

Soonho Kong

Senior Applied Scientist at Amazon Web Services

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Research Interests

Design and implementation of automated reasoning tools, with a particular emphasis on investigating their practical applications within real-world contexts.

Work Experience

- Amazon Web Services (Sep 2021 – Present)
- Toyota Research Institute (Aug 2016 – Sep 2021)

Education

Carnegie Mellon University

Ph.D. in Computer Science

Advisor: Prof. Edmund M. Clarke

Seoul National University

Master of Science in Computer Science and Engineering

Advisor: Prof. Kwangkeun Yi

Seoul National University

Bachelor of Science in Computer Science and Engineering

Software

dReal: SMT solver for nonlinear theories over the Reals (Lead developer, since 2013)

Drake: Model-based design and verification for robotics (Platform-reviewer, 2017 – 2021)

Lean: Lean theorem prover (Contributor, 2013 – 2016)

Publications

- [1] Kevin Lotz, Amit Goel, Bruno Dutertre, Benjamin Kiesl-Reiter, Soonho Kong, Rupak Majumdar, and Dirk Nowotka. “Solving String Constraints Using SAT”. In: *Computer Aided Verification*. Ed. by Constantin Enea and Akash Lal. Cham: Springer Nature Switzerland, 2023, pp. 187–208.
- [2] U. Guajardo, A. Bryan, N. Arechiga, S. Campos, J. Chow, D. Jackson, S. Kong, G. Litt, and J. Pollock. “Certified Perception for Autonomous Cars”. In: *6th Workshop On Monitoring And Testing Of Cyber-Physical Systems* (2021).
- [3] Nikos Arechiga, Jonathan DeCastro, Soonho Kong, and Karen Leung. “Better AI through Logical Scaffolding”. In: *FoMLAS 2019: 2nd Workshop on Formal Methods for ML-Enabled Autonomous Systems*. 2019.

- [4] Sicun Gao, James Kapinski, Jyotirmoy Deshmukh, Nima Roohi, Armando Solar-Lezama, Nikos Arechiga, and Soonho Kong. “Numerically-Robust Inductive Proof Rules for Continuous Dynamical Systems”. In: *Computer Aided Verification*. Ed. by Isil Dillig and Serdar Tasiran. Cham: Springer International Publishing, 2019, pp. 137–154.
- [5] Calvin Huang, Soonho Kong, Sicun Gao, and Damien Zufferey. “Evaluating Branching Heuristics in Interval Constraint Propagation for Satisfiability”. In: *Numerical Software Verification*. Ed. by Majid Zamani and Damien Zufferey. Cham: Springer International Publishing, 2019, pp. 85–100.
- [6] Daniel Jackson, Jonathan DeCastro, Soonho Kong, Dimitrios Koutentakis, Angela Feng Ping Leong, Armando Solar-Lezama, Mike Wang, and Xin Zhang. “Certified Control for Self-Driving Cars”. In: *DARS 2019: 4th Workshop On The Design And Analysis Of Robust Systems*. 2019.
- [7] Soonho Kong, Armando Solar-Lezama, and Sicun Gao. “Delta-Decision Procedures for Exists-Forall Problems over the Reals”. In: *Computer Aided Verification*. Ed. by Hana Chockler and Georg Weissenbacher. CAV’18. Cham: Springer International Publishing, 2018, pp. 219–235.
- [8] Kyungmin Bae, Peter Csaba Ölveczky, Soonho Kong, Sicun Gao, and Edmund M. Clarke. “SMT-Based Analysis of Virtually Synchronous Distributed Hybrid Systems”. In: *Hybrid Systems: Computation and Control*. HSCC’16. Vienna, Austria: ACM, 2016, pp. 145–154.
- [9] Md. Ariful Islam, Greg Byrne, Soonho Kong, Edmund M. Clarke, Rance Cleaveland, Flavio H. Fenton, Radu Grosu, Paul L. Jones, and Scott A. Smolka. “Bifurcation Analysis of Cardiac Alternans Using delta-Decidability”. In: *Computational Methods in Systems Biology*. Ed. by Ezio Bartocci, Pietro Lio, and Nicola Paoletti. CMSB’16. Cham: Springer International Publishing, 2016, pp. 132–146.
- [10] Seunghak Lee, Soonho Kong, and Eric P. Xing. “A network-driven approach for genome-wide association mapping”. In: *Bioinformatics* 32.12 (2016), pp. i164–i173.
- [11] Yungbum Jung, Soonho Kong, Cristina David, Bow-Yaw Wang, and Kwangkeun Yi. “Automatically inferring loop invariants via algorithmic learning”. In: *Mathematical Structures in Computer Science* 25.4 (2015), pp. 892–915.
- [12] Soonho Kong, Sicun Gao, Wei Chen, and Edmund Clarke. “dReach: Delta-Reachability Analysis for Hybrid Systems”. In: *Tools and Algorithms for the Construction and Analysis of Systems*. TACAS’15. New York, NY, USA: Springer-Verlag New York, Inc., 2015, pp. 200–205.
- [13] Bing Liu, Soonho Kong, Sicun Gao, Paolo Zuliani, and Edmund M. Clarke. “Towards Personalized Prostate Cancer Therapy Using Delta-reachability Analysis”. In: *Hybrid Systems: Computation and Control*. HSCC’15. Seattle, Washington: ACM, 2015, pp. 227–232.
- [14] Leonardo de Moura, Soonho Kong, Jeremy Avigad, Floris van Doorn, and Jakob von Raumer. “The Lean Theorem Prover (System Description)”. In: *Automated Deduction*. Ed. by Amy P. Felty and Aart Middeldorp. CADE’15. Cham: Springer International Publishing, 2015, pp. 378–388.
- [15] Qinsi Wang, Paolo Zuliani, Soonho Kong, Sicun Gao, and Edmund M. Clarke. “SReach: A Probabilistic Bounded Delta-Reachability Analyzer for Stochastic Hybrid Systems”. In: *Computational Methods in Systems Biology*. Ed. by Olivier Roux and Jérémie Bourdon. CMSB’15. Cham: Springer International Publishing, 2015, pp. 15–27.

- [16] Sicun Gao, Soonho Kong, and Edmund M. Clarke. “Proof Generation from Delta-Decisions”. In: *Symbolic and Numeric Algorithms for Scientific Computing*. SYNASC’14. Sept. 2014, pp. 156–163.
- [17] Bing Liu, Soonho Kong, Sicun Gao, Paolo Zuliani, and Edmund M. Clarke. “Parameter Synthesis for Cardiac Cell Hybrid Models Using δ -Decisions”. In: *Computational Methods in Systems Biology*. Ed. by Pedro Mendes, Joseph O. Dada, and Kieran Smallbone. CMSB’14. Cham: Springer International Publishing, 2014, pp. 99–113.
- [18] Sagar Chaki, Arie Gurfinkel, Soonho Kong, and Ofer Strichman. “Compositional Sequentialization of Periodic Programs”. In: *Verification, Model Checking, and Abstract Interpretation*. VMCAI’13. Rome, Italy: Springer-Verlag New York, Inc., 2013, pp. 536–554.
- [19] Sicun Gao, Soonho Kong, and Edmund M. Clarke. “dReal: An SMT Solver for Non-linear Theories over the Reals”. In: *Automated Deduction*. CADE’13. Lake Placid, NY: Springer-Verlag, 2013, pp. 208–214.
- [20] Sicun Gao, Soonho Kong, and Edmund M. Clarke. “Satisfiability modulo ODEs”. In: *Formal Methods in Computer-Aided Design*. FMCAD’13. 2013, pp. 105–112.
- [21] Yungbum Jung, Soonho Kong, Bow-Yaw Wang, and Kwangkeun Yi. “Deriving Invariants by Algorithmic Learning, Decision Procedures, and Predicate Abstraction”. In: *Verification, Model Checking, and Abstract Interpretation*. VMCAI’10. Madrid, Spain: Springer-Verlag, 2010, pp. 180–196.
- [22] Soonho Kong, Yungbum Jung, Cristina David, Bow-Yaw Wang, and Kwangkeun Yi. “Automatically Inferring Quantified Loop Invariants by Algorithmic Learning from Simple Templates”. In: *Asian Conference on Programming Languages and Systems*. APLAS’10. Shanghai, China: Springer-Verlag, 2010, pp. 328–343.
- [23] Soonho Kong, Wontae Choi, and Kwangkeun Yi. “Abstract Parsing for Two-staged Languages with Concatenation”. In: *Generative Programming and Component Engineering*. GPCE’09. Denver, Colorado, USA: ACM, 2009, pp. 109–116.
- [24] Soonho Kong, Wontae Choi, and Kwangkeun Yi. “PCC Framework for Program-Generators”. In: *Workshop on Proof-Carrying Code and Software Certification*. 2009.
- [25] Soonho Kong, Nikolai Tillmann, and Jonathan de Halleux. “Automated Testing of Environment-Dependent Programs - A Case Study of Modeling the File System for Pex”. In: *Information Technology: New Generations*. ITNG’09. Apr. 2009, pp. 758–762.

Patents

- [1] “Actively adapting to driving environments based on human interactions”. Soonho Kong, Jonathan DeCastro, Nikos Arechiga, and Frank Permenter United States Patent #11801852. October 2023.
- [2] “Certified control for self-driving cars”. Daniel Jackson, Jonathan Decastro, Soon Ho Kong, Nikos Arechiga Gonzalez, Dimitrios Koutentakis, Feng Ping Angela Leong, Mike Meichang Wang, And Xin Zhang United States Patent #11745732. September 2023.
- [3] “Predictive impairment monitor system and method”. Nikos Gonzalez Arechiga, Soon Ho Kong, Jonathan DeCastro, Frank Permenter, and Dennis Park United States Patent #11518408. December 2022.

- [4] “Predictive parking due to weather”. Nikos Gonzalez Arechiga, Soon Ho Kong, Jonathan DeCastro, Frank Permenter, and Dennis Park United States Patent #11479239. October 2022.
- [5] “Simulation-based Technique to Synthesize Controllers that Satisfy Signal Temporal Logic Specifications”. Nikos Arechiga, Karen Y. Leung, Soon Ho Kong, Jonathan Decastro, and Frank Permenter United States Patent #11256611. February 2022.
- [6] “System and Method for Detecting Errors and Improving Reliability of Perception Systems Using Logical Scaffolds”. Nikos Arechiga, Soonho Kong, Jonathan DeCastro, Sagar Behere, and Dennis Park United States Patent #11157756. October 2021.
- [7] “Actively Adapting To Driving Environments Based On Human Interactions”. Soonho Kong, Jonathan DeCastro, Nikos Arechiga, and Frank Permenter United States Patent #11072342. July 2021.
- [8] “Systems And Methods For Improving Situational Awareness Of A User”. Jonathan DeCastro, Frank Permenter, Soonho Kong, and Nikos Arechiga United States Patent #10621858. April 2020.

Professional Activities

Program Committee Member:

ADHS 2021, HSCC 2021, MEMOCODE 2021, MT-CPS 2021, HSCC 2020, MEMOCODE 2020, DARS 2019, HSCC 2019, MEMOCODE 2019, NSV 2019, DARS 2018, WSC 2018

External Reviewer:

IEEE-IV 2021, IEEE-IV 2020, POPL 2020, ATVA 2015, ASE 2014, FoSSaCS 2013, POPL 2013, APLAS 2012, SAS 2012, GPCE 2010, SPLASH 2010, CAV 2010, VMCAI 2010, SAS 2009, DEFECTS 2009, APLAS 2007