

Gabor Simko

Curriculum Vitae

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Address: Institute for Software Integrated Systems
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Email: gabor.simko@vanderbilt.edu

Nationality: Hungarian

Research Interests

Language design, compilers
Formal methods (specification, analysis, proofs)
Machine learning
Cyber-physical systems
Applications in graph and network theory
Game theory
Data visualization, 3D rendering

Education

- 2008 **M.Sc. Computer Science**, Budapest University of Technology and Economics
Topic: *Image processing - clavicle detection and elimination on chest radio-graph images*
Specialization: *Integrated intelligent systems, machine learning*
- 2010 **M.Sc. Biomedical Engineering**, Budapest University of Technology and Economics
Topic: *Game simulation - Localization of nodes with largest game theoretical influence on cooperation of complex networks*
Advisor: *Professor Peter Csermely*
Specialization: *Protein-protein interaction, protein networks, aging networks*
- 2010 - present **Ph.D Computer Science** (GPA:4.0), Vanderbilt University, School of Engineering
Advisor: *Professor Janos Sztipanovits*
Topic: *Semantics of Domain-Specific Modeling Languages*
- 2013 Stanford University's online *Machine Learning* course at coursera.org (grade: 100%)
Lecturer: Andrew Ng
- 2013 University of Colorado Boulder's online *Linear and Integer Programming* course at coursera.org (grade: 99.1%)
Lecturer: Sriram Sankaranarayanan
- 2013 Georgia Institute of Technology's online *Computational Investing* course at coursera.org (grade: 98.8%)
Lecturer: Tucker Balch

Programming Contests

- 2002
- Hungary's delegate on the International Olympiad in Informatics (IOI) held in South Korea
 - One of the most prestigious computer science competitions in the world (according to Wikipedia)
 - **Bronze medal**, ranked 95th world-wide
- 2003
- **Winner** of XII. National Scientific and Innovation Contest in Hungary
 - Developed a low-cost bluebox system with one colleague.
 - It was top news in Hungary: appeared in TV, newspaper coverage; even international entrepreneurs were interested.
 - I was responsible for developing an OpenGL rendering engine and the communication protocol over the serial port between the PC and a custom-built hardware which measured the orientation of the attached camera.
- 2007
- **10th place** at International Challenge 24 Programming Contest

- We had to develop a multi-player 3-dimensional car game. I was working on the rendering engine and the websocket communication.

2008, Quarter-finalist (in top 1000 worldwide) at Google's Coding Competition

2008, Semi-finalist (in top 200 worldwide) at Microsoft's Imagine Cup Algorithm Contest

2010, Winner of Vanderbilt's coding competition

2006- Topcoder, highest rating: 1641

Honors and Awards

Prime Minister's Fellowship, Hungary (2002)

Fellowship of the Republic of Hungary (2002)

University Professional Fellowship, BUTE (2008)

University Professional Fellowship, BUTE (2009)

Fellowship of the Faculty of Electrical Engineering and Informatics (2008)

Fellowship of the Faculty of Electrical Engineering and Informatics (2009)

Work Experience

06/2013 - 09/2013, **Microsoft Research**

- Symbolic verification of plant-control systems (hybrid verification)
- Developed a custom dataflow language and a C# parser for it
- Developed a C# program that translates this language to first-order logic formulas
- Created a DLL interface for a Linux based C++ project (a verified integrator) using mingw
- Imported the C++ project into C# using PInvoke
- Connected the logic formulas and the verified integrator to get a verification tool
- Experimented with many search strategies (BFS and DFS variants) to examine the reachability graph created with the verification tool

06/2012 - 07/2012, Visiting Research Assistant, **SRI International**

- Used a hybrid system modeling language called HybridSAL to describe a flight protocol
- Used a term rewriting language called Maude to reason about probabilities of failure in safety critical vehicle designs
- Developed a formal proof in the PVS interactive theorem prover language

07/2011 - 10/2011, **Microsoft Research**

- Worked on statistical analysis of Satisfiability Modulo Theories (SMT) solvers

08/2010 - present Graduate Research Assistant, ISIS, **Vanderbilt University**,

- Developed a real-time online monitoring and event generator tool for health protocols in C# and Java running on an Apache server
- Wrote many formal specifications using logic programming (in DARPA's FANG challenge more than 1000 engineers use them)
- Created language transformations between many modeling languages in C#, F# and FORMULA

02/2009 - present LINK-Group, **Semmelweis University**

- Wrote a C++ game simulator for game theoretical network analysis

07/2007 - 06/2008, **Innomed Medical Inc.**

- Developed image processing algorithms in C++ for a chest radiograph based lung cancer detection software, which is shipped with the company's chest radiograph machines (sold in 110 countries).

03/2006 - 06/2006, **Radisson SAS Hotel**

- Developed a multi-threaded C++ application for the hotel's entrance system
- Input processing from a webcam, identification of people
- Video rendering into buffers (in 2006 this was not trivial)
- Merging the video streams based on the webcam data in real-time

04/2005 - 10/2005, **Holografika Ltd.**

- Developed a C++ library for loading 3d models
- Designed a video format for storing 3d movies

- Developed a C++ implementation that rendered these movies on a specialized 3D screen
04/2004 - 12/2007, **Hungarian Academy of Sciences**, Image and Pattern Analysis Group
- Worked on stereo photograph based scene reconstruction
- Developed many image feature point extraction algorithms in C++ (SIFT, MSER, SalScale)
- Developed a real-time video image stitching program in C++
- Wrote C++ code for generating smoke simulations (a grid simulator based on Navier-stokes equations)
- 11/2003 - 10/2004, **Codeland Ltd.**
- Developed 3D model (dxf, 3ds) loaders for the companies CAD software in C++
- Seamless integration of Mesa3D into the company's existing rendering pipeline
- Developing an infinite precision rational number class based on GMP
- 1999 - 2003, **Demoscene**
- As a hobby, I was the programmer of a demoscene group
- Wrote a 256 byte bump mapping demo in assembly
- Developed an OpenGL based C++ engine, which we used for some demos

Pet Projects

- A formal logic language/compiler with forward-inferencing engine
- A simple game in Microsoft Touchdevelop for the Microsoft Hackathon competition 2013 (finished in top 6). One of the most used script in the Touchdevelop market with 4455 users as of now.
- Web scraping for stock recommendations (in C#)
- A fully automated bot agent in Perl for playing an online quiz (way to win 20 rain jackets and watches for my high school mates)
- A simple multi-platform 3D game using Gameplay3d and a home brewed physics engine.
- A differential equations solver and simulator in F#
- ASP.Net project for running it online (and by compiling F# to Javascript with Websharper)
- Experimenting with XML and XSLT, websockets, SQL, and many other technologies
- A scriptable C++ game engine with OpenGL and Direct3D renders
- Machine learning experiments (hand written letter recognition, time series prediction, SVMs, neural networks) in Octave and Matlab
- Computational investment in Python
- ASP.Net webpage for visualizing small businesses on Google maps (this was before the map applications took off)

Professional Skills

Languages

- C, C++, C#, F#, Microsoft Formula, Microsoft Z3, Prolog, Matlab, R, Java, Latex, Haskell, ASML, SQL, Assembly and others

Certificates

- Microsoft Certified Technology Specialist
- .NET Framework 2.0 Web Applications (70-528 and 70-536)
- .NET Framework 2.0 Distributed Applications (70-529 and 70-536)

Language Skills

English High level skills
 Hungarian Native language
 German Basic reading skills

Personal Data

- Hobbies: Playing guitar, going to the gym, hiking, reading about physics and sciences, trying to understand the universe and everything
- DOB: 09/22/1984

- Family status: Single

Conference publications

1. Mosterman P., **Simko G.**, Zander J., Han Z. (2014). A Hyperdense Semantic Domain for Hybrid Dynamic Systems to Model With Impact. In: *17th International Conference on Hybrid Systems: Computation and Control (HSCC)*.
2. **Simko G.**, Jackson E. (2014). A Bounded Model Checking Tool for Periodic Sample-hold Systems. In: *17th International Conference on Hybrid Systems: Computation and Control (HSCC)*.
3. Jackson E., **Simko G.**, Sztipanovits J. (Oct. 2013). Diversely Enumerating System-Level Architectures. In: *ACM/IEEE 13th International Conference on Embedded Software*.
4. Mosterman P., **Simko G.**, Zander J. (Oct. 2013). A Hyperdense Semantic Domain for Discontinuous Behavior in Physical System Modeling. In: *Compositional Multi-Paradigm Models for Software Development (acceptance rate: 50%)*.
5. **Simko G.**, Lindecker D., Levendovszky T., Neema S., Sztipanovits J. (Oct. 2013). Specification of Cyber-Physical Components with Formal Semantics – Integration and Composition. In: *ACM/IEEE 16th International Conference on Model Driven Engineering Languages and Systems (MODELS) (acceptance rate: 23%)*.
6. Lindecker D., **Simko G.**, Madari I., Levendovszky T., Sztipanovits J. (2013). Multi-Way Semantic Specification of Domain-Specific Modeling Languages. In: *20th Annual IEEE International Conference and Workshops on the Engineering of Computer Based Systems (ECBS'13)*.
7. **Simko G.**, Lindecker D., Levendovszky T., Jackson E. K., Neema S., Sztipanovits J. (2013). A Framework for Unambiguous and Extensible Specification of DSMLs for Cyber-Physical Systems. In: *20th Annual IEEE International Conference and Workshops on the Engineering of Computer Based Systems (ECBS'13)*.
8. **Simko G.**, Levendovszky T., Maroti M., Sztipanovits J. (2013). Towards a Theory for Cyber-Physical Systems Modeling. In: *Third Workshop on Design, Modeling and Evaluation of Cyber Physical Systems (CyPhy'13)*.
9. **Simko G.**, Sztipanovits J. (2012). Active monitoring using real-time metric linear temporal logic specifications. In: *5th International Conference on Health Informatics (HEALTHINF)*.
10. **Simko G.**, Levendovszky T., Neema S., Jackson E., Bapty T., Porter J., Sztipanovits J. (2012). Foundation for Model Integration: Semantic Backplane. In: *32nd Computers and Information in Engineering Conference (ASME IDETC/CIE'13)*.
11. Horvath G., Orban G., Horvath A., **Simko G.**, Pataki B., Maday P., Juhasz S., Horvath A. (2009). A CAD System for Screening X-ray Chest Radiography. In: *World Congress on Medical Physics and Biomedical Engineering, September 7-12, 2009, Munich, Germany*. Springer, pp.210–213.
12. **Simko G.**, Orban G., Maday P., Horvath G. (2009). Elimination of clavicle shadows to help automatic lung nodule detection on chest radiographs. In: *4th European Conference of the International Federation for Medical and Biological Engineering*. Springer, pp.488–491.
13. **Simko G.**, Bicskei L. (2007). Localization and elimination of interfering factors on chest radiograph images. In: *Research Student Conference, Budapest University of Technology and Economics*.

Journal publications

1. **Simko G.**, Csermely P. (2013). Nodes Having a Major Influence to Break Cooperation Define a Novel Centrality Measure: Game Centrality. *PLoS ONE (Impact factor:3.7)* **8**.(4).
2. Farkas I., Korcsmaros T., Kovacs I., Mihalik A., Palotai R., **Simko G.**, Szalay K., Szalay-Beko M., Vellai T., Wang S. (2011). Network-based tools for the identification of novel drug targets. *Science Signaling (Impact factor: 7.5)* **4**.
3. **Simko G.**, Gyurko D., Veres D., Nanasi T., Csermely P. (2009). Network strategies to understand the aging process and help age-related drug design. *Genome Medicine* **1**, 90.

4. Horvath G., Juhasz S., **Simko G.** (2008). CAD systems for improving the efficiency of chest radiograph lung screening (in Hungarian: CAD-rendszerek a tüdőszűrés hatékonyságának javítására). *Kepalkoto kulonszam* 7.

Submitted/To be submitted

1. **Simko G.**, Levendovszky T., Neema S., Sztipanovits J. Composition Challenges in Cyber-Physical Systems. In: *To be submitted*.
2. **Simko G.**, Shankar N., Sztipanovits J. A Formally Verified Proof of the L* Algorithm. In: *To be submitted to Journal of Formalized Mathematics*.

Talks

1. **Simko G.** (Oct. 2013). *Formal Specifications for Secure Component Deployment*. NSF Foundations of Resilient Cyber-Physical Systems, PI Meeting, Arlington VA.
2. **Simko G.** (Oct. 2013). *Semantic Specifications for Domain-Specific Modeling Languages*. ACM Student Research Competition, Miami FL, USA.
3. **Simko G.** (Oct. 2013). *Specification of Cyber-Physical Components with Formal Semantics – Integration and Composition*. Model Driven Engineering Languages and Systems, Miami FL, USA.
4. **Simko G.** (Sept. 2013). *A Hyperdense Semantic Domain for Discontinuous Behavior in Physical System Models*. Multi-paradigm Modeling, Miami FL.
5. **Simko G.** (Aug. 2013). *Verification of Periodically Controlled Hybrid Systems*. Microsoft Research, Redmond WA, USA.
6. **Simko G.** (Apr. 2013). *A Framework for Unambiguous and Extensible Specification of DSMLs for Cyber-Physical Systems*. Engineering of Computer Based Systems, Phoenix AZ, USA.
7. **Simko G.** (Apr. 2013). *Towards a Theory for Cyber-Physical Systems Modeling*. Design, Modeling and Evaluation of Cyber Physical Systems, Philadelphia PA, USA.
8. **Simko G.** (Nov. 2012). *Formal Methods for Domain-Specific Modeling Language (DSML) specification, model checking and theorem proving*. WithIT seminar, Vanderbilt University, Nashville TN.
9. **Simko G.** (July 2012). *Formal Specification of Domain Specific Modeling Languages for Cyber-Physical Systems*. SRI International, Menlo Park CA, USA.
10. **Simko G.** (July 2012). *Semantic Backplane: Formal Specification of CyPhyML*. DARPA Tactical Technology Office, PI Meeting, Camp Pendleton CA, USA.
11. **Simko G.** (Oct. 2011). *Towards Statistical Properties of Design Space Exploration Algorithms*. Microsoft Research, Redmond WA, USA.
12. **Simko G.** (Sept. 2011). *Temporal Logic Monitoring*. Microsoft Research, Redmond WA, USA.
13. **Simko G.** (Feb. 2011). *Real-time Metric Linear Temporal Logic Monitoring*. Carnegie Mellon University, Pittsburgh PA.

Posters

1. **Simko G.** (Oct. 2013). *Formal Specifications for Secure Component Deployment*. NSF Foundations of Resilient Cyber-Physical Systems, PI Meeting, Arlington VA.
2. **Simko G.**, Sztipanovits J. (2012). *Active monitoring using real-time metric linear temporal logic specifications*. International Conference on Health Informatics.