YU WANG

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EDUCATION

Ph.D. in Mechanical Engineering 2018
University of Illinois at Urbana-Champaign
Dissertation: Statistical verification and differential privacy in cyber-physical systems
Committee: Geir E. Dullerud (Advisor), Magnus Egerstedt, Mahesh Viswanathan, Sayan Mitra, Matthew West
Nominated for CSL PhD Thesis Award

M.S. in Statistics 2017
University of Illinois at Urbana-Champaign

M.S. in Mathematics 2016
University of Illinois at Urbana-Champaign

M.S. in Mechanical Engineering 2014
University of Illinois at Urbana-Champaign
Dissertation: Stability of linear autonomous systems under regular switching sequences
Advisor: Geir E. Dullerud

B.E. in Engineering Mechanics 2012
Tsinghua University
Dissertation: A study of dynamic contact angles of shear-thickening power-law fluids
Advisor: Ke-Qin Zhu

RESEARCH INTERESTS

Automated analysis and design of cyber-physical, embedded computing or robotic systems with high-assurance on security and privacy via formal method, model checking and machine learning.

RESEARCH EXPERIENCE

Postdoctoral Associate 2018 - now
Duke University

Graduate Research Assistant 2012 - 2018
University of Illinois at Urbana-Champaign

Undergraduate Research Assistant 2009 - 2012
Tsinghua University

TEACHING AND MENTORING EXPERIENCE

Ph.D. Student Mentor 2018 - now
Mentees: Alper Bozkurt, Mahmoud Elfar, Siddhartha Nalluri, Mojtaba Zarei
Duke University

Teaching Assistant Spring 2018
Convex Methods in Control (ME 561)
University of Illinois at Urbana-Champaign

Teaching Assistant Spring 2017
Estimation and Stochastic Control (ME 598)
University of Illinois at Urbana-Champaign

PUBLICATIONS (JOURNALS)

[J1] **Yu Wang**, Alper Kamil Bozkurt, and Miroslav Pajic, "Attack-Resilient Supervisory Control of Discrete Event Systems", IEEE Transactions on Automatic Control (**TAC**), 2019, **under review**.

[J2] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Verifying Stochastic Hybrid Systems with Temporal Logic Specifications via Mori-Zwanzig Model Reduction", IEEE Transactions on Automatic Control (**TAC**), 2019, **under review**.

[J3] **Yu Wang**, Mojtaba Zarei, Borzoo Bonakdarpour, and Miroslav Pajic, "Statistical Verification of Hyperproperties for Cyber-Physical Systems", ACM Transactions on Embedded Computing Systems (**TECS**), part of the ESWEEK-TECS special issue, presented in the ACM SIGBED International Conference on Embedded Software (**EMSOFT**), 2019, **to appear**. **(Best Paper Award Finalist)**

[J4] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Statistical Verification of PCTL Using Antithetic and Stratified Samples", Formal Methods in System Design (**FMSD**), 2019, **to appear**.

[J5] **Yu Wang**, Xuan Bi, and Annie Qu, "A Logistic Factorization Model for Recommender Systems with Multinomial Responses", Journal of Computational and Graphical Statistics (**JCGS**), 2019, **to appear**.

[J6] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Stability Analysis of Switched Linear Systems Defined by Regular Languages", IEEE Transactions on Automatic Control (**TAC**), vol. 26, no. 5, pp. 2568-2575, May 2017.

[J7] **Yu Wang**, Zhenqi Huang, Sayan Mitra, and Geir E. Dullerud, "Differential Privacy in Linear Distributed Control Systems: Entropy Minimizing Mechanisms and Performance Tradeoffs", IEEE Transactions on Control of Network Systems (**TCNS**), vol. 4, no. 1, pp. 118-130, March 2017.

[J8] **Yu Wang** and Ke-Qin Zhu, "A Study of Dynamic Contact Angles of Shear-Thickening Power-Law Fluids", Physics of Fluids (**PoF**), vol. 26, no. 5, p. 052103, May 2014.

PUBLICATIONS (CONFERENCES)

[C1] Mojtaba Zarei, **Yu Wang**, and Miroslav Pajic, "Statistical Verification of Learning-Enabled Controlled Systems", 23rd ACM International Conference on Hybrid Systems: Computation and Control (**HSCC**), 2020, **under review**.

[C2] **Yu Wang**, Siddhartha Nalluri, Borzoo Bonakdarpour, and Miroslav Pajic, "Statistical Model Checking for Hyperproperties", International Conference on Tools and Algorithms for the Construction and Analysis of Systems (**TACAS**), 2020, **under review**.

[C3] Nima Roohi, **Yu Wang**, Matthew West, Geir E Dullerud, and Mahesh Viswanathan, "STMC: Statistical Model Checker with Stratified and Antithetic Sampling", International Conference on Tools and Algorithms for the Construction and Analysis of Systems (**TACAS**), 2020, **under review**.

[C4] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Verifying PCTL Specifications on Markov Decision Processes via Reinforcement Learning", 21st International Conference on Verification, Model Checking, and Abstract Interpretation (**VMCAI**), 2020, **under review**.

[C5] **Yu Wang** and Miroslav Pajic, "Hyperproperties for Robotics: Motion Planning via HyperLTL", IEEE International Conference on Robotics and Automation (**ICRA**), 2020, **under review**.

[C6] Alper Kamil Bozkurt, **Yu Wang**, Michael Zavlanos, and Miroslav Pajic, "Control Synthesis from Linear Temporal Logic Specifications Using Model-Free Reinforcement Learning", IEEE International Conference on Robotics and Automation (**ICRA**), 2020, **under review**.

[C7] **Yu Wang** and Miroslav Pajic, "Attack-Resilient Supervisory Control with Intermittently Secure Communication", 58th IEEE Conference on Decision and Control (**CDC**), 2019, **to appear**.

[C8] **Yu Wang** and Miroslav Pajic, "Supervisory Control of Discrete Event Systems in the Presence of Sensor and Actuator Attacks", 58th IEEE Conference on Decision and Control (**CDC**), 2019, **to appear**.

[C9] **Yu Wang**, Mojtaba Zarei, Borzoo Bonakdarpour, and Miroslav Pajic, "Statistical Verification of Hyperproperties for Cyber-Physical Systems", ACM Transactions on Embedded Computing Systems (**TECS**), part of the ESWEEK-TECS special issue, presented in the ACM SIGBED International Conference on Embedded Software (**EMSOFT**), 2019, **to appear**. **(Best Paper Award Finalist)**

[C10] Mahmoud Elfar, **Yu Wang** and Miroslav Pajic, "Security-Aware Synthesis Using Delayed-Action Games", 31st International Conference on Computer-Aided Verification (**CAV**), pp. 180-199, New York, NY, July 2019.

[C11] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Statistical Verification of PCTL Using Stratified Samples", 6th IFAC Conference on Analysis and Design of Hybrid Systems (**ADHS**), IFAC-PapersOnLine, Vol. 51, no. 1, pp. 85-90, Oxford, UK, July 2018.

[C12] **Yu Wang**, Sayan Mitra, and Geir E. Dullerud, "Differential Privacy and Minimum-Variance Unbiased Estimation in Multi-Agent Control Systems", 20th IFAC World Congress (**WC**), IFAC-PapersOnLine, Vol. 50, pp. 9521-9526, Toulouse, France, July 2017.

[C13] Nima Roohi, **Yu Wang**, Matthew West, Geir E. Dullerud, and Mahesh Viswanathan, "Statistical Verification of the Toyota Powertrain Control Verification Benchmark", 20th ACM International Conference on Hybrid Systems: Computation and Control (**HSCC**), pp. 65-70, Pittsburgh, PA, April 2017.

[C14] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Verifying Continuous-Time Stochastic Hybrid Systems via Mori-Zwanzig Model Reduction", 55th IEEE Conference on Decision and Control (**CDC**), pp. 3012-3017, Las Vegas, NV, December 2016.

[C15] **Yu Wang**, Hale Hale Matthew, Magnus Egerstedt, and Geir E. Dullerud, "Differentially Private Objective Functions in Distributed Cloud-Based Optimization", 55th IEEE Conference on Decision and Control (**CDC**), pp. 3688-3694, Las Vegas, NV, December 2016.

[C16] Zhenqi Huang, **Yu Wang**, Sayan Mitra, and Geir E. Dullerud, "Controller Synthesis for Linear Dynamical Systems with Adversaries", 3rd ACM Symposium and Bootcamp on the Science of Security (**HoTSoS**), pp. 53-62, Pittsburgh, PA, April 2016.

[C17] Zhenqi Huang, **Yu Wang**, Sayan Mitra, Geir E. Dullerud, and Swarat Chaudhuri, "Controller Synthesis with Inductive Proofs for Piecewise Linear Systems: An SMT-Based Algorithm", 54th IEEE Conference on Decision and Control (**CDC**), pp. 7434-7439, Osaka, Japan, December 2015.

[C18] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "A Mori-Zwanzig and MITL Based Approach to Statistical Verification of Continuous-Time Dynamical Systems", 5th IFAC Conference on Analysis and Design of Hybrid Systems (**ADHS**), IFAC-PapersOnLine, Vol. 48, no. 27, pp. 267-273, Atlanta, GA, October 2015.

[C19] **Yu Wang**, Nima Roohi, Matthew West, Mahesh Viswanathan, and Geir E. Dullerud, "Statistical Verification of Dynamical Systems Using Set Oriented Methods", 18th ACM International Conference on Hybrid Systems: Computation and Control (**HSCC**), pp. 169-178, Seattle, WA, April 2015.

[C20] **Yu Wang**, Zhenqi Huang, Sayan Mitra, and Geir E. Dullerud, "Entropy-Minimizing Mechanism for Differential Privacy of Discrete-Time Linear Feedback Systems", 53rd IEEE Conference on Decision and Control (**CDC**), pp. 2130-2135, Los Angeles, CA, December 2014.

[C21] **Yu Wang**, Nima Roohi, Geir E. Dullerud, and Mahesh Viswanathan, "Stability of Linear Autonomous Systems under Regular Switching Sequences", 53rd IEEE Conference on Decision and Control (**CDC**), pp. 5445-5450, Los Angeles, CA, December 2014.

[C22] Zhenqi Huang, **Yu Wang**, Sayan Mitra, and Geir E. Dullerud, "On the Cost of Differential Privacy in Distributed Control Systems", 3rd International Conference on High Confidence Networked Systems

(**HiCoNS**), pp. 105-114, Berlin, Germany, April 2014.

SOFTWARE ARTIFACTS

[A1] ARSC: Design tool for attack-resilient supervisory controllers.
`https://gitlab.oit.duke.edu/cpsl/arsc`

[A2] HyperSMC: Statistical model checker for hyper probabilistic temporal logics.
`https://gitlab.oit.duke.edu/cpsl/hypersmc`

[A3] MPHyper: Symbolic motion planner for HyperLTL objectives.
`https://gitlab.oit.duke.edu/cpsl/mp_hyper`

[A4] STMC: Statistical model checker with stratified and antithetic sampling.
`https://nima-roohi.github.io/STMC/#/`

[A5] CSRL: Control synthesis for LTL objectives by reinforcement learning.
`https://gitlab.oit.duke.edu/cpsl/csrl`

[A6] SMCLearning: Statistical model checker for deep-neural-network-enabled cyber-physical systems.
`https://gitlab.oit.duke.edu/cpsl/smclearning`

RESEARCH PROPOSALS

Collaborative Research: SHF: Medium: Foundations of Formal and Scalable Verification of Hyperproperties in Probabilistic Systems, submitted on 09/30/2019 as **Senior Personnel** (with PI: Borzoo Bonakdarpour, Iowa State University and PI: Miroslav Pajic, Duke University).

HONOR AND AWARDS

Best Paper Finalist 2019
ACM SIGBED International Conference on Embedded Software (**EMSOFT**)

CSL PhD Thesis Award Nomination 2018
Coordinated Science Laboratory, University of Illinois at Urbana-Champaign

George B. Grim Fellowship 2012
Department of Mechanical Engineering, University of Illinois at Urbana-Champaign

INVITED TALKS

[T1] “Verifying the Security of Cyber-Physical Systems”, Postdoc Plenary Talk, Southeast Controls Conference, Atlanta, GA, September 2019.

[T2] “Verifying the Security of Cyber-Physical Systems”, Department of Computer Science, Iowa State University, September 2019.

[T3] “Security and Privacy in Cyber-Physical Systems”, Kevin T. Crofton Department of Aerospace and Ocean Engineering, Virginia Polytechnic Institute and State University, February 2019.

[T4] “Statistical Verification and Differential Privacy in Cyber-Physical Systems”, Department of Electrical and Computer Engineering, University of New Mexico, May 2018.

[T5] “Statistical Verification and Differential Privacy in Cyber-Physical Systems”, GRASP Lab, Department of Electrical and Systems Engineering, University of Pennsylvania, November 2017.

[T6] “Differential Privacy, Entropy and Security in Distributed Control of Cyber Physical Systems”, TSS/SoS Seminar, Information Trust Institute, University of Illinois at Urbana-Champaign, April 2016.

[T7] “A Mori-Zwanzig and MITL Based Approach to Statistical Verification of Continuous-time Dynamical Systems”, Midwest Verification Day, Urbana, IL, October 2015.

ACADEMIC SERVICES

Reviewer for American Control Conference (**ACC**) '17-'19, European Control Conference (**ECC**) '16, Conference on Decision and Control (**CDC**) '16-'19, International Conference on Hybrid Systems: Computation and Control (**HSCC**) '17, International Conference on Cyber-Physical Systems (**ICCPS**) '16-'19, International Conference on integrated Formal Methods (**iFM**) '19, Conference on Decision and Game Theory for Security (**GameSec**) '19, IEEE Transactions on Automatic Control (**TAC**), IEEE Transactions on Control of Network Systems (**TCNS**), Control Systems Letters, (**L-CSS**) IEEE Transactions on Signal Processing, (**TSP**) IEEE Transactions on Intelligent Transportation Systems (**TITS**), and Automatica.