Shenyu Liu

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TEACHING INTERESTS

Control systems, digital control systems, linear systems and control, random process, nonlinear systems and control, optimal control, switched/hybrid systems.

RESEARCH INTERESTS

Stability of nonlinear systems, switched/hybrid systems, data-driven approaches.

POSITIONS

Beijing Institute of Technology, China

- *Assistant Professor* in School of Automation 04/2022 – present

University of California, San Diego, USA

- *Postdoctoral Scholar* in Department of Mechanical and Aerospace Engineering 02/2020 – 04/2022

Mentors: Jorge Cortes, Sonia Martinez.

EDUCATION

University of Illinois at Urbana Champaign, USA

- Ph.D., Electrical and Computer Engineering 01/2016 – 05/2020

Supervisors: Daniel Liberzon, Mohamed-Ali Belabbas.

Dissertation: *Nonlinear and Switched Systems: Geometric Motion Planning, Non-Monotonic Lyapunov Functions and Input-to-State Stability*

- M.S., Mechanical Engineering 08/2014 – 12/2015

National University of Singapore, Singapore

- B.S., Mathematics 08/2010 – 06/2014
- B.E., Mechanical Engineering 08/2010 – 06/2014

FUNDED PROJECTS

"Modeling, analysis and stabilizer design of cyber-physical systems: a hybrid system based approach," National Science Foundation of China, 62203053, 2023-2025.

TEACHING

Beijing Institute of Technology, School of Automation, 2022 - present

- Image processing techniques (0600042, graduate)

TEACHING ASSISTANTSHIP

University of California, San Diego, Department of Mechanical and Aerospace Engineering, 2021

- Hybrid Systems (MAE286, graduate)

University of Illinois at Urbana-Champaign, Department of Electrical and Computer Engineering, 2016-2019

- Control Systems (ECE486, undergraduate)
- Optimum Control Systems (ECE553, graduate)

University of Illinois at Urbana-Champaign, Department of Mechanical Science and Engineering, 2014-2015

- Dynamics of Mechanical Systems (ME340, undergraduate)
- Introduction to Robotics (ME445, undergraduate)

PUBLICATIONS

Working papers

- P. Wen and **S. Liu**. Stability Analysis and Moment Estimation for Randomly Impulsive Switched Systems with Restrictions. Submitted to *Automatica*.
- **S. Liu** and A. Tanwani. Impulsive switching signals with functional inequalities: Stability analysis using hybrid systems framework. Submitted to *Automatica*.
- **S. Liu**, J. Cortes and S. Martinez. Data-Driven Distributed Spectrum Estimation for Linear Time-Invariant Systems. Submitted to *IEEE Transactions on Control of Network Systems*.
- **S. Liu** and P. Wen. Non-conservative stability criteria for semi-Markovian impulsive switched systems. Submitted to *SIAM Journal on Control and Optimization*.
- J. Eising, **S. Liu**, S. Martinez and J. Cortes. Data-driven mode detection and stabilization of unknown switched linear systems. Submitted to *IEEE Transactions on Automatic Control*.

Journal articles

- **S. Liu** and A. Russo. Further characterizations of integral input-to-state stability for hybrid systems. *Automatica*, in press, 2023.
- **S. Liu**, S. Martinez and J. Cortes. Stabilization of linear cyber-physical systems against attacks via switching defense. *IEEE Transactions on Automatic Control*, early access, 2023.
- **S. Liu**. Characterizations and Stability Criteria for the 2-Mode Markovian Switched Nonlinear Systems. *IEEE Transactions on Automatic Control*, early access, 2023.
- Y. Zhang, Y. Xia, **S. Liu** and Z. Sun. On Polynomially Solvable Constrained Input Selections for Fixed and Switched Linear Structured Systems. *Automatica*, vol. 158, 11308, 2023.
- **S. Liu**. Unified stability criteria for perturbed LTV systems with unstable instantaneous dynamics. *Automatica*, vol. 144, 110499, 2022.
- **S. Liu**, A. Tanwani and D. Liberzon. ISS and integral-ISS of switched systems with nonlinear

supply functions. *Mathematics of Control, Signals, and Systems*, vol. 34, pp. 297–327, 2022.

- **S. Liu**, S. Martinez and J. Cortes. Iterative algorithms for assessing network resilience against structured perturbations, *IEEE Transactions on Control of Network Systems*, vol. 9, no. 4, pp. 1816-1827, 2022.
- **S. Liu**, S. Martinez and J. Cortes. Average dwell-time minimization of switched systems via sequential convex programming. *IEEE Control System Letters*, vol. 6, pp. 1076-1081, 2021.
- **S. Liu**, A. Russo, D. Liberzon and A. Cavallo. Integral-input-to-state stability of switched nonlinear systems under slow switching. *IEEE Transactions on Automatic Control*, vol. 67, no. 11, pp. 5841-5855, 2021.
- Y. Fan, **S. Liu** and M.-A. Belabbas. Geometric heat flow methods for legged locomotion planning. *IEEE Control Systems Letters*, vol. 5, no. 3, pp 941-946, 2020.
- Y. Fan, **S. Liu** and M.-A. Belabbas. Mid-air motion planning of robot using heat flow method with state constraints. *Mechatronics*, vol. 66, 102323, 2020.
- **S. Liu**, D. Liberzon and V. Zharnitsky. Almost Lyapunov functions for nonlinear systems. *Automatica*, vol 113, 108758, 2020.

Conference proceedings

- Russo and **S. Liu**. Do 0-GAS-Guaranteeing Impulse Sequences Ensure ISS or iISS Impulsive Systems? Not Always. Accepted by the *62nd IEEE Conference on Decision and Control*, 2023.
- **S. Liu**, K. Chen and J. Eising. Online Data-Driven Adaptive Control for Unknown Linear Time-Varying Systems. Accepted by the *62nd IEEE Conference on Decision and Control*, 2023.
- J. Eising, **S. Liu**, S. Martinez and J. Cortes. Using Data Informativity for Online Stabilization of Unknown Switched Linear Systems. In proceedings of the *61st IEEE Conference on Decision and Control*, 8–13, 2022.
- **S. Liu**, A. Tanwani and D. Liberzon. Average Dwell-Time Bounds for ISS and Integral ISS of Switched Systems using Lyapunov Functions. In proceedings of the *59th IEEE Conference on Decision and Control*, 6291–6296, 2020.
- Russo, **S. Liu**, D. Liberzon and A. Cavallo A. Quasi-Integral-Input-To-State Stability for Switched Nonlinear Systems. *IFAC World Congress 2020*. *IFAC-PapersOnline* vol. 53, issue 2, 1992–1997, 2020.
- **S. Liu** and D. Liberzon. Higher Order Derivatives of Lyapunov Functions for Stability of Systems with Inputs. In proceedings of the *58th IEEE Conference on Decision and Control*, 6146–6151, 2019.
- **S. Liu** and D. Liberzon. On Almost Lyapunov Functions for Systems with Inputs. In proceedings of the *58th IEEE Conference on Decision and Control*, 468–473, 2019.
- **S. Liu**, Y. Fan and M.-A. Belabbas. The Affine Geometric Heat Flow and Motion Planning for Dynamic Systems. *11th IFAC Symposium on Nonlinear Control Systems*. *IFAC-PapersOnLine* vol. 52, issue 16, 168–173, 2019.
- **S. Liu** and D. Liberzon. Global Stability and Asymptotic Gain Imply Input-to-State Stability for State-Dependent Switched Systems. In proceedings of the *57th IEEE Conference on Decision and Control*, 2360–2365, 2018.

- M.-A. Belabbas and **S. Liu**, S. New Method for Motion Planning for Non-holonomic Systems Using Partial Differential Equations. In proceedings of the *2017 American Control Conference*, 4189–4194, 2017.
- **S. Liu**, D. Liberzon and V. Zharnitsky. On Almost Lyapunov Functions for Non-vanishing Vector Fields. In proceedings of the *55th IEEE Conference on Decision and Control*, 5557–5562, 2016.

PRESENTATIONS AND INVITED TALKS

- "Do 0-GAS-Guaranteeing Impulse Sequences Ensure ISS or iISS Impulsive Systems? Not Always," at the *62nd IEEE Conference of Decision and Control*, December 2023, Singapore.
- "Online Data-Driven Adaptive Control for Unknown Linear Time-Varying Systems," at the *62nd IEEE Conference of Decision and Control, December 2023*, Singapore.
- "Switched Nonlinear Systems: Stability Analysis via Average Dwell-time and Average Activation Time Switching," invited talk at Qilu University of Technology, November 2023, Jinan, Shandong, China.
- "Distributed Spectrum Estimation for Linear Time-Invariant Systems," at the *6th IEEE International Conference on Unmanned Systems*, October 2023, Hefei, Anhui, China.
- "Switched Nonlinear Systems: Stability Analysis via Average Dwell-time and Average Activation Time Switching," invited talk at Tongji University, June 2023, Shanghai, China.
- "Average Dwell-Time Minimization of Switched Systems via Sequential Convex Programming", at the *60th IEEE Conference of Decision and Control*, December 2021, Austin, Texas, USA (virtual).
- "Average Dwell-Time Bounds for ISS and Integral ISS of Switched Systems using Lyapunov Functions," at the *59th IEEE Conference of Decision and Control,* December 2020, Jeju Island, Korea (virtual).
- "Higher Order Derivatives of Lyapunov Functions for Stability of Systems with Inputs," at the *58th IEEE Conference of Decision and Control*, December 2019, Nice, France.
- "On Almost Lyapunov Functions for Systems with Inputs," at the 58th *IEEE Conference of Decision and Control*, December 2019, Nice, France.
- "The Affine Geometric Heat Flow and Motion Planning for Dynamic Systems," at the *Joint 8th IFAC Symposium on Mechatronic Systems and 11th IFAC Symposium on Nonlinear Control Systems*, September 2019, Vienna, Austria.
- "Global stability and asymptotic gain imply input-to-state stability for state-dependent switched systems," at the *57th IEEE Conference of Decision and Control*, December 2018, Miami, Florida, USA.
- "Path planning and obstacle avoidance of unicycle using the heat flow method," at the *12th CSL Student Conference*, February 2017, Urbana, Illinois, USA.
- "New Method for Motion Planning for Non-Holonomic Systems Using Partial Differential Equations," at the *2017 American Control Conference*, May 2017, Seattle, Washington, USA.
- "On almost Lyapunov Functions for Non-Vanishing Vector Fields," at the *55th IEEE Conference of Decision and Control*, December 2016, Las Vagas, Nevada, USA.

MAJOR PROFESSIONAL SERVICES

Journal review

- IEEE Transactions on Automatic Control
- Automatica
- IEEE Control Systems Letters
- Nonlinear Analysis: Hybrid Systems
- IEEE Open Journal of Control Systems
- Circuits, Systems and Signal Processing

Conference review

- IEEE Control and Decision Conference
- American Control Conference
- European Control Conference

Conference organization

- *Program committee* for Repeatability evaluation of the International Conference on Hybrid Systems: Computation and Control 2021, 2022.
- *Session chair* for "Time-varying Systems" at the 62th IEEE Control and Decision Conference, Singapore, 2023.
- *Session chair* for "Decision and Control" at the 13th CSL Student Conference, IL, USA, 2019.

AWARDS AND HONORS

- *Finalist* for the Best Paper Award at the 2019 IFAC Symposium on Nonlinear Control Systems in Vienna, Austria, 2019.
- *Best Talk Award* in CSL Student Conference, UIUC, USA, 2017.