

Georg Weissenbacher

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Research Interests

- Automated Verification of Software and Hardware
- Logic and Decision Procedures, Automated Reasoning
- Fault Localisation and Error Explanation

Education

- 2016 Habilitation in Computer Science, **TU Wien**
Thesis: *Logical Methods in Automated Hardware and Software Verification*
- 2010 Doctor of Philosophy in Computer Science, **Oxford University**
Dissertation: *Program Analysis with Interpolants*
Supervisor: Prof. Daniel Kröning
Examiners: Prof. Tom Melham and Prof. Thomas A. Henzinger
(passed without corrections)
Nominated by Oxford University for the 2011 BCS Distinguished Dissertation Award
Funded by a *Microsoft Research European PhD scholarship*
- 2003 Master's level degree (Dipl.-Ing.), **Graz University of Technology, Austria**
Telematics (Computer Science and Electrical Engineering)
Thesis: *An Abstraction/Refinement Scheme for Model Checking C Programs*
Supervisor: Prof. Roderick Bloem

Professional Experience

- Since Feb. 2017 Associate professor (tenured), **TU Wien**
- July 2012 Assistant professor (tenure track), **TU Wien**
to Jan. 2017 Leader of WWTF funded Vienna Research Group for Young Investigators
- June 2012 Research assistant, **Oxford University**
- Oct. 2010 Postdoctoral research associate, **Princeton University**
to May 2012 Fault localisation in post-silicon validation
Supervisor: Prof. Sharad Malik
- Oct. 2005 to Research assistant, **ETH Zurich**
April 2010 Acquisition, management, and lead researcher on "*Model-based Generation of Tests for Dependable Embedded Systems*". Research on automated program analysis.
- Spring 2006 Intern, **Microsoft Research**, Cambridge, UK
Implemented model checker for concurrent programs. Supervisor: Dr. Byron Cook.

Professional Experience (continued)

- Oct. 2004 to
Sept. 2005 Software engineer, **Austrian Research Centers/Seibersdorf Research**
Designed testing and safety analysis techniques for time triggered communication networks for dependable systems. (project DECOS, 6th EU Framework Programme).
- Summer 2003 Intern, **Microsoft Research**, Redmond, WA, USA
Extended the SLAM verification tool to provide support for concurrent programs.
Supervisors: Dr. Sriram K. Rajamani and Dr. Thomas Ball.
- Summer 2000 Intern, **IFAD**, Odense, Denmark
◦ Developed a CORBA networking interface for IFAD's VDM Toolkit, a development environment for the formal specification language VDM-SL.
◦ Integrated model checking techniques into the experimental proof engine of the tool (project PROSPER, ESPRIT Framework IV)
Supervisors: Dr. Peter Gorm Larsen and Dr. Kim Sunesen
- Jan. 1999 to
Sept. 1999 Software developer, **HS-Art Digital Service GesmbH**
◦ Implemented tools for automated digital film restoration (project DIAMANT, 5th EU Framework Programme)
◦ Developed networking interface for copyright clearing software providing automatic identification of film material.
- Summer 1997
to summer 1998 Intern/part-time employee, **Joanneum Research**, Graz, Austria
Worked as software developer on ESPRIT project Limelight/FAME (automatic restoration of digital film material)

Research Grants

- 2016** Microsoft Research European PhD Scholarship
Funding body: Microsoft Research Cambridge
Role: Recipient and author of grant application
Sum granted: EUR 100 000
- 2014** FWF Doctoral College "Logical Methods in Computer Science"
Funding body: Austrian Science Fund (FWF)
Role: Co-author of proposal
Sum granted: EUR 2.8m (overall, 15 PhD positions)
- 2012** WWTF Vienna Research Group for Young Investigators
Funding body: Vienna Science and Technology Fund (WWTF)
Project: *Heisenbugs: From Detection to Explanation*
Role: Author of proposal, Vienna Research Group Leader
Sum granted: EUR 1 500 000
- 2007** EU FP7 Specific Targeted Research Project "MOGENTES"
Funding body: European Commission
Project: *Model-based Generation of Tests for Dependable Embedded Systems*
Role: Co-author of proposal
Sum granted: EUR 3 100 000 for 10 participants (EUR 412 000 for ETH Zurich)

Teaching Experience

- Since July 2012 Assistant/associate professor, **TU Wien**
Courses: “*Verification of Programs and Systems*” (undergraduate),
 “*Formal Methods in Computer Science*” (graduate),
 “*Computer Aided Verification*” (graduate),
 “*Software Model Checking*” (graduate),
 “*Semantics of Programming Languages*” (graduate; guest lecturer),
 “*Seminar in Formal Methods*” (graduate)
PhD students: Andreas Fellner, Henning Günther, Jens Katelaan,
 Thomas Pani, Adrián Rebola Pardo, and Matthias Schlaipfer
Co-Supervision: Johannes Wallner (Dr. techn. 2014, now in Helsinki)
 Charlie Shucheng Zhu (PhD Princeton 2016, now Google)
Master student: Johannes Birgmeier (graduated, now in Stanford)
PostDocs: Mitra Tabaei Befrouei (Dr. techn. at TU Wien Dec. 2016)
 Alfons Laarman (2014-2016)
- Feb. 2011 to Lecturer, **Princeton University**
June 2011 Developed and taught course “*Automated Verification and Software Model Checking*”
Co-supervised PhD student Charlie Shucheng Zhu (topic: post-silicon validation)
- Oct 2005 to Teaching assistant, **ETH Zurich**
April 2010
 - Co-supervised master’s student Raphael Mack
 Thesis: “*Modeling and verifying embedded operating systems*”, 2008
 - Digitaltechnik (digital circuit design)
 Assisted for this course 3 times (2007, 2008, 2009). Co-authored the text-book
 “*Digitaltechnik*” (A. Biere, D. Kroening, G. Weissenbacher, and C. Wintersteiger),
 on which the course was based.
 - Formal Verification
 - Software Engineering Seminar
 - Seminar on Digital Circuit Design and Computer Architecture
- 2000 to Tutorial assistant, **Graz University of Technology**
2003
 - Introduction to Computer Science (summer term 2000, summer term 2002)
 - Software Technology (winter term 2001/2002)
 - Compiler construction (winter term 2002/2003)
- Feb. 2000, Skiing Instructor, Flachau, Austria
Dec 2001 taught beginners courses for kids and grown ups
- 1997 to Organiser, Instructor, Austrian Alpine Club
2004 organised and conducted climbing and ski-touring courses

Publications

Conference Proceedings

Formal Methods in Computer-Aided Design (FMCAD) 2017
with Daryl Stewart
Vienna, Austria, 2017

Books and Book-Chapters

Boolean Satisfiability: Solvers and Extensions
with Pramod Subramanyan and Sharad Malik
In Software Systems Safety 2014
NATO Science for Peace and Security Series, IOS Press

Boolean Satisfiability Solvers: Techniques and Extensions
with Sharad Malik
In Software Safety and Security 2012
NATO Science for Peace and Security Series, IOS Press

Digitaltechnik
with Armin Biere, Daniel Kroening, and Christoph Wintersteiger
Springer text-book, March 2008

Journal Papers

Labelled Interpolation Systems for Hyper-Resolution, Clausal, and Local Proofs
with Matthias Schlaipfer
Journal of Automated Reasoning
published online February 2016

Abstraction and Mining of Traces to Explain Concurrency Bugs
with Mitra Tabaei Befrouei and Chao Wang
Formal Methods in Systems Design
published online January 2016

Boolean Satisfiability Solvers and Their Applications in Model Checking
with Yakir Vizel and Sharad Malik
Proceedings of the IEEE
Volume 103, Issue 11, October 2015

Journal Papers (continued)

Under-approximating Loops in C Programs for Fast Counterexample Detection
with Daniel Kroening and Matt Lewis

Formal Methods in Systems Design

Volume 47, Issue 1, August 2015

Verification and Falsification of Programs with Loops Using Predicate Abstraction

with Daniel Kroening

Formal Aspects of Computing

Volume 22, Issue 2, March 2010

A Survey of Automated Techniques for Formal Software Verification

with Vijay D'Silva and Daniel Kroening

IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems

Volume 27, Issue 7, July 2008

Conference Papers

Model-based, mutation-driven test case generation via heuristic-guided branching search

with Andreas Fellner, Willibald Krenn, Thorsten Tarrach, and Rupert Schlick

MEMOCODE 2017: Formal Methods and Models for System Design

Dynamic Reductions for Model Checking Concurrent Software

with Henning Günther, Alfons Laarman, and Ana Sokolova

VMCAI 2017: Verification, Model Checking, and Abstract Interpretation

Error Invariants for Concurrent Traces

with Andreas Holzer, Daniel Schwartz-Narbonne, Mitra Tabaei Befrouei, and Thomas Wies

FM 2016: Symposium on Formal Methods

Vienna Verification Tool: Parallel Software with IC3 (competition contribution)

with Henning Günther and Alfons Laarman

TACAS 2016: Tools and Algorithms for the Construction and Analysis of Systems

Proving Safety with Trace Automata and Bounded Model Checking

with Daniel Kroening and Matt Lewis

FM 2015: Symposium on Formal Methods

Silicon Fault Diagnosis Using Sequence Interpolation with Backbones

with Charlie Shucheng Zhu and Sharad Malik

ICCAD 2014: International Conference on Computer-Aided Design

Conference Papers (continued)

Reduction of Resolution Refutations and Interpolants via Subsumption
with Roderick Bloem, Sharad Malik, and Matthias Schlaipfer
HVC 2014: Haifa Verification Conference

Abstraction and Mining of Traces to Explain Concurrency Bugs
with Mitra Tabaei Befrouei and Chao Wang
RV 2014: Conference on Runtime Verification
(shortlisted for best paper award)

Incremental Bounded Software Model Checking
with Henning Günther
SPIN 2014: SPIN Symposium on Model Checking of Software

Counterexample to Induction-Guided Abstraction-Refinement (CTIGAR)
with Johannes Birgmeier and Aaron Bradley
CAV 2014: Conference on Computer Aided Verification

Under-Approximating Loops in C Programs for Fast Counterexample Detection
with Daniel Kroening and Matt Lewis
CAV 2013: Conference on Computer Aided Verification

Coverage-based Trace Signal Selection for Fault Localisation in Post-Silicon Validation
with Charlie Shucheng Zhu and Sharad Malik
HVC 2012: Haifa Verification Conference

Parallel Assertions for Architectures with Weak Memory Models
with Daniel Schwartz-Narbonne and Sharad Malik
ATVA 2012: Automated Technology for Verification and Analysis

Interpolant Strength Revisited
SAT 2012: Theory and Applications of Satisfiability Testing

Wolverine: Battling Bugs with Interpolants (competition contribution)
with Daniel Kroening and Sharad Malik
TACAS 2012: Tools and Algorithms for the Construction and Analysis of Systems

Post-Silicon Fault Localisation Using Maximum Satisfiability and Backbones
with Charlie Sucheng Zhu and Sharad Malik
FMCAD 2011: Formal Methods in Computer Aided Design

Conference Papers (continued)

Interpolation-based Software Verification with Wolverine
with Daniel Kroening
CAV 2011: 23rd Conference on Computer Aided Verification

Interpolant Strength
with Vijay D'Silva, Mitra Purandare, and Daniel Kroening
VMCAI 2010: Verification, Model Checking and Abstract Interpretation
(Extended version available as ETH Technical Report 652)

Mutation-based Test Case Generation for Simulink Models
with Angelo Brillout, Nannan He, Michele Mazzucchi, Daniel Kroening,
Mitra Purandare, and Philipp Rümmer
FMCO 2009: Post-proceedings of Formal Methods for Components and Objects

An Interpolating Decision Procedure for Transitive Relations with Uninterpreted Functions
with Daniel Kroening
HVC 2009: Haifa Verification Conference

A Complete Bounded Model Checking Algorithm for Pushdown Systems
with Gérard Basler and Daniel Kroening
HVC 2007: Haifa Verification Conference

Lifting Propositional Interpolants to the Word-Level
with Daniel Kroening
FMCAD 2007: Formal Methods in Computer Aided Design

Model Checking Concurrent Linux Device Drivers
with Thomas Witkowski, Nicolas Blanc, and Daniel Kroening
ASE 2007: Automated Software Engineering

Counterexamples with Loops for Predicate Abstraction
with Daniel Kroening
CAV 2006: Computer Aided Verification

From Requirements to Deployment: Verify That the Right Things Are Done Correctly
with Wolfgang Herzner and Erwin Schoitsch
ITSC 2005: IEEE Conference on Intelligent Transportation Systems

Conference Papers (continued)

Counter-Example Driven Abstraction Refinement.
A Pattern Supporting Formal Verification of Large Systems
with Wolfgang Herzner
EuroPLoP 2005: European Conference on Pattern Languages of Programs

Workshop Papers

Advanced SAT Techniques for Abstract Argumentation
with Johannes P. Wallner and Stefan Woltran
CLIMA 2013: Workshop on Computational Logic in Multi-Agent Systems

SAT-based Techniques for Determining Backbones for Post-Silicon Fault Localisation
with Charlie Sucheng Zhu, Divjyot Sethi, and Sharad Malik
HLDVT 2011: IEEE International High Level Design Validation and Test Workshop

SAT-based Summarization for Boolean Programs
with Gérard Basler and Daniel Kroening
SPIN 2007: SPIN Workshop on Model Checking Software

Allocation of Dependable Software Modules under Consideration of Replicas
with Wolfgang Herzner and Egbert Althammer
First ERCIM Workshop on Software-Intensive Dependable Embedded Systems, 2005

Informal Workshop Proceedings (peer-reviewed)

A Proposal for a Theory of Finite Sets, Lists, and Maps for the SMT-Lib Standard
with Daniel Kroening and Philipp Rümmer
SMT workshop 2009: 7th International Workshop on Satisfiability Modulo Theories

Theses

Logical Methods in Automated Hardware and Software Verification
Habilitation Thesis at TU Wien, July 2016

Program Analysis with Interpolants
Doctoral Thesis at Oxford University, Computing Laboratory
September 2010. Supervisor: Dr. Daniel Kröning

An Abstraction/Refinement Scheme for Model Checking C Programs
Master's Thesis at Graz University of Technology, Institute for Software Technology
March 2003. Supervisor: Dr. Roderick Bloem

Publications in Magazines (not peer-reviewed)

Drum prüfe: Model Checking: Bugs in C-Programmen finden
with Daniel Kroening

iX Magazin für professionelle Informationstechnik 5/2009, pg. 159, <http://www.heise.de/ix>

Abstrakte Kunst: Fehler finden mit Model-Checkern

iX Magazin für professionelle Informationstechnik 5/2004, pg. 116, <http://www.heise.de/ix>

Ohne Beweis: VDM++, Lightweight Formal Methods

iX Magazin für professionelle Informationstechnik 3/2001, pg. 157, <http://www.heise.de/ix>

Talks

Interpolation-based Model Checking and IC3

- MEMICS Doctoral Workshop on Mathematical Engineering Methods in Computer Science Tutorial, Masaryk University, Telč, October 2017

Interpolation Algorithms and their Applications in Model Checking

- Automata, Logic and Games Tutorial, Institute for Mathematical Sciences, NUS, Singapore, August 2016

Explaining Heisenbugs

- Runtime Verification Invited talk, Vienna, Austria, September 2015

Proving Safety with Trace Automata and Bounded Model Checking

- Formal Methods Symposium Conference Talk, Oslo, Norway, June 2015

Software Model Checking with Predicate Abstraction, Interpolation, and IC3

- Dutch Model Checking Day 2014, University of Twente Invited talk, Twente, May 2014

Labelled Interpolation Systems

- Dagstuhl Seminar 12461 on Games and Decisions for Rigorous Systems, November 2012

Interpolant Strength Revisited

- Theory and Applications of Satisfiability Testing (SAT) Conference talk, Trento, Italy, June 2012
- Department of Computer Science, University of Toronto, April 2011

Battling Bugs with Interpolants

- Symposium "Logic and Algorithms: A Scientific Perspective", Vienna Keynote talk for opening of Vienna Center for Logic and Algorithms, January 2012

Post-Silicon Fault Localisation Using Maximum Satisfiability and Backbones

- Formal Methods in Computer Aided Design (FMCAD) Conference talk, Austin (Texas, USA) November 2011
- Center for Embedded Systems for Critical Applications, Virginia Tech CESCA seminar, Blacksburg (Virginia, USA) October 2011

Interpolation-based Software Verification with WOLVERINE

- Conference for Computer Aided Verification, Snowbird Conference talk & tool presentation, July 2011

Talks (continued)

Interpolant Strength

- Conference on Verification, Model Checking & Abstract Interpretation (VMCAI)
Conference talk, Madrid (Spain), January 2010
- NEC Princeton, November 2010

An Interpolating Decision Procedure for Transitive Relations with Uninterpreted Functions

- United Nations University, International Institute for Software Technology (UNU IIST)
Internal seminar, Macau (China) January 2010
- Haifa Verification Conference
Conference talk, Haifa (Israel), October 2009

Lifting Propositional Interpolants to the Word-Level

- École Polytechnique Fédérale de Lausanne (EPFL)
Thrust in Reliable Software Research (TRESOR) seminar, Lausanne (CH), March 2008
- Formal Methods in Computer Aided Design (FMCAD)
Conference talk, Austin (Texas, USA), November 2007

Counterexamples with Loops for Predicate Abstraction

- Computer Aided Verification Conference (CAV)
Conference talk, Seattle (Washington, USA) August 2006

SAT-based Summarization for Boolean Programs

- SPIN Workshop on Model Checking Software
Workshop presentation, Berlin (Germany), July 2006

Allocation of Dependable Software Modules under Consideration of Replicas

- ERCIM Workshop on Software-Intensive Dependable Embedded Systems
Workshop presentation, Porto (Portugal), August 2005

Academic Service

Chair/Organiser	Computer Aided Verification (CAV) 2018 (co-chair) Formal Methods in Computer Aided Design (FMCAD) 2017 (co-chair) Formal Methods and Models for System Design (MEMOCODE) 2017 (organiser) Austrian Computer Science Day 2015 (co-organiser) FMCAD Student Forum 2015 (chair) iPrA: Annual Workshop on Interpolation 2013-2015 (co-organiser) 4 th SAT/SMT Summer School 2014 (co-organiser)
Committee	CAV: Computer Aided Verification, 2013 (proceedings chair), 2014/15, 2017 ICCAD: International Conference on Computer Aided Design, 2015-2016 FMCAD: Formal Methods in Computer Aided Design, 2013-2015 DUHDe: Workshop on Design Automation for Understanding Hardware Designs, 2016-2017 CREST: Workshop on Causal-based Reasoning for Embedded and safety-critical Systems Technologies, 2016-2017 Satisfiability Modulo Theory workshop 2014 1 st Competition on Software Verification (held at TACAS 2012)
Journal reviews	CACM: Communications of the ACM FMSD: Formal Methods in System Design IJCM: International Journal for Computer Mathematics JAR: Journal of Automated Reasoning JCST: Journal of Computer Science & Technology STTT: Journal on Software Tools for Technology Transfer TCS: Theoretical Computer Science TCAD: Trans. on Computer-Aided Design of Integrated Circuits and Systems
Conference reviews	TACAS: Tools and Alg. for the Constr. and Analysis of Syst., 2009-10,12,14 CAV: Computer Aided Verification, 2008-2015 DATE: Design, Automation and Test in Europe, 2009-2011 DSN/PDS: Dependable Systems and Networks, 2009 FMCAD: Formal Methods in Computer Aided Design, 2007-11, 13-15 FMICS: Formal Methods for Industrial Critical Systems, 2009 HVC: Haifa Verification Conference, 2007-2008 IFM: Integrated Formal Methods, 2009 MEMOCODE: Formal Methods and Models for Codesign 2006, 2009 SYNASC: Symbolic and Numeric Algorithms for Scientific Computing, 2013 VMCAI: Verification, Model Checking and Abstract Interpretation, 2014
Workshop reviews	SMT: Satisfiability Modulo Theory workshop, 2010, 2014

Verification Tools (implementation experience)

Wolverine	at University of Oxford Implemented an interpolation-based software verification tool for C/C++.
Satabs, Cbmc	at ETH Zurich, University of Oxford Verification based on predicate abstraction and bounded model checking, contributor
Slam	at Microsoft Research Implemented support for analysis of concurrent programs in SLAM, Microsoft's predicate abstraction-based verification tool for Windows device drivers
Vdm Tools	at IFAD, Denmark Implemented networking interface and model checking algorithms for verification toolbox for the VDM formal specification language

Other (Non-Scientific) Occupations

Oct. 2003 to Sept. 2004	Community service (in lieu of military service) as an IT administrator at Caritas (a social service organisation) at Graz
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