

Zirui Liao

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School of Automation Science and Electrical Engineering (SASEE), Beihang University, Beijing 100191, P. R. China

EDUCATION

- **School of Automation Science and Electrical Engineering, Beihang University** Sep. 2020 - Present
Ph. D. in Mechanical and Electronic Engineering Beijing, China
 - GPA: 93.1/100 (**Ranking: 1/93**)
 - Supervisor: Professor Shaoping Wang (**Cheungkong Scholar**) and Associate Professor Jian Shi
- **Department of Electrical Engineering, Eindhoven University of Tehcnology** Oct. 2022 - Apr. 2024
Joint Supervision Project Supported by China Scholarship Council Eindhoven, The Netherlands
 - Supervisor: Assistant Professors Zhiyong Sun and Sofie Haesaert
- **College of Engineering, China Agricultural University (Project 985 Institution)** Sep. 2016 - Jun. 2020
B. S. in Mechanical and Electronic Engineering (Double Degree: English) Beijing, China
 - GPA: 3.89/4.00 (**Ranking: 1/53**)
 - Supervisor: Professor Jian Chen

RESEARCH INTEREST

- Resilient coordination for multi-agent systems
- Resilient distributed optimization for cyber-physical systems
- Static event-triggering, dynamic event-triggering, and self-triggering resilient algorithms
- Cooperative situational awareness based on multi-source data infusion

PUBLICATIONS AND PATENTS

J=JOURNAL, C=CONFERENCE, S=IN SUBMISSION, P=PATENT

Journal Papers

- [J.1] **Z. Liao**, S. Wang, J. Shi, S. Haesaert, Y. Zhang, and Z. Sun. **Resilient containment under time-varying networks with relaxed graph robustness**. *IEEE Transactions on Network Science and Engineering*, 2024, 11(5):4093-4105.
- [J.2] **Z. Liao**, S. Wang, J. Shi, M. Li, Y. Zhang, and Z. Sun. **Resilient distributed optimization for cyber-physical systems under adversarial environments: an event-based method**. *ISA Transactions*, 2024, 149:1-15.
- [J.3] **Z. Liao**, S. Wang, J. Shi, Y. Zhang, and Z. Sun. **Resilient consensus through dynamic event-triggered mechanism**. *IEEE Transactions on Circuits and Systems II: Express Briefs*, 2024, 71(7):3463-3467.
- [J.4] **Z. Liao**, S. Wang, J. Shi, Z. Sun, Y. Zhang, and MB. Sial. **Cooperative situational awareness of multi-UAV system based on improved D-S evidence theory**. *Aerospace Science and Technology*, 2023, 142: 108605.
- [J.5] **Z. Liao**, S. Wang, J. Shi, D. Liu and R. Chen. **Reliability-oriented configuration optimization of more electrical control system**. *Aerospace*, 2022, 9(2):85.
- [J.6] **Z. Liao**, J. Shi, S. Wang, Y. Zhang, R. Mu, and Z. Sun. **Self-triggering secure consensus against adversarial attacks**. *Guidance, Navigation and Control* (**Accepted**).
- [J.7] M. Sial, Y. Zhang, S. Wang, S. Ali, X. Wang, X. Yang, **Z. Liao**, and Z. Yang. **Bearing-based distributed formation control of unmanned aerial vehicle swarm by quaternion-based attitude synchronization in three-dimensional space**. *Drones*, 2022, 6(9):1-19.

Submitted Papers

- [S.1] **Z. Liao**, J. Shi, Y. Zhang, S. Wang, R. Chen, and Z. Sun. **A leader-follower attack-tolerant algorithm for resilient rendezvous with reduced network redundancy**. Manuscript submitted for publication in *IEEE Systems Journal* (**Minor Revision**).
- [S.2] **Z. Liao**, J. Shi, S. Wang, Y. Zhang, R. Chen, and Z. Sun. **Dynamic event-triggering resilient coordination for time-varying heterogeneous network**. Manuscript submitted for publication in *IEEE Transactions on Signal and Information Processing over Networks* (**Major Revision**).
- [S.3] **Z. Liao**, J. Shi, S. Wang, Y. Zhang, R. Mu, and Z. Sun. **A survey of resilient coordination for cyber-physical systems against malicious attacks**. Manuscript submitted for publication in *IEEE Internet of Things Journal* (**Under Review**).

Conference Papers and Abstracts

- [C.1] **Z. Liao**, S. Wang, J. Shi, Z. Li, and MB. Sial. **Cooperative situation awareness of multi-UAVs based on multi-sensor information fusion**. In *Proc. of the International Conference on Guidance, Navigation and Control (ICGNC)*, 2022, pp. 628–638.
- [C.2] **Z. Liao**, S. Wang, J. Shi, and Q. Weng. **Differential evolution based multi-agent formation fault reconstruction**. In *Proc. of the International Conference on Guidance, Navigation and Control (ICGNC)*, 2020, pp. 2273–2285.
- [C.3] M. Sial, S. Wang, X. Wang, J. Wyrwa, **Z. Liao**, and W. Ding. **Mission oriented flocking and distributed formation control of UAVs**. In *Proc. of the IEEE Conference on Industrial Electronics and Applications (ICIEA)*, 2021, pp. 1507–1512.
- [C.4] Z. Chen, S. Wang, C. Zhang, P. Zhang, and **Z. Liao**. **Anthropomorphic flexible joint design and simulation**. In *Proc. of the IEEE Conference on Industrial Electronics and Applications (ICIEA)*, 2020, pp. 1673–1678.
- [C.5] J. Chen, N. Du, **Z. Liao**, Y. Cao, H. Meng, Y. Han, Y. Zheng, and Y. Tan. **Energy storage battery parameters identification algorithms of a solar powered communication/remote-sensing UAV**. In *Proc. of the 5th IFAC Symposium on Telematics Applications*, 2019, 52(24):41–46.

Patents

- [P.1] **Z. Liao**, J. Shi, Z. Li, S. Wang, and Y. Qiao. **A method and system for multi-UAV cooperative situation awareness based on information fusion**, 2024, Patent No. ZL202210170253.8.
- [P.2] J. Chen, S. Wang, Y. Han, Z. Zhang, G. Wang, N. Du, Y. Cao, H. Meng, **Z. Liao**, Y. Wang, and Y. Zheng. **A device and method for delivering multiple biological agents on UAV**. 2019, Patent No. CN201910720188.X.
- [P.3] J. Chen, S. Wang, Y. Han, G. Wang, Z. Zhang, N. Du, Y. Cao, H. Meng, Y. Wang, **Z. Liao**, and Y. Zheng. **A UAV airborne multi biological agent delivery device**. 2019, Patent No. CN201921259931.8.

PROJECTS

- **Project A: Resilient Coordination and Optimization for Multi-Agent Systems (MASs)** Oct. 2022 - Apr. 2024
Support: Chinese Scholarship Council (Co-Supervised by Assistant Professors Zhiyong Sun and Sofie Haesaert)
 - Motivated by the critical security concern of MASs caused by distributed property and simple hardware, as well as being in open environments.
 - Developed attack-tolerant algorithms to address resilient consensus problems for heterogeneous MASs.
 - Optimized the network robustness with the introduction of trusted nodes and time-varying digraphs.
 - Mitigated the communication burden with the introduction of dynamic event-triggering mechanism.
 - Validated the effectiveness of the proposed method on multi-microgrid systems.
 - Published 4 SCI journal papers ([J.1], [J.2], [J.3], [J.6]) and submitted 3 SCI journal papers ([S.1], [S.2], [S.3]) as the first author.
- **Project B: Cooperative Situational Awareness for Multi-UAV Systems based on Data Fusion** Dec. 2022 - Present
Support: Outstanding Research Funding of Shenyuan Honors College (Project Leader)
 - Motivated by the low detection accuracy of a single drone and the inability of existing data fusion methods to handle evidence conflicts.
 - Developed a centralized cooperative situational awareness scheme based on D-S evidence theory.
 - Improved the traditional D-S evidence theory to handle the high conflict between evidence.
 - Prepare to validate the effectiveness of the proposed method on a practical multi depth camera platform.
 - Published 1 SCI journal paper ([J.4]), 1 EI conference paper ([C.1]), and authorized a Chinese invention patent ([P.1]) as the first author.

HONORS AND AWARDS

- **National Scholarship** for Doctoral Students (Chinese Highest honor for University Students, **Top 1%**) Oct. 2024
- **Yuyuan Star** (Highest Honor in the School of Automation Science and Electrical Engineering, **Top 5%**) Oct. 2024
- **President Scholarship** for Outstanding Student Cadre (Highest Honor in Beihang University, **Top 1%**) Dec. 2022
- Outstanding Student Scholarship of Shenyuan Honors College Mar. 2023
- First-class Academic Scholarship (Twice) Sept. 2021 and Sept. 2022
- First-class Freshman Scholarship Aug. 2020
- Outstanding Graduates of Beijing Municipality Jun. 2020
- Outstanding Graduation Project of Beijing Municipality Jun. 2020
- **National Scholarship** for Undergraduates (Twice, **Top 1%**) Nov. 2018 and Nov. 2019
- Outstanding Student Scholarship of China Agricultural University Nov. 2017
- First-class Academic Scholarship (Three Times) Nov. 2017, Nov. 2018, and Nov. 2019
- Second Prize of the National **Mathematics Competition** for College Students Nov. 2017
- First Prize of the Provincial and Ministerial **Physics Competition** for College Students Dec. 2017
- Third Prize of the National **English Competition** for College Students (Twice) Dec. 2018 and Dec. 2019

CONFERENCE PRESENTATIONS

- **9th International Conference on Guidance, Navigation, and Control**(Oral Presentation in English) Oct. 2020
- **10th International Conference on Guidance, Navigation, and Control**(Oral Presentation in English) Aug. 2022
- **42nd Benelux Meeting on Systems and Control**(Oral Presentation in English) Mar. 2023
- **43rd Benelux Meeting on Systems and Control**(Oral Presentation in English) Mar. 2024
- **43rd Chinese Control Conference**(Oral Presentation in English) Jul. 2024

ADDITIONAL INFORMATION

Languages: Chinese (native), English (CET-4: 582, CET-6: 579, double degree)

Interests: Badminton, Frisbee, Table Tennis

ACADEMIC SERVICE

• Journal and Conference Reviewer

Active reviewer for several journal and conferences, such as:

- ISA Transactions
- American Control Conference (ACC)
- International Conference on Guidance, Navigation, and Control (ICGNC)
- CSAA/IET International Conference on Aircraft Utility Systems (AUS)

• Conference Volunteer

- 9th International Conference on Guidance, Navigation, and Control

REFEREES

1. Shaoping Wang

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Relationship: Doctoral Supervisor

2. Jian Shi

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Relationship: Doctoral Co-Supervisor

3. Zhiyong Sun

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Relationship: Project Supervisor

4. Sofie Haesaert

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Relationship: Project Supervisor

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Relationship: Undergraduate Supervisor