

# MINGSHUAI CHEN

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## EDUCATION

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### Chinese Academy of Sciences

*Ph.D. Candidate in Computer Science & Control*

Sep. 2013 - Jun. 2019

*Advisor: Prof. Dr. Naijun Zhan*

- Research Interests: Modelling, Verification and Synthesis of Hybrid Systems – Reachability Computation; Program Reasoning; Interpolant/Invariant Synthesis; Time-Delayed Systems
- Dissertation (tentative): Verification and Synthesis of Time-Delayed Dynamical Systems

### Carl von Ossietzky Universität Oldenburg

*Visiting Scholar in Dpt. für Informatik*

Fall, 2015 - 2018

*Advisor: Prof. Dr. Martin Fränzle*

### Jilin University

*B.Sc. in Computer Science & Technology*

Sep. 2009 - Jun. 2013

## RESEARCH INTERESTS

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My research interest lies in formal reasoning of programs and hybrid systems, for ensuring the reliability and effectiveness of software systems, especially embedded software systems. This is an interdisciplinary subject that spans the areas of mathematics, computer science and control theory. The formal techniques that I have been interested in includes computer algebra, symbolic computation, automated/interactive theorem proving, linear/quadratic/semi-definite programming, SAT/SMT-solving, abstract interpretation, validated simulation-based approximation, process algebra, interval arithmetic, temporal logic, etc. In particular, I have been working on formal modelling and verification of hybrid systems, reachability computation for differential dynamics, interpolant synthesis over nonlinear arithmetic, as well as termination analysis of polynomial programs with equality conditions. Recently I have been focusing on formal verification of delayed differential dynamics and controller synthesis for games under delayed interactions, as the first attempts to address delays in the scope of automatic verification/synthesis.

## HONORS & AWARDS

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Distinguished Paper Award of ATVA 2018	Oct. 2018
National Scholarship	Oct. 2018
Selected Participant of the 6th Heidelberg Laureate Forum	Sep. 2018
Outstanding Student Award of UCAS Scientific Research Project	Dec. 2013
Outstanding Graduation Design of Dpt. CCST, Jilin University	Jun. 2013
National Motivational Scholarship	Oct. 2012
SAMSUNG Scholarship	Sep. 2011
National Scholarship	Oct. 2010

## GRANTS

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[Co-I] NSFC-61872341 “Formal Verification of Delayed Dynamical and Hybrid Systems”	
SAP Grant at the 6th Heidelberg Laureate Forum	Sep. 2018
Travel Grant from the PhD Academic Visiting Program of ISCAS	Aug. 2017
Accommodation Grant from the 4th SAT/SMT Summer School	Jul. 2014

## SELECTED PUBLICATIONS

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- [1] M. Fränzle, M. Chen, and P. Kröger. In memory of Oded Maler: Automatic reachability analysis of hybrid-state automata. *ACM SIGLOG News*, 6(1):19–39, 2019.
- [2] S. Feng, M. Chen, N. Zhan, M. Fränzle, and B. Xue. Taming delays in dynamical systems: Unbounded verification of delay differential equations. In *Computer Aided Verification - 31st International Conference, CAV 2019, New York City, USA, July 13-18, 2019, Proceedings*, 2019. To appear.
- [3] M. Chen, J. Wang, J. An, B. Zhan, D. Kapur, and N. Zhan. Nil: Learning nonlinear interpolants. In *Automated Deduction - 27th International Conference, CADE 2019, Natal, Brazil, August 23-30, 2019, Proceedings*, 2019. To appear.
- [4] T. Gan, M. Chen, Y. Li, B. Xia, and N. Zhan. Reachability analysis for solvable dynamical systems. *IEEE Trans. Automat. Contr.*, 63(7):2003–2018, 2018.
- [5] M. Chen, M. Fränzle, Y. Li, P. N. Mosaad, and N. Zhan. What’s to come is still unsure - synthesizing controllers resilient to delayed interaction. In *Automated Technology for Verification and Analysis - 16th International Symposium, ATVA 2018, Los Angeles, CA, USA, October 7-10, 2018, Proceedings*, pages 56–74, 2018. [Distinguished Paper Award].
- [6] B. Xue, P. N. Mosaad, M. Fränzle, M. Chen, Y. Li, and N. Zhan. Safe over- and under-approximation of reachable sets for delay differential equations. In *Formal Modeling and Analysis of Timed Systems - 15th International Conference, FORMATS 2017, Berlin, Germany, September 5-7, 2017, Proceedings*, pages 281–299, 2017.
- [7] M. Chen, X. Han, T. Tang, S. Wang, M. Yang, N. Zhan, H. Zhao, and L. Zou. MARS: A toolchain for modelling, analysis and verification of hybrid systems. In *Provably Correct Systems*, pages 39–58. 2017.
- [8] T. Gan, L. Dai, B. Xia, N. Zhan, D. Kapur, and M. Chen. Interpolant synthesis for quadratic polynomial inequalities and combination with EUF. In *Automated Reasoning - 8th International Joint Conference, IJCAR 2016, Coimbra, Portugal, June 27 - July 2, 2016, Proceedings*, pages 195–212, 2016.
- [9] T. Gan, M. Chen, Y. Li, B. Xia, and N. Zhan. Computing reachable sets of linear vector fields revisited. In *2016 European Control Conference, ECC 2016, Aalborg, Denmark, June 29 - July 1, 2016*, pages 419–426, 2016.
- [10] M. Chen, A. P. Ravn, S. Wang, M. Yang, and N. Zhan. A two-way path between formal and informal design of embedded systems. In *Unifying Theories of Programming - 6th International Symposium, UTP 2016, Reykjavík, Iceland, June 4-5, 2016, Revised Selected Papers*, pages 65–92, 2016.
- [11] M. Chen, M. Fränzle, Y. Li, P. N. Mosaad, and N. Zhan. Validated simulation-based verification of delayed differential dynamics. In *Formal Methods - 21st International Symposium, FM 2016, Limassol, Cyprus, November 9-11, 2016, Proceedings*, pages 137–154, 2016.
- [12] T. Gan, M. Chen, L. Dai, B. Xia, and N. Zhan. Decidability of the reachability for a family of linear vector fields. In *Automated Technology for Verification and Analysis - 13th International Symposium, ATVA 2015, Shanghai, China, October 12-15, 2015, Proceedings*, pages 482–499, 2015.

## SELECTED TALKS

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1. “Modelling · Verification · Synthesis - A Peek into the Blueprint of Hybrid Systems”, *RWTH Aachen University, Aachen & Technische Universität München*, München, Germany, Oct. 2018.
2. “What’s to Come is Still Unsure - Synthesizing Controllers Resilient to Delayed Interaction”, *ATVA*, Los Angeles, USA, Oct. 2018 & *CAP*, Beijing, China, Sep. 2018.
3. “Towards Delays in Dynamical and Control Systems - Verification & Synthesis”, *Universität des Saarlandes*, Saarbrücken, Germany, Jul. 2016 & *LEDS*, Shanghai, China, Dec. 2016.

4. “Validated Simulation-Based Verification of Delayed Differential Dynamics”, *FM*, Limassol, Cyprus, Nov. 2016.
5. “Computing Reachable Sets of Linear Vector Fields Revisited”, *ECC*, Aalborg, Denmark, Jun. 2016.
6. “A Two-Way Path between Formal and Informal Design of Embedded Systems”, *UTP&iFM*, Reykjavik, Iceland, Jun. 2016.
7. “HHL Prover: An Improved Interactive Theorem Prover for Hybrid Systems”, *ICFEM*, Paris, France, Nov. 2015.
8. “Decidability of the Reachability for a Family of Linear Vector Fields”, *ATVA*, Shanghai, China, Oct. 2015.

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## ACADEMIC SERVICES

### Graduate Teaching Assistant

Theories of Programming, Univ. of Chinese Academy of Sciences Fall, 2018 - 2019

### Organizer & Volunteer

Volunteer of CONFESTA 2018 Sep. 2018

Organization Committee Member of the Summer School on Formal Methods 2018 Aug. 2018

### Reviewer

MEMOCODE '18, ATVA '15/18, ADHS '18, ICECCS '17, TIME '16, VSTTE '16, UTP '16, ECC '16, TASE '15, NAHS, Chaochen Zhou's Festschrift

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## VISITS & PARTICIPATIONS

### Academic Visits

Dpt. für Informatik, Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany Fall, 2015 - 2018

Chair for Software Modelling and Verification, RWTH Aachen University, Aachen, Germany Oct. 2018

Chair of Robotics, AI and Real-time Syst., Technische Universität München, München, Germany Oct. 2018

Dpt. of Computer Science, Universität des Saarlandes, Saarbrücken, Germany Jul. 2016

### Conferences & Workshops

HLF '18, CONFESTA '18, CAV '17, SETTA '17, FM '16, ECC '16, iFM&UTP '16, ICFEM '15, ATVA '15/18; CAP '17/18, FMAC '16/17, YR-SETTA '15, SAVE '14, CDZ '14, LEDS '14/16

### Summer/Autumn Schools

The Summer School on Formal Methods 2018, Beijing, China Aug. 2018

The 3rd School on Engineering Trustworthy Software Systems, Chongqing, China Apr. 2017

The 2nd AVACS Autumn School, Oldenburg, Germany Oct. 2015

The 4th Summer School in Symbolic Computation, Beijing, China Aug. 2015

The 5th Summer School on Formal Techniques, Atherton, CA, USA May 2015

The 4th SAT/SMT Summer School, Semmering, Austria Jul. 2014

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## EXTRACURRICULAR ACTIVITIES

3rd Prize in American Interdisciplinary Contest in Modelling Jan. 2012  
*Criminal Network Analysis*

1st Provincial Prize in Chinese Undergraduate Mathematical Contest in Modelling Dec. 2011  
*Detecting Sources of the Heavy Metal Pollution in Urban Topsoil*

2nd Prize in Jilin Undergraduate Mathematical Contest in Modelling Jul. 2011  
*Transportation Analysis Based on Taxi-GPS Data in Shenzhen*

1st Prize in Jilin University ACM Programming Competition Feb. 2010

## TECHNICAL SKILLS

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<b>Programming Languages</b>	C/C++, Mathematica, Maple, Matlab/Simulink, L <sup>A</sup> T <sub>E</sub> X
<b>Operating Systems</b>	Unix/Linux, macOS, Windows (dedicated to video games)
<b>Software Tools</b>	ARCH toolset, ATP/ITP, model checkers, SDP solvers, algebra systems

## LANGUAGES

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English: fluent	German: for survival only	Chinese: mother-tongue
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