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, J. Shi, Y. Zhang, S. Wang, R. Chen, and Z. Sun. **A leader-follower attack-tolerant algorithm for resilient rendezvous with reduced network redundancy**. *IEEE Systems Journal*, 2024 **(Accepted)**.

[J.5] Z. Liao, J. Shi, S. Wang, Y. Zhang, R. Mu, and Z. Sun. **Self-triggering secure consensus against adversarial attacks**. *Guidance, Navigation and Control*, 2024 **(Accepted)**

[J.6] 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.7] 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.8] 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, 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.2] 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 5 SCI journal papers (**[J.1]**, **[J.2]**, **[J.3]**, **[J.4]**, **[J.5]**) and submitted 2 SCI journal papers (**[S.1]**, **[S.2]**) 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.6]**), 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*
- **Shenyuan Medal** nomination (Highest Honor in Beihang University, **Top 1%**) *Dec. 2024*
- **Shixiang Medal** (Highest honor in the Shenyuan Honors College, **Top 2%**) *Nov. 2024*
- **Yuyuan Star** (Highest Honor in the School of Automation Science and Electrical Engineering, **Top 5%**) *Oct. 2024*
- **President Scholarship** for Outstanding Student Cadre *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, Aerospace Science and Technology
  - American Control Conference (ACC)
  - International Conference on Guidance, Navigation, and Control (ICGNC)
  - CSAA/IET International Conference on Aircraft Utility Systems (AUS)
- **Development Mentor for Undergraduate Students at Shenyuan Honors College, Beihang University**
  - Responsible for providing academic, research and life guidance to students.
  - Awarded as an **Excellent Development Mentor** for being diligent and responsible in work.
  - One of the mentored students was awarded **Outstanding Student**.
- **Teaching Assistant for the Course "Entering the Robot World"**
  - Responsible for assisting students with the design, fabrication and presentation of wheeled robots.
  - The group led by me achieved third place in the final course presentation.
- **Conference Volunteer**
  - A volunteer in the 9th International Conference on Guidance, Navigation, and Control (ICGNC 2020).
  - Responsible for the production of the program book and the summary of the conference information.
  - Awarded as an **Outstanding Volunteer** in ICGNC 2020.

Referees

1. **Shaoping Wang**
   Professor, School of Automation Science and Electrical Engineering
   Beihang University, Beijing 100191, P. R. China
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   Relationship: Doctoral Supervisor

2. **Jian Shi**
   Associate Professor, School of Automation Science and Electrical Engineering
   Beihang University, Beijing 100191, P. R. China
   Email: shijian@buaa.edu.cn
   Relationship: Doctoral Co-Supervisor

3. **Zhiyong Sun**
   Assistant Professor, College of Engineering
   Peking University, Beijing 100091, P. R. China
   Email: zhiyong.sun@pku.edu.cn
   Relationship: Project Supervisor

4. **Sofie Haesaert**
   Assistant Professor, Department of Electrical Engineering
   Eindhoven University of Technology, Eindhoven 5600 MB, The Netherlands
   Email: S.Haesaert@tue.nl
   Relationship: Project Supervisor

5. **Jian Chen**
   Professor, College of Engineering
   China Agricultural University, Beijing 100083, P. R. China
   Email: jchen@cau.edu.cn
   Relationship: Undergraduate Supervisor