 1–28. Springer, March 2011. Invited paper.
- [14] Gavin M. Bierman, Andrew D. Gordon, Cătălin Hrițcu, and David Langworthy. Semantic subtyping with an SMT solver. In *15th ACM SIGPLAN International Conference on Functional programming (ICFP 2010)*, pages 105–116. ACM Press, September 2010. (Acceptance rate: 30/99=0.30).
- [15] Michael Backes, Martin P. Grochulla, Cătălin Hrițcu, and Matteo Maffei. Achieving security despite compromise using zero-knowledge. In *22th IEEE Symposium on Computer Security Foundations (CSF 2009)*, pages 308–323. IEEE Computer Society Press, July 2009. (Acceptance rate: 22/93=0.24).
- [16] Michael Backes, Cătălin Hrițcu, and Matteo Maffei. Type-checking zero-knowledge. In *15th ACM Conference on Computer and Communications Security (CCS 2008)*, pages 357–370. ACM Press, October 2008. (Acceptance rate: 51/281=0.18).
- [17] Michael Backes, Cătălin Hrițcu, and Matteo Maffei. Automated verification of remote electronic voting protocols in the applied pi-calculus. In *21th IEEE Symposium on Computer Security Foundations (CSF 2008)*, pages 195–209. IEEE Computer Society Press, June 2008. (Acceptance rate: 21/115=0.18).
- Workshops [18] Udit Dhawan, Albert Kwon, Edin Kadric, Cătălin Hrițcu, Benjamin C. Pierce, Jonathan M. Smith, Gregory Malecha, Greg Morrisett, Thomas F. Knight, Jr., Andrew Sutherland, Tom Hawkins, Amanda Zyxnfryx, David Wittenberg, Peter Trei, Sumit Ray, Greg Sullivan, and André DeHon. Hardware support for safety interlocks and introspection. In *SASO Workshop on Adaptive Host and Network Security*, September 2012.
- [19] Michael Backes, Cătălin Hrițcu, and Thorsten Tarrach. Automatically verifying typing constraints for a data processing language. In *First First International Workshop On Intermediate Verification Languages (BOOGIE 2011)*, July 2011.
- [20] Michael Backes, Cătălin Hrițcu, Matteo Maffei, and Thorsten Tarrach. Type-checking implementations of protocols based on zero-knowledge proofs – work in progress. In *Workshop on Foundations of Computer Security (FCS 2009)*, August 2009.
- [21] Michael Backes, Martin P. Grochulla, Cătălin Hrițcu, and Matteo Maffei. Achieving security despite compromise using zero-knowledge. In *Joint Workshop on Automated Reasoning for Security Protocol Analysis and Issues in the Theory of Security (ARSPA-WITS’09)*, March 2009.
- [22] Michael Backes, Cătălin Hrițcu, and Matteo Maffei. Type-checking zero-knowledge. In *Joint Workshop on Foundations of Computer Security, Automated Reasoning for Security Protocol Analysis and Issues in the Theory of Security (FCS-ARSPA-WITS’08)*, June 2008.
- [23] Cătălin Hrițcu and Jan Schwinghammer. A step-indexed semantics of imperative objects. In *International Workshop on Foundations of Object-Oriented Languages (FOOL’08)*, January 2008.
- Theses [24] Cătălin Hrițcu. *Union, Intersection, and Refinement Types and Reasoning About Type Disjointness for Security Protocol Analysis*. PhD thesis, Saarland University, January 2012.

[25] Cătălin Hrițcu. A step-indexed semantic model of types for the functional object calculus. Master's thesis, Saarland University, May 2007.

## Selected Talks

- 03/2014      *QuickChick: Property-based testing for Coq.* Coq Working Group at PPS, Paris 7.  
              *Micro-Policies: A Framework for Verified, Hardware-Assisted Security Monitors*
- 07/2014      Joint Workshop on Foundations of Computer Security and Formal and Computational Cryptography (FCS-FCC)
- 03/2014      Grande Region Security and Reliability Day in Saarbrücken  
              *Testing Noninterference, Quickly*
- 06/2013      Short talk at IEEE 26th Computer Security Foundations Symposium (CFP)
- 05/2013      Stanford Security Lunch
- 05/2013      *Formally Verified Privacy-Preserving Distributed Applications.*  
INRIA Paris-Rocquencourt.  
              *All Your IFCEException Are Belong To Us:*
- 05/2013      IEEE Symposium on Security & Privacy (Oakland)
- 11/2012      New Jersey Programming Languages and Systems Seminar
- 11/2012      IFIP WG 2.8 – Functional Programming
- 10/2012      PL Group, Harvard University  
              *CRASH/SAFE: Clean-slate Co-design of a Secure Host Architecture:*
- 03/2013      Microsoft Research Cambridge
- 01/2013      Prosecco team at INRIA Paris-Rocquencourt
- 12/2012      CASED / EC SPRIDE at TU Darmstadt
- 12/2012      Information Security and Cryptography group at Saarland University
- 10/2012      *Poison-pills and dynamic information flow control.* PLClub, UPenn.
- 04/2012      *On the Development and Formalization of an Extensible Code Generator for Real Life Security Protocols.* 4th NASA Formal Methods Symposium (NFM 2012).
- 11/2011      *Breeze: A Language For Writing Secure Software.* Stevens Institute of Technology.  
              *Union, Intersection, and Refinement Types and Reasoning about Type Disjointness for Analyzing Protocol Implementations:*
- 07/2011      PLClub, University of Pennsylvania
- 12/2010      MSR-INRIA Joint Centre, Orsay  
              *Semantic Subtyping with an SMT Solver:*
- 09/2010      15th ACM SIGPLAN International Conference on Functional Programming (ICFP 2010)
- 05/2010      Workshop on Relations and Data Integrity Constraints and Languages (RADICAL 2010), Microsoft Research Cambridge (UK).
- 08/2009      *Type-checking Implementations of Protocols Based on Zero-knowledge Proofs – Work in Progress.* Workshop on Foundations of Computer Security (FCS 2009).

*Achieving Security Despite Compromise Using Zero-knowledge:*

- 07/2009            22th IEEE Symposium on Computer Security Foundations (CSF 2009)  
03/2009            Joint Workshop on Automated Reasoning for Security Protocol Analysis and  
                         Issues in the Theory of Security (ARSPA-WITS'09)

*Type-checking Zero-knowledge:*

- 10/2008            15th ACM Conference on Computer and Communications Security (CCS 2008)  
07/2008            Microsoft Research Cambridge (UK)

*Automatic Verification of Remote Electronic Voting Protocols:*

- 07/2008            Microsoft Research Cambridge (UK)  
06/2008            21th IEEE Symposium on Computer Security Foundations (CSF 2008)  
01/2008            *Step-indexed Semantics of Imperative Objects*. Workshop on Foundations of Object-  
                         Oriented Languages (FOOL'08).

## Teaching

- Fall 2012            *Advanced Martial Arts in Coq* (guest lecturer for 2 lectures)  
                         CIS 670, University of Pennsylvania, instructor: Benjamin C. Pierce
- Spring 2012        *Software Foundations* (TA; guest lecturer for 6 lectures; **book co-author**)  
                         CIS 500, University of Pennsylvania, instructor: Benjamin C. Pierce
- Fall 2011            *Advanced Topics in Programming Languages* (guest lecturer for 2 lectures)  
                         CIS 670, University of Pennsylvania, instructor: Benjamin C. Pierce
- Winter 2010/11    *Security* (guest lecturer for 1 lecture)  
                         Core Lecture, Saarland University, instructor: Michael Backes
- Summer 2009        *Practical Aspects of Security* (teaching assistant; guest lecturer for 3 lectures)  
                         Advanced Lecture, Saarland University, instructor: Michael Backes  
                         (**best course award**)
- Winter 2008/09    *Observational Equivalence for Security Protocols* (organizer; advised students)  
                         Seminar, Saarland University, instructor: Michael Backes
- Winter 2007/08    *The Analysis of Electronic Voting Protocols and* (organizer; advised students)  
                         *The Secure Implementation of Cryptographic Protocols*  
                         Seminar, Saarland University, instructor: Michael Backes
- Summer 2007        *Introduction to Computational Logic* (teaching assistant)  
                         Core Lecture, Saarland University, instructor: Gert Smolka
- Winter 2006/07    *Language-based Security* (teaching assistant; conducted weekly recitation sections)  
                         Advanced Lecture, Saarland University, instructor: Matteo Maffei

## Advised Students

- 03/2014–08/2014   **Arthur Azevedo de Amorim.** *Micro-Policies: Formally Verified, Hardware-Assisted Security Monitors* (Inria Research Internship; PhD student at UPenn)
- 04/2014–09/2014   **Zoe Paraskevopoulou.** *QuickChick: A Coq Framework For Verified Property-Based Testing* (Inria Research Internship; Master's thesis at NTU Athens; now student in MPRI graduate school)
- 04/2014–09/2014   **Nick Giannarakis.** *Formally Verified Tag-Based Enforcement of Control Flow Integrity* (Inria Research Internship; Master's thesis at NTU Athens; now student in MPRI graduate school)

10/2011–04/2012	<b>Sam Panzer &amp; Nick Watson.</b> <i>Zephyr: A Content Management System in Breeze</i> (Senior design project at University of Pennsylvania)
04/2011	<b>Alex Busenius.</b> <i>Mechanized Formalization of a Transformation from an Extensible Spi Calculus to Java.</i> (Master’s thesis at Saarland University)
08/2010	<b>Thorsten Tarrach.</b> <i>Automatically Verifying “M” Modeling Language Constraints.</i> (Master’s thesis at Saarland University; now PhD student at IST Austria)
01/2009	<b>Martin Grochulla.</b> <i>Security Despite System Compromise with Zero-Knowledge Proofs.</i> (Master’s thesis at Saarland University; co-advised with Matteo Maffei; now PhD student at MPI-INF)
10/2008	<b>Alex Busenius.</b> <i>Expi2Java – An Extensible Code Generator for Security Protocols.</i> (Bachelor’s thesis at Saarland University)
10/2008	<b>Thorsten Tarrach.</b> <i>Spi2F# – A Prototype Code Generator for Security Protocols.</i> (Bachelor’s thesis at Saarland University)

## Recent Software Projects

2014 – now	<b>newF*</b> : Next Generation Security Type System (with Karthik Bhargavan, Cédric Fournet, Chantal Keller, Alfredo Pironti, Pierre-Yves Strub, Nikhil Swamy, and others)
2013 – now	<b>QuickChick</b> : Property-Based Testing Plugin for Coq (with Maxime Dénès, Leonidas Lampropoulos, Zoe Paraskevopoulou, and Benjamin C. Pierce)
2013 – now	<b>Micro-Policies</b> : Formally Verified, Hardware-Assisted Security Monitors (with Arthur Azevedo de Amorim, André deHon, Maxime Dénès, Udit Dhawan, Nick Giannarakis, Benjamin C. Pierce, Antal Spector-Zabusky, and Andrew Tolmach)
2011 – 2013	<b>CRASH/SAFE</b> : participated in the clean-slate co-design of a secure architecture, including novel hardware, OS, and programming language (team effort)
2011 – 2012	<b>Breeze</b> : a programming language with dynamic information flow control and label-based access control (with Michael Greenberg, Ben Karel, Benoît Montagu, Greg Morrisett, Benjamin C. Pierce, and others)
2010	<b>DVerify</b> a verification tool for Microsoft’s codename “M” language (by Thorsten Tarrach, coordinated only)
2009 – 2010	<b>Dminor</b> : a type-checker for “M” using semantic subtyping and an SMT solver (with Gavin Bierman and Andy Gordon)
2009 – 2011	<b>F5</b> : a type-checker and toolchain for an extension of Refined Concurrent FPC (RCF) with union, intersection and polymorphic types (with Thorsten Tarrach)
2008 – 2011	<b>Expi2Java</b> : code generator that converts verifiable protocol models into interoperable Java implementations (by Alex Busenius, coordinated only)
2008 – 2011	<b>zk-typechecker</b> : the first type-checker for automatically analyzing protocols that use zero-knowledge proofs (with Stefan Lorenz, Kim Pecina and Thorsten Tarrach)

## Community Service

**PC member**: FCS-FCC 2014, ACNS 2014, FCS 2013

**Reviewer for journals**:

JACM (×1), JCS (×1), HOSC (×1), JFP (×1), TOPLAS (×1), JLAMP (×1)

**External reviewer for conferences**:

PLAS 2014 (×1), POST 2014 (×1), POPL 2014 (×2), CPP 2013 (×1), CSF 2013

( $\times 1$ ), POPL 2013 ( $\times 2$ ), CSF 2012 ( $\times 1$ ), POST 2012 ( $\times 1$ ), ICFP 2011 ( $\times 1$ ), CSF 2009 ( $\times 4$ ), ISC 2008 ( $\times 1$ ), PETS 2008 ( $\times 2$ ), ICALP 2008 ( $\times 1$ )

## Organization

2014                      Organizer Joint EasyCrypt-F\*-CryptoVerif School in Paris (over 75 participants)

2012 – 2013            Organizer of the TOS reading group at UPenn on the interplay between security, programming languages, verification, operating systems, and hardware architecture

## References

**Benjamin C. Pierce**, Professor at University of Pennsylvania  
3330 Walnut Street, Philadelphia, PA 19104, USA; Phone: +1 215 898 6222;  
E-mail: bcpierce@cis.upenn.edu

**Michael Backes**, Professor at Saarland University, Max Planck Fellow at MPI-SWS, Director of CISP, and Vice-coordinator of MMCI  
Postfach 15 11 50, D-66041 Saarbrücken, Germany; Phone: +49 681 302 3259;  
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**Andrew D. Gordon**, Principal Researcher at Microsoft Research Cambridge and Manager of the PPT Group; Professor at University of Edinburgh  
21 Station Road, Cambridge CB1 2FB, UK; Phone: +44 1223 479780;  
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**Matteo Maffei**, Associate Professor at Saarland University  
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**Greg Morrisett**, Professor at Harvard University  
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