Hongfei Fu

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Research Interest

Formal Verification of Probabilistic Systems, Program Verification

Positions

Assistant Professor, Shanghai Jiao Tong University, September 2017 – present
Assistant Researcher, Institute of Software, Chinese Academy of Sciences, September 2016 – August 2017
Postdoc Researcher, Institute of Science and Technology Austria, May 2015 – August 2016
Assistant Researcher, Institute of Software, Chinese Academy of Sciences, February 2015 – May 2015

Education

Ph.D. in Computer Science, RWTH Aachen University, 2014
Thesis: "Verifying Probabilistic Systems: New Algorithms and Complexity Results"
Supervisor: Prof. Joost-Pieter Katoen
Master in Computer Science, Shanghai Jiao Tong University, September 2007 – March 2010
Bachelor in Computer Science, Shanghai Jiao Tong University, September 2003 – July 2007

Awards

Best Student Paper Award at the international conference HSCC 2013
Excellent Academic Scholarship (third-class) of Shanghai Jiao Tong University (academic year 2005 - 2006)
Excellent Academic Scholarship (third-class) of Shanghai Jiao Tong University (academic year 2004 - 2005)
Excellent Student (top 10%) of Shanghai Jiao Tong University (2004)
Excellent Academic Scholarship (first-class) of Shanghai Jiao Tong University (academic year 2003 - 2004)

Publications

Computational Approaches for Stochastic Shortest Path on Succinct MDPs. IJCAI-ECAI 2018, the 27th International Joint Conference on Artificial Intelligence and the 23rd European Conference on Artificial Intelligence, to appear.
CCF Rank A

Non-polynomial Worst-case Analysis of Recursive Programs (with Prof. Krishnendu Chatterjee and Amir Kafshdar Goharshady). Computer Aided Verification, 29th International Conference, CAV 2017.
CCF Rank A

Automated Recurrence Analysis for Almost-Linear Expected-Runtime Bounds (with Prof. Krishnendu Chatterjee and Aniket Murhekar). Computer Aided Verification, 29th International Conference, CAV 2017.
CCF Rank A

Termination Analysis of Probabilistic Programs Through Positivstellensatz's. (with Prof. Krishnendu Chatterjee and Amir Kafshdar Goharshady). Computer Aided Verification, 28th International Conference, CAV 2016.
CCF Rank A

Algorithmic analysis of qualitative and quantitative termination problems for affine probabilistic programs. (with Petr Novotný, Prof. Krishnendu Chatterjee and Rouzbeh Hasheminezhad). Proceedings of the 43rd Annual ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages, POPL 2016.
CCF Rank A

Maximal Cost-Bounded Reachability Probability on Continuous-Time Markov Decision Processes. Foundations of Software Science and Computation Structures, 17th International Conference, FOSSACS 2014, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2014.
CCF Rank B

Approximating acceptance probabilities of CTMC-paths on multi-clock deterministic timed automata. Proceedings of the 16th international conference on Hybrid systems: computation and control, HSCC 2013.
Best Student Paper, CCF Rank B

Computing Game Metrics on Markov Decision Processes. Automata, Languages, and Programming, 39th International Colloquium, ICALP 2012.

CCF Rank B

Model Checking EGF on Basic Parallel Processes. Automated Technology for Verification and Analysis, 9th International Symposium, ATVA 2011.
CCF Rank C

Deciding Probabilistic Simulation between Probabilistic Pushdown Automata and Finite-State Systems (with Prof. Joost-Pieter Katoen). IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2011.
CCF Rank C

Decidability of Behavioral Equivalences in Process Calculi with Name Scoping (with Chaodong He and Prof. Yuxi Fu). Fundamentals of Software Engineering - 4th IPM International Conference, FSEN 2011.

Branching Bisimilarity between Finite-State Systems and BPA or Normed BPP Is Polynomial-Time Decidable. Programming Languages and Systems, 7th Asian Symposium, APLAS 2009.
CCF Rank C

Projects

- Model Checking for Large-Scale Probabilistic Concurrent Real-Time Systems
  NSFC Key-Program Grant 61532019, 2.85 Million RMB, Jan. 2016 – Dec. 2020, participation
- Graph Games
  ERC Start Grant 279307, 1.2 Million Euro, Nov. 2011 – Nov. 2016, participation
- Quantitative Reactive Modelling
  ERC Advanced Grant 267989, 2 Million Euro, Mar. 2011 – Mar. 2016, participation

Research

Currently, I keep interest in both the following two directions.

Program Verification Program verification is the study to prove correctness of programs through logical and mathematical approach. My contributions in this area include the following. First, I extended the martingale-approach to probabilistic programs with non-determinism. In detail, I devised efficient algorithms for synthesizing linear ranking supermartingales over probabilistic programs with both angelic and demonic nondeterminism, and for synthesizing polynomial ranking supermartingales with demonic nondeterminism. Besides, I also established a new result through martingale theory that detects exponential-decreasing non-termination tail bounds over probabilistic programs with both angelic and demonic nondeterminism. Second, I developed an effective approach for worst-case analysis of recursive programs through synthesis of non-polynomial ranking functions. I also introduced an efficient approach for expected runtime analysis of recurrence relations derived from randomized algorithms.

Probabilistic Systems Formal verification of probabilistic systems aims to ensure quality of computer or physical systems with stochastic feature through rigorous reasoning. My contributions in this area include the following. First, I proved that deciding strong simulation preorder between probabilistic pushdown automata and finite-state systems is EXPTIME-complete, and obtained optimal parameterized computational complexity. Second, I proved that deciding bisimilarity metric over probabilistic automata lies in both NP and coNP, which is the best known complexity for this problem. Third, I devised the first model-checking algorithm for checking continuous-time Markov chains against deterministic-timed-automata specification with an unbounded number of clocks. Last but not the least, I developed the first model-checking algorithm for checking continuous-time Markov decision processes with cost-bounds and zero-costs.