Yehan Ma 马叶涵

Ph.D. Candidate (fifth-year)

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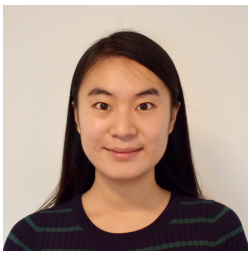

Research Interests

Industrial Internet of Things (IIoT).
Cyber-Physical Systems.
Embedded Systems.
Edge Computing.
Wireless Sensor Networks.
Machine Learning.

Education

Washington University in St. Louis — St. Louis, MO, U.S.
- *Ph.D. candidate in Computer Science; Advisor: Prof. Chenyang Lu* — *Aug. 2015 – present*
  GPA: 3.95/4.0

Harbin Institute of Technology — Harbin, China
- *M.S. in Control Science and Engineering; Advisor: Prof. Changhong Wang* — *Aug. 2013 – Jul. 2015*
  GPA: 95.2/100, Rank: 3/161

Harbin Institute of Technology — Harbin, China
- *B.S. in Automation* — *Aug. 2009 – Jul. 2013*
  GPA: 93.2/100, Rank: 1/123

Professional Experience

- **Washington University in St. Louis** — St. Louis, MO, U.S.
  Graduate Research Assistant — *Aug. 2015 – present*
  Teaching Assistant of Wireless Sensor Networks (CSE 521S) — *2017 Spring, 2018 Spring*
  Teaching Assistant of Real-Time Systems (CSE 520S) — *2017 Fall*
- **Mitsubishi Electric Research Laboratories** — Boston, MA, U.S.
  Research Intern — *May. 2017 - Aug. 2017, May. 2018 - Aug. 2018*
- **Harbin Institute of Technology** — Harbin, China
  Graduate Research Assistant — *May. 2013 – Jul. 2015*

Research Experience

- **Cyber-Physical Systems Laboratory** — Washington University in St. Louis
  Research Assistant — *Aug. 2015 - Present*

1. **Learning-based optimization for multi-tier control of cyber-physical systems** **(Nov. 2019 - Aug. 2020)**

We establish a learning-based approach that dynamically optimizes control performance by switching between local and edge controllers in response to changing network conditions, while guaranteeing system stability based on an extended Simplex approach tailored for two-tier platforms. The data-driven approach addresses the theoretical challenges of analyzing control performance over various control systems and network characteristics. (**Submitted Publication:**[**1**])

2. **Implementation of dynamic network scheduling for cyber-physical systems (Jan. 2019 - Jan. 2020)**
   We design and implement the dynamic TDMA scheduling protocol for IEEE 802.15.4 network. To evaluate dynamic wireless scheduling for control over real-world wireless dynamics, we develop network-in-the-loop simulations. (Collaboration with Mitsubishi Electric Research Laboratories)
3. **Exploring edge computing for multi-tier industrial control (Sep. 2018 - Oct. 2019)**
   We explore edge computing as a multi-tier computing platform for holistic control. We propose a *switching multi-tier control* architecture to dynamically optimize the control performance. To evaluate the proposed systems, we build a real-time hybrid simulator, WCPS-EC, which integrates real local/edge computation platforms, real or simulated wired/wireless networks, and physical plants simulated by MATLAB/Simulink.
4. **Efficient holistic control over industrial wireless sensor-actuator networks (Mar. 2017 - May. 2018)**
   We explore efficient holistic control designs to maintain control performance while reducing the communication cost. We introduce a holistic control architecture that integrates low-power wireless bus (LWB) and two control strategies, rate adaptation and self-triggered control, specifically proposed to reduce communication cost. We design robust network reconfiguration protocols to support rate adaptation and self-triggered control, respectively, in a multi-hop WSAN. We build a real-time network-in-the-loop simulator, WCPS-RT, which integrates MATLAB/Simulink and a three-floor WSAN testbed to evaluate efficient holistic control designs. (**Publication:**[**2,7**])
5. **Holistic management for dependable wireless control system (Mar. 2016 - Apr. 2017)**
   To enhance the dependability of industrial wireless control, we propose a holistic cyber-physical management framework that employs run-time coordination between the plant control and network management. Our design includes a holistic controller that generates actuation signals to physical plants and reconfigures the WSAN. The framework can enhance the dependability of wireless control system in the face of both physical disturbance and wireless interference. (**Publication:**[**3**])
6. **Cyber-physical case study of wireless routing and control (Aug. 2015 - Feb. 2016)**
   The control design of wireless control system integrates extended Kalman Filter (EKF), model predictive controller (MPC), and buffered actuation to eliminate the packet loss in wireless network. In network side, we propose a flexible asymmetric routing approach tailored for wireless control system. Open source WCPS v3.0 (Docker): http://wcps.cse.wustl.edu. (**Publication:**[**8**])

- **Mitsubishi Electric Research Laboratories** Mitsubishi Electric Research Laboratories
  Research Intern *May. 2017 - Aug. 2017, May. 2018 - Aug. 2018*

1. **Optimal dynamic scheduling of wireless networked control systems (May. 2018 - Aug. 2018)**
   Suffering from limited bandwidth and nondeterministic link quality, in order to bridge the gap between network design and control system performance, we propose an optimal dynamic scheduling strategy that optimizes performance of multi-loop control systems by allocating network resources based on predictions of both link quality and control performance at run-time. (**Publication:**[**5**])
2. **A smart actuation architecture for wireless networked control systems (May. 2017 - Aug. 2017)**
   In order to addresses the safety concern of closing the control loop using wireless network, we present a smart actuation architecture, which deploys (1) a remote controller, which communicates with physical plant via wireless network, accounting for optimality, adaptation, and constraints by conducting computationally expensive operations; (2) a smart

actuator, which co-locates with the physical plant, executing a local control policy and accounting for system safety in the view of network imperfections. (**Publication:[6, 11]**)

- **Space Control and Inertial Technology Research Center** Harbin Institute of Technology
  Research Assistant *May. 2012 - July 2015*

1. **Build the analysis system for office health based on Kinect (Jun. 2014 - Jun. 2015)**
   It is my thesis of M.S. degree, which aims at designing a product for office workers by correcting seat positions and counting common actions and their frequencies, using learning-based approaches such as HMM and DTW. (It is awarded Gold-medal Master Thesis of Harbin Institute of Technology.)
2. **Design and implement real-time semi-physical simulations of OTV (Nov. 2012 - Jul. 2013)**
   Real-time simulation systems of the model of orbital transfer vehicle (OTV) were designed in two ways based on xPC Target and mix-programming of LabVIEW/SIT companied with MATLAB/Simulink, respectively. Set the real-time simulation system of OTV in the spacecraft ground test system via fiber-optic reflective memory, and the test bed was driven to realize the 3 degrees of freedom translation. (**Publication:[9]**)
3. **Participate in designing the real-time control program of 3-DoF robot (May. 2012 - Aug. 2012)**
   The control program could drive the motors of robot to realize different forms of motion according to the external command, such as monotone-increasing wave, sine wave, square wave and trapezoidal wave. Satisfy the requirements of the properties such as stability, rapidity, overshoot and accuracy of the 3-degree-of-freedom robot by adjusting the control parameters of the controller and filtering of the signal.

Honors and Awards

Fullgraf Fellowship (20 named fellowships in Engineering School)	*2020,2019,2018,2017,2016*
Honors Award (top 15-20%) in annual Periodic Review of Doctoral Students (Started 2020)	*2020*
Gold-medal Master Thesis of HIT	*2015*
Samsung Scholarship	*2014*
First Level Graduate Student Scholarship	*2014,2013*
National Postgraduate Mathematic Contest in Modeling: Second Prize	*2014*
Excellent Graduate	*2013*
National Scholarship of China	*2011*
Outstanding Student	*2014,2011,2010*
People Scholarship	*2013,2012,2011,2010*
Excellent Student Leader	*2010*
88412 Scholarship	*2010*

Publications

Journals:

1. **Yehan Ma**, Chenyang Lu, Bruno Sinopoli, and Shen Zeng. "Exploring Edge Computing for Multi-Tier Industrial Control." *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)(Journal track of EMSOFT)*, (2020), **accepted**.
2. **Yehan Ma**, Chenyang Lu and Yebin Wang, "Efficient Holistic Control: Self-Awareness across Controllers and Wireless Networks." *ACM Transactions on Cyber-Physical Systems (TCPS)* 4, no. 4 (2020): 41.

3. **Yehan Ma**, Dolvara Gunatilaka, Bo Li, Humberto Gonzalez, and Chenyang Lu. "Holistic cyber-physical management for dependable wireless control systems." *ACM Transactions on Cyber-Physical Systems (TCPS)* 3, no. 1 (2018): 3.
4. Jiayu Li, Haoran Li, **Yehan Ma**, Yang Wang, Ahmed A. Abokifa, Chenyang Lu, and Pratim Biswas. "Spatiotemporal distribution of indoor particulate matter concentration with a low-cost sensor network." *Building and Environment* 127 (2018): 138-147.

Conferences:

5. **Yehan Ma**, Jianlin Guo, Yebin Wang, Ankush Chakrabarty, Heejin Ahn, Philip Orlik, and Chenyang Lu. "Optimal dynamic scheduling of wireless networked control systems." In *Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS 2019)*, pp. 77-86. ACM, 2019. **(acceptance rate: 23.0%)**
6. **Yehan Ma**, Yebin Wang, Stefano Di Cairano, Toshiaki Koike-Akino, Jianlin Guo, Philip Orlik, and Chenyang Lu. "A smart actuation architecture for wireless networked control systems." In *2018 IEEE Conference on Decision and Control (CDC 18)*, pp. 1231-1237. IEEE, 2018.
7. **Yehan Ma**, and Chenyang Lu. "Efficient holistic control over industrial wireless sensor-actuator networks." In *2018 IEEE International Conference on Industrial Internet (ICII 2018)*, pp. 89-98. IEEE, 2018. **(acceptance rate: 27.3%)**
8. Bo Li*, **Yehan Ma***, Tyler Westenbroek, Chengjie Wu, Humberto Gonzalez, and Chenyang Lu. "Wireless routing and control: a cyber-physical case study." In *2016 ACM/IEEE 7th International Conference on Cyber-Physical Systems (ICCPS 16)*, pp. 1-10. IEEE, 2016.**(co-first-author)(acceptance rate: 27.8%)**
9. **Yehan Ma**, Mingxiang Ling, Changhong Wang, and Qingshuang Zeng. "Design and implementation of real-time simulation system of OTV based on xPC target and SIT." In *Proceeding of the 11th World Congress on Intelligent Control and Automation (WCICA 14)*, pp. 5896-5900. IEEE, 2014.
10. An Zou, Hui Zhao, **Yehan Ma**, and Da Li. "Analysis calculation and testing of rotary inductosyn angle measuring errors." In *Proceedings of the 33rd Chinese Control Conference (CCC 14)*, pp. 8091-8096. IEEE, 2014.

Patents:

11. Yebin Wang, **Yehan Ma**, Philip Orlik, Toshiaki Koike-akino, Jianlin Guo. "Network Adapted Control System." In *United States Patent Application 20200192336*, 2020.

Professional Service Activities

IFAC Reviewer	*2019*
IEEE TII Reviewer	*2019*
IEEE RTAS Secondary Reviewer	*2018*
ACM TCPS Reviewer	*2017*
IEEE ESL Reviewer	*2017*

Technique Skills

Programming Languages: *C/C++; M language; Python; SQL; Latex*

Software: *MATLAB; TOSSIM; VIM; Gurobi; LabVIEW; PostgreSQL*

Operating System: *Linux; Contiki OS; Mac OS X; Windows; TinyOS*